Service Occupations

About one out of every eight workers in the United States is in a service occupation; in 1960, the number of these workers exceeded 8 million. Service workers help to protect people's lives and property and add to their comfort and convenience in many other ways. Domestic service workers in private homes are the largest group. Others are protective service workers such as policemen and firemen; and workers such as barbers, beauty operators, and practical nurses, who give personal services to people. The remaining group—a large one—is composed of waiters, cooks, janitors, elevator operators, and other workers who perform services directly connected with the operation of the business firms and other organizations which employ them.

Service occupations should not be confused with service industries. Service industries—which include hotels, automobile repair shops, amusement enterprises, and advertising agencies—employ not only workers in service occupations but also many professional, clerical, and skilled workers, such as writers, actors, stenographers, and mechanics. On the other hand, many workers in service occupations are employed outside the service industries; watchmen and cleaners in factories and porters on railroad trains are examples of service occupations found in manufacturing and in transportation industries.

The following chapters give information about some of the principal protective and personal service occupations. Information about some other service occupations is given in the chapters on hotel and restaurant occupations. (See index for page numbers.)

PROTECTIVE SERVICE OCCUPATIONS

Protecting life and property is the chief job of more than three-quarters of a million civilian workers in the United States. Guards and watchmen are the largest group of protective service workers—probably well over one-third of the total number. Some guards and watchmen are employed by private companies to protect their property and enforce company rules and regulations; others are employed in jails and other government buildings. Policemen and detectives are the second largest group of protective service workers. Most policemen and detectives are government employees, but some work for hotels, stores, or other companies, or as private detectives. Firemen, who work mainly for city governments, are the third largest group. The remaining protective service workers, who together probably represent less than a tenth of the total number, are sheriffs and bailiffs, crossing watchmen and bridge tenders, and marshals and constables.

A college education is needed to enter some protective service jobs. For many others, high-school graduation is required, but for some there are no formal educational requirements. To become an FBI agent, for example, a young man must be either a lawyer or an accountant and, in most cities, young people seeking appointment to the police force are required to be high school graduates. On the other hand, the amount of education completed is not an important consideration for many guard and watchman jobs.

In addition to specific educational requirements, candidates for protective service jobs in government agencies may have to meet very rigid standards with respect to health, age, and strength, as well as to personal reliability.
In contrast, guards and watchmen are sometimes handicapped persons or older men. The number of protective service workers in the United States has been growing faster than the population as a whole, during the past 50 years—owing partly to the increasing proportion of people living in cities where police, firefighting, and other protective services are especially needed. In 1910, there was only 1 protective service worker for every 450 persons in the United States. By 1960, the ratio had nearly doubled—about 1 for every 235 persons. In all probability, the need for protective service workers will continue to increase faster than the population. Besides, thousands of new workers will be required each year to replace those who retire, die, or transfer to other occupations. Many openings for protective service workers will occur even in years when the general level of business activity is declining. Since police and other protective services are always necessary, employment is steadier in most protective service occupations than in many other fields of work.

The employment outlook for FBI agents, firemen, and policemen—three large protective service occupations which offer career opportunities for young people—is described in the sections that follow.

**FBI Agents**

(D.O.T. 2-66.99)

**Nature of Work**

Federal Bureau of Investigation (FBI) agents investigate many types of violations of Federal law, such as bank robberies, kidnappings, frauds against the Government, thefts of Government property, and cases of espionage or sabotage. The FBI is part of the U.S. Department of Justice. Altogether, it has jurisdiction over some 160 Federal investigative matters, and each agent may be assigned to work on any one of them. However, agents with specialized training in accounting are likely to be assigned chiefly to cases involving complex financial records; for example, frauds involving Federal Reserve Bank records. An agent can never be certain what his day will be like, what new assignment may be given him, or where it will lead him.

Owing to the highly confidential nature of the FBI's work, agents may not disclose to unauthorized persons, including members of their families, any of the information which they gather in the course of their official duties. The FBI is primarily a fact-gathering and fact-reporting agency, and its agents function strictly as investigators. Agents may be called upon to testify in court about cases that they investigate, but they do not make recommendations pertaining to prosecution, express opinions concerning the guilt or innocence of suspects, or issue “clearances.”

Under ordinary circumstances agents wear regular business suits. They generally work alone and must maintain continual contact with their superiors by radio or telephone. Two or more agents always are assigned to handle arrests, raids, and other potentially dangerous duties.

**Where Employed**

Most of the approximately 6,000 agents employed in 1960 were assigned to the Bureau's 54 field offices located in major cities throughout the Nation. The remainder worked out of the Bureau's office in Puerto Rico or were stationed at FBI headquarters at the U.S. Department of Justice, Washington, D.C. In addition to the field offices, there are FBI resident agencies, staffed by small numbers of agents, in many cities and towns across the United States. These agencies facilitate the prompt and economical handling of all investigative matters which are within the FBI's jurisdiction.

**Training, Other Qualifications, and Advancement**

To be eligible for appointment as an FBI agent, an applicant must have graduated from
a State-accredited resident law school or a 4-year resident accounting school requiring personal attendance on the part of the student. The law school training must have been preceded by at least 2 years of college education. Accounting graduates must also have had at least 3 years of experience in accounting or auditing or a combination of both.

All applicants for positions as FBI agents must be male citizens of the United States, between the ages of 25 and 40, and willing to serve anywhere in the United States or its territorial possessions. They must be at least 5 feet 7 inches tall and capable of strenuous physical exertion, and they must have unimpaired hearing, very good vision, normal color perception, and no physical defects which would prevent the use of firearms or participation in dangerous assignments. Each applicant must pass a rigid physical examination, as well as written and oral examinations testing his knowledge of law or accounting and his aptitude for meeting the public and conducting investigations. All the tests except the physical examination are given by the FBI at its field offices. In addition, all applicants undergo exhaustive background and character investigations. Appointments are made on a probationary basis and become permanent after 1 year of satisfactory service.

Each newly appointed agent is given 13 weeks of training before he is assigned to a field office. He takes most of this training at the FBI headquarters in Washington, D.C., and the rest at the FBI Academy at the U.S. Marine Corps Base in Quantico, Va. During this period, he is taught judo and defensive tactics and becomes familiar with FBI rules and regulations, investigative work, fingerprinting, and the firearms normally used by the FBI. After assignment to a field office, the new agent works closely with an experienced agent for a period of about 2 weeks before he qualifies for independent assignments.

All higher grade positions are filled from within the ranks of FBI agents. It is possible, therefore, for an experienced agent to advance to more responsible administrative and supervisory positions, such as field supervisor, special agent in charge of a field office, and inspector.

**Employment Outlook**

The FBI is a career service, and its rate of personnel turnover traditionally has been lower than that of private industry and the Government as a whole. Accordingly, unless there is a substantial expansion of its investigative staff, it is not anticipated that many vacancies for agents will arise in the immediate future. Nevertheless, the FBI is always interested in receiving applications from qualified men who would like to be considered for positions as agents.

**Earnings and Working Conditions**

The entrance salary for FBI agents was $6,995 in 1960. This was somewhat higher than the usual starting salary for college graduates entering employment in other Federal agencies. FBI agents are not appointed under Federal Civil Service regulations, but, like other Federal employees, they receive periodic within-grade salary raises if their work performance is satisfactory, and they can advance
in grade as they gain experience. The top salary for regular field agents was $11,935 in 1960; agents in supervisory and administrative positions received higher salaries.

Agents are subject to call 24 hours a day and must be available for assignments at all times. They work longer than the customary 40-hour week and, under certain specified conditions, receive overtime pay at the rate of $977 a year (about $38 each 2-week pay period).

They receive paid vacations and sick leave and annuities on retirement. Some aspects of the FBI agent’s work are adventurous; he travels frequently and meets all kinds of people. The work is potentially dangerous and involves a great deal of responsibility.

Where To Go for More Information

The Federal Bureau of Investigation,
U.S. Department of Justice, Washington 25, D.C.

Firemen
(D.O.T. 2-63.)

Nature of Work

Firefighters in city and town fire departments have the exciting job of protecting the public against fire. Through efficient teamwork, they prevent loss of life and minimize property damage from fire. For many thousands, particularly in large cities, firefighting is a full-time job. In small towns, however, there are also thousands of volunteer firemen and paid “call men” who hold themselves ready to help fight fires whenever their services are needed. This statement is concerned principally with the work of full-time firemen.

When an alarm sounds at the station, firemen put on protective clothing and are ready to drive to the scene of the fire in a matter of seconds. They may fight fires ranging from spectacular waterfront blazes, requiring men and equipment from several fire companies, to smoldering trash fires that can be controlled with a fire extinguisher.

Because firefighting is a dangerous and complicated activity, it must be well organized. The scene of a fire may appear to be one of confusion, with many fire trucks, thousands of feet of fire hose, and firemen working at a feverish pace. Nevertheless, each fireman performs specific duties under the direction of a commanding officer. Truckmen drive the fire trucks; hosemen unreel and couple fire hose, put on nozzles, turn on water hydrants, and direct streams of water on the fire; and laddermen set up ladders. Other firefighters may be assigned to forcible entry jobs, using tools such as axes, crowbars, and fire hooks to get inside burning buildings. Still others work as rescue teams to reach people trapped in burning buildings, carry them to safety, and administer first aid. Depending on the judgment of the officer in charge, firemen may be shifted from one of these duties to another while the company is in action. After a fire is put out, firemen carefully inspect the premises to make sure no further danger exists; if necessary, firefighters may be put on standby watch or hand extinguishers used on smoldering objects.

Firemen fighting a blaze from a building roof.
Another important responsibility of city fire departments is fire prevention. In big departments, certain kinds of fire prevention work may be handled by specially trained personnel, and other kinds by regular firemen. In many cities, however, firefighters do practically all kinds of fire prevention work. Firemen on assignments of this kind inspect factories, theatres, and other public buildings for conditions that might cause fire, and check on whether owners are complying with local regulations relating to fire escapes, fire doors, storage of inflammable materials, and other possible hazards. Educating the general public about fire prevention and safety measures is also a part of their job. Sometimes they speak on this subject before school assemblies and civic groups, and in many communities they inspect private homes in an effort to prevent fires by pointing out possible hazards to homeowners.

Between alarms, firefighters spend a great deal of time at the local station improving their knowledge of firefighting and doing maintenance work. They participate in practice drills, lubricate and polish firefighting equipment, stretch hoses to dry, stand watch at fire alarm instruments, and verify and record alarms. They may also use their spare time to study fire manuals and textbooks in preparation for examinations which will qualify them for promotion. Some firemen, who have to be at the station 24 hours at a stretch, take turns performing various housekeeping duties such as mopping floors or making beds. Firemen usually have some leisure time in which to read, watch television, and play table tennis or other games.

Where Employed

An estimated 125,000 to 150,000 full-time firefighters were employed in 1960 by city fire departments. A few large cities—New York, Chicago, Los Angeles, and Philadelphia—each had several thousands of firemen, while at the other extreme many very small cities had fewer than 50 firefighters each.

Training, Other Qualifications, and Advancement

To become eligible for appointment as a fireman, young men generally have to pass a written intelligence test, a rigid physical examination, and an athletic performance test (running, climbing, etc.) as specified by local civil service regulations. In most communities, these examinations are open only to men who are at least 21 years of age, meet certain height and weight requirements, and have a high school education. The men who receive the highest grades on their examinations (with credit usually given for military service) have the best chances for appointment. Other factors, such as previous firefighting training, may also be considered. Experience gained as a volunteer fireman may improve a young man's chances for appointment to a paid job.

As a rule, the beginner in a large fire department is given training for several weeks at the city's fire service school. During this training, formal study is combined with practice drills related to the fundamentals of firefighting—forcible entry, rescue work, first aid, and the use of equipment such as axes, bars, life-lines, chemical extinguishers, ladders, and pumps. The recruit is then assigned to one of the city fire companies, usually as a hoseman, truckman, or ladderman. After 1 to 5 years of experience, he may be eligible for promotion. Eventually he may become an officer; in a large city, the line of promotion is to lieutenant, then to captain, battalion chief, deputy or assistant chief, and finally to chief. Chances for advancement generally depend upon the candidate's position on the promotion list, as determined by his rating on a written examination and on his work as a fireman. Throughout his service, the fireman continues to receive in-service training and spends many hours studying such subjects as hydraulics, ventilation, salvage work, fire investigation and incendiarism, and fire prevention. This broadened knowledge helps him to pass the subject matter sections of the promotion examinations.

Among the personal qualities which are important for firefighters are above average physical stamina, mental alertness, courage, and mechanical aptitude. Leadership qualities and good judgment are valuable assets for officers,
since they have the responsibility of establishing and maintaining a high degree of discipline and efficiency, as well as planning and directing the activities of firemen.

**Employment Outlook**

Several thousand employment opportunities for firefighters are expected each year through the mid-1960's. Most openings will arise from the need to replace men who retire, die, or otherwise leave the occupation; the replacement rate is higher than that for many occupations. A moderate number of new jobs will also become available, as city fire departments enlarge their staffs and as new departments are formed to replace volunteer fire companies in rapidly growing communities. In addition, some openings will probably be created as city fire departments continue to shorten the scheduled hours of duty for their firefighters.

The number of young men who apply and qualify for firefighter jobs in large cities is usually greater than the number of job openings, even though the written examination and stiff physical requirements always eliminate many applicants. Competition for fireman jobs is apt to be very keen when there is considerable unemployment, since this occupation is an extremely stable one and especially desirable when many other jobs are insecure.

Over the long run, the number of firefighters will continue to increase moderately. The need for more firemen resulting from population growth, urbanization, and additional building construction will be offset, to some extent, by certain other factors—among them, more widespread use of fireproof and fire-resistant materials in building construction, improved firefighting techniques and equipment, the rebuilding of slum areas and replacement or modernization of old dwellings, and increased efforts at fire prevention. At the same time, however, fire departments are likely to be called on to spend more time in fire prevention activities, as campaigns are undertaken to inform people about the measures that can be taken, and as city governments revise fire and building codes, improve fire inspection procedures, and enforce more strictly their fire regulations.

**Earnings and Working Conditions**

Average (median) beginning salaries of firefighters in 1960 ranged from $3,900 a year in small cities (10,000 to 25,000 population) to $4,840 in larger cities (over 500,000 population), according to a study by The International City Managers' Association. Beginning salaries were as low as $2,340 in one relatively small city and as high as $6,000 or more in a few larger ones. Generally, firemen receive salary increases annually during the first 2 to 5 years of service. Maximum salaries of firemen (below the rank of officer) averaged about $4,500 in small cities and $5,900 in the largest ones. Fire chiefs averaged $6,000 in small cities and almost $14,000 in the largest ones. Practically all city fire departments furnish or pay allowances for protective firefighting clothing (helmets, boots, and rubber coats), and many also provide for firemen’s dress uniforms.

In most cities, firemen are on duty for a 24-hour shift, and then off for 24 hours, with an extra day off at intervals. In a few cities, the day shift is 10 hours, and the night shift 14 hours, with firemen rotating shifts at least once a month. The time firemen are scheduled to be on duty may range all the way from 40 to 96 hours a week. In most cities, firemen are on duty 60 or more hours a week, but in the very largest cities with the biggest fire departments, weekly schedules are usually shorter than this.

In addition to their scheduled hours, firemen must work as much overtime as necessary to bring a fire under control. As a rule, they receive time off instead of extra pay for overtime work.

The job of a firefighter involves risk of life or injury from sudden cave-ins of floors or toppling walls, in addition to the dangers from exposure to flames, smoke, and bad weather. In fighting fires in industrial establishments, firemen may come in contact with poisonous, flammable, and explosive gases and chemicals.

Firemen are generally covered by liberal pension plans, which often provide for retirement at half pay at age 50 after 25 years of service, or at any age if disabled in line of duty. Should disability occur, men may be transferred from active firefighting to vacancies in such jobs as
fire alarm operator or dispatcher. Firefighters receive regular paid vacations like other city employees. In addition, because of the hazards of the occupation, provisions for sick leave are usually very liberal. Some fire departments allow firefighters time off for working on holidays, although a substantial number give paid holidays.

A majority of firefighters are members of the International Association of Fire Fighters (AFL-CIO).

Where To Go for More Information

Information on how to obtain a job as a firefighter may be obtained from your local civil service commission or fire department.

General information on the occupation may be obtained from:

International Association of Fire Fighters, 815 16th St. NW., Washington 6, D.C.

Additional information on the salaries and hours of work of firemen in various cities is published by The International City Managers' Association in its Municipal Yearbook, available in many libraries.

Policemen

(D.O.T. 2-66.)

Nature of Work

Policemen who direct traffic at street corners, patrol "beats," or make newspaper headlines by arresting dangerous criminals are all helping to enforce the law with respect to such things as people's lives and property. They are employed mainly by police departments in cities and towns. (Sheriffs, State highway patrolmen, immigration inspectors, Federal border patrolmen, and others who help enforce the law are not covered by this discussion of policemen; nor does it cover guards, railroad police, and others employed, for the most part, by business firms to protect lives and property.)

Policemen usually begin their day by reporting to police headquarters or their local precinct stations. In large police departments, they may answer rollcall and stand personal inspection. They take notes while their superior officer briefs them on such matters as "wanted" criminals, stolen cars, and missing persons. Most policemen patrol an assigned "beat" on foot, in police cars, or on motorcycles. They may be assigned to a congested business district, a crowded tenement area, or an outlying residential district. Patrolmen become familiar with conditions on their beat: They know when shopkeepers open and close their stores; they are aware of local banking hours and payroll movements; and they know who the neighborhood "toughs" are. At night, patrolmen check to see that the doors of business establishments are locked and watch for anything that looks suspicious. Through signal boxes or by two-way radios, they report to headquarters at regular intervals and sometimes receive special instructions regarding problems in their vicinity. In emergencies—
riots, serious accidents, or fires—the patrolman on the beat is often the first to take action before reinforcements can reach the scene. Although in large cities many policemen are specifically assigned to traffic duty, patrolmen on their beats also watch for traffic violations and direct traffic if necessary.

Whether on or off duty, policemen are expected to exercise their authority whenever necessary. Policemen spend part of their time filling out various forms such as "tickets" for parking violations and other traffic offenses, writing reports on arrests or stolen articles, and testifying in court.

In large cities, some policemen may be specially assigned to communications work, laboratory work, firearm or fingerprint identification, testing for drivers' licenses, duty at precinct jails, or other special work. Detectives (plainclothes men) are usually assigned to precinct detective squads or to burglary, homicide, narcotics, or other special squads. A small number of policewomen are employed, mainly in crime prevention and detection work with girls and women. Policemen may also be detailed to do this kind of work with boys.

Where Employed

More than 170,000 full-time policemen of all ranks were employed in 1959 by police departments in cities of over 2,500 population. Additional thousands of workers not classified as policemen were also employed in these cities, checking parking meters, and doing other kinds of work related to law enforcement. New York City had approximately 23,000 policemen in 1959; Chicago had about 11,000. In contrast, many small cities, with populations under 25,000, employed fewer than 25 policemen each.

Most policemen work outdoors, on beats which may range from a block or two in a crowded downtown district to a wide area in less congested sections. However, some policemen perform their duties mainly indoors—for example, in laboratories or at desks in police headquarters or in local precinct stations.

Training, Other Qualifications, and Advancement

To become eligible for appointment as a policeman, young men generally have to pass a written intelligence test, a rigid physical examination, and a test of strength and agility as specified by local civil service regulations. In many cities, these examinations are open only to men who are at least 21 years of age, meet certain height and weight requirements, have a high school education, and have been residents of the city for a specified period. In an increasing number of cities, however, the residence requirements are being relaxed. Many police departments give preference in hiring to young men trained at the growing number of colleges and universities which offer degrees in police science and administration.

Since personal characteristics such as honesty and emotional stability are especially important in police work, many departments give each prospective appointee an interview and investigate his character and background. Those who receive the highest grades on examinations and also rate high on personal evaluation have the best chances of appointment. Credit is usually given for military service.

As a rule, the beginner in a police department receives from 2 weeks' to several months' training at the police school maintained by the city. He practices shooting and takes lessons in self-defense, including boxing, wrestling, and judo. Formal instruction may cover such subjects as the law of arrest, search, and seizure, State criminal laws, and local ordinances; patrol procedures; accident investigation; and traffic control. The beginner may also receive training in first aid and other subjects so that he will be able to deal with emergencies of all kinds—which can range from delivering a baby to handling explosives. The recruit often patrols a beat with an experienced officer for a week or so. He is then usually assigned to either patrol or traffic duty.

After some experience, the patrolman becomes eligible for promotion. In a large city, promotion to sergeant, lieutenant, and captain generally depends upon the candidate's position on the promotion list, based on a written
examination and his work as a policeman. Often, however, patrolmen are promoted to the job of detective solely because of an aptitude for investigative work or a citation for outstanding performance. The latter may also serve as a basis for promotion to higher ranks in any type of police work.

Many training opportunities are available to help policemen improve their performance and prepare them for advancement. Most large city departments have in-service training programs. A limited number of police officers are selected to take advanced training at the National Police Academy in Washington, D. C., conducted by the Federal Bureau of Investigation; and others may be given an opportunity to take college and university courses in police administration, scientific investigation, traffic control, and other police science subjects, with all or part of their tuition paid by the police departments where they are employed. In the opinion of many police officials, college-trained men, especially those who have taken courses in police science, will have the best chances for advancement in the future, owing to the increasing need for men with specialized knowledge who can handle the complex work of modern police departments.

Some large cities have police cadet systems which make it possible for high school graduates interested in police careers to get a start without waiting until they are old enough to be eligible for appointment to regular police jobs. Cadets are paid police department employees who spend part of their time doing clerical and other nonenforcement work, and the remaining time attending courses in police science. When they reach the age of 21, they may be appointed to the police force, provided their work has been satisfactory and they meet other requirements. Like most policemen, cadets must serve a probationary term before their appointments to the police force become permanent.

**Employment Outlook**

Many opportunities for qualified young men to enter police work are expected annually through the mid-1960's. Thousands of men will be needed each year to fill new jobs created as police departments expand, and vacancies which occur as policemen retire, die, or transfer to other occupations. Many policemen retire before the usual retirement age for workers in most occupations. Chiefly for this reason, the proportion of policemen who have to be replaced yearly is higher than in many other occupations.

Employment of policemen will continue to rise fairly rapidly over the long run, as growth in population, particularly in and around cities, creates a need for more men in traffic control and crime detection and prevention. Police authorities, concerned over the rise in the number of juvenile offenders, will probably further increase preventive and enforcement work in this field. Of course, the number of policemen employed depends on the amount of money made available by local governments. Because of the essential nature of the work, however, it is likely that police department appropriations will be increased to take care of growing needs.

The number of policemen needed in the future and the nature of their work will be influenced also by technological advances—the use of improved methods and equipment in police work. For many years, police departments have used automatic signal lights for traffic control, cars and motorcycles for patrol work, scientific methods for crime detection, and, more recently, trained police dogs for patrol and detection work, and radar and closed-circuit television in connection with traffic enforcement work. Along with these changes in police methods, police employment has continued to grow. Further technological developments will probably increase the need for policemen with specialized skills and knowledge, as well as help to make police work more efficient.

The number of young men applying for jobs as policemen is usually greater than the number of openings. However, the written examinations and stiff physical requirements always eliminate many applicants. Competition for police jobs is very keen during periods of high unemployment, since this is an unusually stable occupation.
Earnings and Working Conditions

Beginning salaries for patrolmen ranged from slightly less than $3,000 a year in several small cities to considerably more than $5,000 in some large ones in 1960, according to a study by The International City Managers' Association. The average (median) entrance salary for patrolmen in middle-size cities (50,000 to 100,000 population) was $4,340 a year. Generally, patrolmen's salaries are raised at regular intervals during their first years of employment, until a specified maximum is reached. In small cities, top salaries paid patrolmen in 1960 were generally from $500 to $600 more than starting salaries; in the largest cities, the difference was close to $1,000. Detectives, sergeants, lieutenants, and other officers are paid higher salaries than the patrolmen in their police departments. For police chiefs, salaries ranged from less than $5,000 a year in several small cities to more than $20,000 a year in a few of the largest.

Most policemen are paid special allowances for uniforms and are furnished the special equipment they use, such as revolvers, nightsticks, handcuffs, and badges.

The majority of policemen have a 40-hour workweek, although the average is 48 hours in small cities. They often work nights, since they generally rotate on a 3-shift basis; for example, shifts may be from 8 a.m. to 4 p.m., from 4 p.m. to midnight, and from midnight to 8 a.m. Those who are called to work in emergencies often receive additional time off or extra pay for overtime worked.

Policemen are generally covered by liberal pension plans which often provide for retirement at age 55 after 25 years of service, or at any age if disabled in line of duty. They receive regular paid vacations and, in a number of cities, are given time off to compensate for work on holidays. Sick leave and medical, surgical, and life insurance plans are also among the benefits provided.

In this occupation, men must often stand or walk for long periods in bad weather. The higher-than-average injury rate of policemen reflects the risks they take in pursuing speeding motorists, capturing lawbreakers, and rescuing would-be suicides. Relatively few policemen are killed in line of duty, however.

Where To Go for More Information

Information on how to become a policeman may be obtained from local civil service commissions or police departments.

General information on the occupation may be obtained from:

International Association of Chiefs of Police,
704 17th St., NW., Washington 6, D.C.

Additional information on the salaries and hours of work of policemen in various cities is published by The International City Managers' Association in its Municipal Year Book, available in many libraries.
OTHER SERVICE OCCUPATIONS

About 7.5 million workers were employed in service occupations in 1960 (not counting protective service workers, discussed in the preceding chapter). These occupations are of many different kinds and afford opportunities for workers with entirely different backgrounds and personal qualifications. Many of the service occupations require workers with considerable skill and training; others require comparatively little. Barbers and beauty operators are among those who need specialized vocational training. Chefs and cooks in restaurants must also be specially trained for their work, either in school or on the job. On the other hand, such workers as kitchen helpers, maids, charwomen, and janitors need little, if any, special training. For porters, life guards, and certain other service occupations, physical strength is necessary. A pleasant manner and nice appearance are particularly important for such workers as elevator operators, hat check girls, and theater ushers. Still other service workers—for example, practical nurses and travel guides—need to have a special knack for dealing with people.

Private household workers, who numbered more than 2 million in 1960, are the largest group in the service field. The number of domestic workers fell sharply during World War II, as is likely to happen whenever there is a general and acute shortage of labor, but in recent years, it has been rising again. Between 1950 and 1960, employment of private household workers increased by about 17 percent, somewhat faster than the work force as a whole, though not as fast as employment in most service occupations.

Employment in service occupations outside private households increased by 32 percent between 1950 and 1960—or considerably faster than the average for the entire work force.

For the most part, this increase resulted from rising income levels and changing patterns of American living. The proportion of women who work outside their homes has risen steadily, for example; this has led to a growing need for such services outside the home as meal preparation and care of the sick, and to a substantial rise in the employment of service workers in eating and drinking places and in hospitals and nursing homes. Educational institutions are among the other types of establishments where employment of service workers has grown—reflecting the rapid rise in school and college enrollments and the fact that it has become customary to provide meals not only for college students but also for many pupils attending elementary and secondary schools.

In the long run, employment in service occupations will probably continue to rise substantially. Most of this growth will probably continue to be in jobs outside private households. Some rise in employment of domestic workers is also probable, because of the increasing number of working mothers with young children. However, most job openings for workers in all service occupations, both in and outside private households, will result from the need to replace the thousands of workers who annually leave their jobs. Turnover is high in these occupations for several reasons—the high proportion of women, especially in private household work, the many temporary and part-time jobs, and the relatively low rates of pay. Turnover will no doubt continue high because of these factors, and will result in many thousands of job openings each year.

Additional information on service workers is given in the statements on barbers, beauty operators, and practical nurses which follow.
Barbers
(D.O.T. 2-32.01)

Nature of Work

About 200,000 barbers were employed full time in the occupation in 1960, and many others did some part-time barbering. Besides cutting hair, barbers give hair and scalp treatments, fit hair pieces, and provide customers with other personal services such as shaves, facial massages, and shampoos. They sometimes sell hair tonics, shampoos, and related preparations, and give advice on care of the hair and scalp. Barbers must know all hair styles and be alert to follow customers' wishes on the type of haircut wanted. They must also try to finish each haircut in the way best suited to the shape of the customer's head.

A barber builds up a steady clientele not only by giving good haircuts but also by putting customers at ease, giving them quick and courteous service, and keeping a clean, attractive shop. In small shops, a barber may be expected to keep his own work area clean or take his turn sweeping the shop. Each barber is usually responsible for keeping his barbering instruments sterilized and in good condition. Barbers who run their own shops have responsibilities common to many small businessmen, such as ordering supplies, paying bills, and hiring and managing employees.

The few women barbers sometimes perform all types of barbering services, or sometimes specialize in a particular type of work, for example, cutting children's hair.

Where Employed

More than half of the barbers in the more than 100,000 barbershops in the country in 1960 owned or operated their own shops. Most barbershops are one- or two-man establishments, where the owner either works alone or with one other barber. However, shops employing several barbers are to be found in large hotels and office buildings in downtown areas of cities and in a growing number of suburban shopping centers. A few thousand barbers are employed in combination barber and beauty shops. A small number have jobs in such places as hospitals and on ocean liners, or work in government agencies.

All cities and towns and most villages have barbershops. However, barbers are concentrated in large cities and in the most populous States.

Training, Other Qualifications, and Advancement

Almost every State requires that barbers be licensed or certified by the State board of barber examiners or some other State authority. In order to qualify for his license or certificate, a barber is required in most States to pass a State examination which includes both a written test and a demonstration of his ability to perform barbering services. Nearly all States admit to their licensing examinations only those candidates who are at least 16 or 18 years old, meet certain health standards, and have completed at least the 8th grade and then graduated from a State-approved barber school. In most States, the new barber school graduate is required first to take an examination for a license as an apprentice.
barber and then—usually after 1 or 2 years of work experience—he takes another examination for his journeyman barber's license. A few States issue journeyman licenses to beginners without requiring any apprenticeship. Barbers who move to another State must meet whatever licensing requirements may have been established by that State.

Barber training is offered in more than 100 public vocational schools and private barber colleges. Courses may be up to a year in length. The student barber studies principally the basic barber services—haircutting, shaving, massaging, and facial and scalp treatments—and, under supervision, practices these services on people. Besides attending lectures on barber services and the use and care of barber instruments, the student also takes courses in anatomy, sanitation, and hygiene, including the recognition of skin diseases. Instruction is also given in salesmanship and general business practices.

A beginner may obtain his first job as a barber by being recommended to an employer by the barber school where he received his training, or he may locate a job through the barber's union or through personal contacts in his own local community. He customarily buys his own tools—usually at a cost of about $75 to $100. Experienced barbers may advance by opening their own shops, by becoming managers of large shops, or by moving to shops which have more patrons. If they meet the requirements, a few barbers may eventually teach at barber schools. Barbers who go into business for themselves must have the capital necessary to buy or rent a shop and install equipment. The usual cost of equipping a one-chair barbershop is roughly estimated at $1,500. Costs differ greatly, however, as some barbershop owners may buy used equipment and fixtures at reduced prices, whereas others pay higher prices to procure the newest and best equipment.

Dealing with customers may call for patience and a better-than-average disposition on the part of the barber. Good general health and stamina are important also, as barbers must stand for long periods, much of the time working with both hands above shoulder level.

**Employment Outlook**

Several thousand openings for barbers are expected each year through the mid-1960's. Most of the openings will arise from the need to replace barbers who retire, die, or transfer to other fields of work. The death and retirement rates in this occupation are relatively high, since barbers are somewhat older, on the average, than workers in many other occupations. Also, experienced barbers as well as beginners are often attracted to other types of jobs and many vacancies have to be filled as they leave the occupation.

In addition, employment of barbers will probably increase moderately during the 1960's. This employment increase will be due principally to population growth and the resulting need for more barbering services. The small shop with only one or two barbers will probably remain the most common type of establishment; however, the continuing shift of population to suburban communities should result in more opportunities to open large shops in these areas and in a need for larger staffs in suburban shops which are already established.

**Earnings and Working Conditions**

Most full-time barbers earned between $50 and $150 a week in 1960, according to the limited data available. A few barbers in the most desirable locations in big cities probably earned up to $175 or more a week. These estimates include tips, which are often an important part of barbers' earnings. Aside from tips, most barbers not in business for themselves are either paid commissions—usually 65 to 80 percent of the money they take in—or receive salaries plus commissions. A few barbers are paid straight salaries. In the Federal Government, where this is the practice, most barbers earned from $70 to $85 a week in 1960.

A barber's earnings depend to a great extent on the size of the community where he works and the location of his shop, since the income level and tipping customs of the community, the competition from other barbershops, and
the prices that can be charged all affect earnings. The price of haircuts, for example, ranged from $1 in most cities in 1960 to as much as $2 in others, with some special types of haircuts costing $2.50 or more. Earnings, of course, depend also on the barber's skill and personality, which help bring him regular customers. Barbers who own and work in their own shops generally earn considerably more than other barbers.

Most full-time barbers work between 5 and 6 days and 40 and 50 hours weekly. A barber may have to serve a steady stream of customers during peak hours and on especially busy days, such as Saturday, but there are slack periods when he can have time off to attend to personal matters. Under some union contracts, barbers receive 1- or 2-week paid vacations, insurance, and medical benefits.

The principal union which organizes barbers—both employed barbers and barbershop owners—is the Journeymen Barbers, Hairdressers, Cosmetologists, and Proprietors' International Union of America. Some shopowners and managers are represented by the Associated Master Barbers and Beauticians of America.

Where To Go for More Information

Information on State licensing requirements may be obtained from the State board of barber examiners or other State authority at each State capital, and information about approved barber schools from each State's division of vocational education.

General information on the occupation of barber may be obtained from:

Journeymen Barbers, Hairdressers, Cosmetologists, and Proprietors' International Union of America, 1141 North Delaware St., Indianapolis 7, Ind.

National Educational Council, Associated Master Barbers and Beauticians of America, 537 South Dearborn St., Chicago 5, Ill.

Beauty Operators *

(D.O.T. 2-32.11 through .31)

Nature of Work

Most beauticians provide their customers with a variety of services, largely related to the care of the hair. They give permanent waves and cut, style, shampoo, set, straighten, bleach, dye, or tint the hair. In addition, beauticians may give manicures and scalp, facial, and body treatments; provide make-up analysis; shape eyebrows; tint eyebrows and eyelashes; give treatments for damaged hair; remove superfluous hair; and arrange wigs and chignons. General duties of a beauty operator may occasionally include making appointments; cleaning the shop, equipment, and furniture; and sterilizing implements.

In a small shop, which primarily provides hair and manicuring services, an operator may perform a great variety of tasks. In larger shops, where a wider range of services is available, operators may specialize in a particular phase of the work, such as hair styling, hair coloring, permanent waving, facial and body treatments, or manicuring.

A beauty shop owner, in addition to working as an operator herself, usually performs a number of administrative duties, such as record-keeping, property maintenance, control of supplies, and supervision of employees.

Where Employed

Beauticians, also called hairdressers or cosmetologists, work in all parts of the country. Job opportunities were formerly concentrated in cities, but in recent years, the demand for beauty services in small towns and rural areas has shown a substantial growth.

In 1959, most beauty operators worked in the estimated 190,000 commercial beauty shops licensed by State cosmetology boards. These licensed shops were generally individual business establishments, but quite a few were located in department or specialty stores and in
hotels. A smaller number of shops were on Government bases, ocean liners, and in hospitals, schools, and other institutions. Some beauticians rented booths within a shop from the shopowner and operated independently.

A large proportion of beauty operators are either owner-operators of small shops or are employed in small establishments with 1 to 3 operators; few shops have as many as 15 workers. Other operators are employed in branch shops of citywide or nationwide chains. In States and communities where the practice is permitted, a beautician may set up a small shop within her home. Some manicurists work in barber shops.

Nearly 692,000 State licenses were issued to beauty operators in 1959. Beauticians may obtain a license even though not actually employed, and some hold a license in more than one State. The number of operators actually employed in 1960 was, therefore, probably closer to 300,000. Men make up only a small part of the total number of operators, but their number has been increasing steadily since World War II. They are more often engaged in specialized work than are women and frequently work as hair stylists or shop managers.

Training, Other Qualifications, and Advancement

All but two States (Delaware and Virginia) require that a beauty operator be licensed. To obtain a license, an applicant must pass an examination on the theory and practice of cosmetology given by an agency of the State in which she intends to practice. Most States charge a fee (ranging from $3 to $20) for admittance to the examination and/or a fee (ranging from $2 to $15) for issuance of an operator's license.

Requirements which a candidate must meet before being admitted to examination vary by State. However, all States (except Delaware and Virginia) have set a minimum age for operators and require applicants to complete an approved cosmetology course which has included an established minimum number of hours of training. In about half, the age is 16 years; in the others, 17 or 18. Most States have set a minimum requirement for formal education—generally completion of the eighth grade, but the education required ranges from completion of elementary school to graduation from high school. A health certificate is required by a majority of States.

Nearly two-thirds of the States require a separate license for manicurists, for which substantially fewer hours of training are required than for the all-round operator's license. Many State boards require teachers and shop managers to obtain special licenses. Moreover, many States set higher age, education, and experience requirements for a teaching license than for an operator's license.

Beauty operators are often able to practice in a different State from the one in which they are licensed; over 85 percent of the States provide for reciprocity, usually without an additional examination.

There were 1,922 private cosmetology schools in 1960, according to the National American Cosmetology Schools. A course in most private schools consists of combined classroom work and practice in beauty service, lasting from 1,000 to 1,500 hours, depending on State licensing requirements. It usually takes from 6 to 9 months to complete such a course. In a few States, where 2,000 hours or more of study and practice are required, the course may last up to 12 months.
Typically, one-fourth of the training time in a private school is devoted to classroom study, lectures, and demonstrations, and three-fourths to practical work. Beginning students get practice by working on each other and/or manikins. When they have completed the beginning training course satisfactorily, they may practice in the "clinic" on customers who pay a small fee for the services rendered.

Some beauty schools provide a free lifetime placement service for their graduates. Other schools may have no formal placement service, but advise their students of openings.

Cosmetology courses conducted as part of public vocational education programs meet State license requirements and are usually part of a curriculum leading to a high school or a vocational high school diploma. There were 329 public vocational schools throughout the country which offered this type of program in 1960. Because of the required academic subjects, the program may run from 2 to 3 years. However, in some States, students who meet State agency requirements in cosmetology before completing the vocational high school academic program may secure a license and work part time as beauty operators while completing the other courses necessary for a high school diploma.

Some junior colleges also offer programs in beauty culture.

In addition to formal educational programs, nearly half of the States accept apprenticeship training as the basis for admittance to examination. This type of training is usually spread over a longer period than formal training programs.

Over 107,000 students were enrolled in public and private beauty schools in 1959. Another 5,700 students were enrolled in apprenticeship programs.

A beautician may continue her training by taking post-graduate courses. Schools offering such courses are licensed and regulated in the same manner as basic training schools. Usually one must be a licensed operator in order to take an advanced course. Some employers provide special training for their personnel by holding demonstrations of the latest hair styles and beauty techniques, and a number of manufacturers of beauty supplies and equipment conduct beauty shows.

The entry job of a beautician is usually that of an all-round operator, performing a variety of services. Advancement in this occupation may come as one gains experience and becomes specialized in one or more phases of the work, such as hair tinting or styling.

A trained and experienced operator may advance to the job of a manager of a large shop or a teacher in a beauty school. She may even set up her own shop, either working alone or employing other beauticians.

An experienced operator may also have the opportunity to utilize her training in related fields. She may be employed as a representative of a manufacturer of cosmetics or beauty shop equipment, as a beauty editor for a newspaper or magazine, as a make-up artist, or as an inspector for a State licensing board.

To be successful, a beauty operator should keep abreast of changing hair styles and beauty techniques through reading trade and fashion magazines and taking refresher training. She must be able to establish and maintain friendly relationships with people. She should be well groomed, since many customers identify her appearance with the results they expect to see in their own appearance. Dexterity is necessary in almost every operation. A sense of form and artistry in cutting and styling hair is important, as are ability and willingness to follow instructions and customers' wishes. The work also calls for physical stamina, since a great deal of standing is normally required.

In smaller shops, an operator may be required to furnish such equipment as brushes, combs, clips, rollers, nets, scissors, thinning shears, and rods for permanent waves. In larger establishments, most of the equipment is provided by the shop. Almost without exception, an operator furnishes her own uniform.

Employment Outlook

Employment is expected to continue expanding to meet the needs of a growing population with an increasing awareness of the part good
grooming plays in social and business life. Beauty shop receipts increased nearly 60 percent and beauty shop payrolls by over 55 percent, between 1954 and 1958, according to the Bureau of the Census. In this 4-year period, the number of beauty shops, including beauty and barber shop combinations, increased by 40 percent.

In addition to jobs created by expansion, many job opportunities are created annually by turnover. Many young women who enter this field leave because of home or family responsibilities.

A career as a beautician is open to men and women. There are opportunities for young workers and for mature workers. The availability of part-time work is especially attractive to married women who wish to increase their income but are unable to work full time.

**Earnings and Working Conditions**

The earnings of a beautician depend on such factors as experience, speed of performance, and ability to please customers. The location of place of employment may be a major factor. For example, earnings of an individual working in a small shop in a rural area might be quite different from those of an operator in a large multiservice salon located in the main business center of a large city.

Beauty operators who work in shops as employees are often paid a basic wage plus a commission. Under a customary arrangement, an operator must take in twice her basic wage in customers' fees before being eligible for a commission. She then receives a specified percent of any receipts she takes in over this amount, often as high as 40 or 50 percent. However, some operators are paid only a salary or a commission. In some shops where cosmetics are sold directly to the customer, a small commission (up to 10 percent) may be paid to the beautician selling these products. A number of States have minimum-wage laws which are applicable to beauty operators.

It is difficult to estimate the basic wage of a beginning beautician because of the great variation in salary arrangements. Some estimates placed the basic wage in 1960 at about $50 a week. Expert operators in exclusive shops earn considerably more. Top salon stylists or teachers in advanced cosmetology schools may earn from $150 to $300 a week, and possibly as much as $500 a week, including tips. The practice of tipping varies in different parts of the country; it is likely to be more prevalent and the tips more liberal in the larger cities.

Incomes of owners of beauty shops are determined, among other things, by the size and location of the shop. For example, the income of an owner of a salon of wide reputation in a large city may be many times greater than that of a beautician who owns a shop in a small town.

Most full-time beauticians work 40 hours a week, although in some areas, the 44-hour week is common. Hours frequently include evening and Saturday work. Some States have laws which require employers to pay overtime for hours worked beyond a specified minimum.

Most beauty shops have too few employees to be eligible for membership in group life and health insurance plans. However, beauticians who work in establishments such as department stores usually participate in employee benefit plans sponsored by the employer. Most shops allow their employees at least 1 week's vacation with pay. In some organizations, a beautician may have as much as 3 weeks of paid vacation, depending on length of service.

Although the occupational field is not highly organized, one union—The Journeymen Barbers, Hairdressers, Cosmetologists, and Proprietors' International Union—is active in the United States. Other organizations in the field include: The National Hairdressers' and Cosmetologists' Association, an organization which includes both shopowners and operators; the National Beauty Culturists' League, made up of Negro operators, teachers, managers, and shopowners; and the Associated Master Barbers and Beauticians of America, an association for shopowners and managers.

**Where To Go for More Information**

State boards of cosmetology can supply information on approved beauty operator train-
Practical Nurses and Auxiliary Nursing Workers *

Nature of Work

Practical nurses and auxiliary nursing workers assist in the care and treatment of the physically or mentally ill, under the direction of physicians or professional nurses. Their importance on the nursing team has increased over the past decade as they have been utilized more and more to perform many of the less complex nursing tasks, thus freeing professional nurses for more skilled and specialized nursing duties.

Licensed practical nurses (D.O.T. 2–38.20), known also as licensed vocational nurses, usually perform such duties as giving prescribed treatments and medications; taking patients' temperature, pulse, and blood pressure; and helping with personal hygiene tasks. They may provide nursing care for newborn babies, mothers, the handicapped, the chronically ill, or the convalescent. Practical nurses may also assist physicians or professional nurses with more complicated diagnostic procedures or treatments.

In doctors' offices, practical nurses assist physicians or professional nurses in the examination of patients, give simple medications or treatments as directed, carry out routine laboratory tests, and perform some clerical tasks. In industrial establishments, their duties may vary from first aid at the place of business to home-visiting services for workers and their families.

Among auxiliary nursing workers, most of the women are called nursing aids (D.O.T. 2–42.20) and most of the men, orderlies (D.O.T. 2–42.10) or hospital attendants. These auxiliary nursing workers are not licensed. They generally are trained on the job and perform duties requiring less nursing skill than those of professional or practical nurses. Working under the direction of nurses in either of these groups, auxiliary nursing workers may make beds, bathe patients, deliver messages, count and stack linens, escort patients to other departments of the hospital, help with examinations, or take care of hospital equipment.

In recent years, psychiatric aids or assistants have been trained in many hospitals and institutions which lack sufficient numbers of professional and practical nurses in their psychiatric wards. Psychiatric aids assist in providing the specialized type of care and treatment needed by mentally ill patients. Their duties and level of responsibility, however, vary considerably among hospitals.

Where Employed

In 1958, there were an estimated 220,700 licensed practical nurses. Auxiliary nursing
workers in hospitals numbered approximately 364,000. Hospitals employ the largest proportion of both groups. According to a survey of the American Hospital Association in 1959, hospitals had on their staffs 95,900 practical nurses; 309,300 nursing aids and attendants; 37,900 orderlies; and 29,600 other auxiliary nursing personnel.

A large number of licensed practical nurses are also engaged for private duty. They are hired by patients or their families to provide individual nursing care in hospitals or private homes. Practical nurses also work in doctors' offices and in some industrial firms. In addition, employment of practical nurses—and to some extent auxiliary nursing personnel—by public health agencies and nursing homes is increasing.

Many practical nurses and nursing aids are mature women who have returned to paid employment after a period devoted to homemaking responsibilities. Many of these women had wanted a career in nursing, but lacked the time or money necessary for the extensive preparation required for professional nursing. Today, a growing number of younger women also are entering the field of practical nursing. Although most practical nurses are women, the number of men is increasing. Most men performing nursing services, however, are employed as orderlies, hospital attendants, or psychiatric aids.

Training and Other Qualifications

Practical nurses, today, receive formal training in nursing skills. Not very long ago, the majority of practical nurses were either self-trained or learned their skills through practice on the job. Auxiliary nursing workers, for the most part, still do not have formal preemployment training.

Practical nurse training may be obtained in two major types of schools: Those operated by public school systems, usually as part of a vocational school or adult education program; and private schools, usually controlled by hospitals, health agencies, junior colleges and universities, or community organizations. Approval of schools of practical nursing is given by State boards of nursing. In addition, standards of operation are established by State boards of vocational education for schools under their control.

Over the past 30 years, there has been a very rapid growth in the number of practical nurse training programs. In 1930, there were only 11 approved programs. By 1960, this number had grown to 661, of which about three-fifths were operated by public school systems. In recent years, an increasing number of high schools have included practical nursing courses in their regular curriculum. Admissions to approved practical nurse programs exceeded 23,700 in 1960.

Entrance requirements vary among schools of practical nursing. In most cases, applicants under 25 years of age must have completed at least 2 years of high school or its equivalent; however, for those over 25 years of age, a grammar school education is often accepted. Most schools prefer applicants between the ages of 18 and 50, but occasionally relax these limits. A main requirement is that candidates be in good physical and mental health. Candidates usually must have a preentrance health examination, take a psychological test, come for a personal interview, and submit references and school records.

In schools of practical nursing which charge tuition, the amounts range between $50 and $200 a year. Vocational education programs under public school systems may charge tuition to local students in States which have no tax funds for adult education or to out-of-State students. All programs entail certain expenses such as those for books, equipment, laboratory fees, and uniforms. During their period of practice training, students may receive a monthly allowance to help pay for living costs; in some cases, the hospital may provide room and board.

Practical nursing courses in most schools last 1 year. Training includes classroom study of basic nursing skills and related subjects such as body structure and function, conditions of illness, nutrition, and types of medicine and medications, as well as supervised clinical practice in applying these skills to actual nursing situations. The practice period is arranged
to offer a wide variety of nursing experiences so that students may gain confidence in caring for patients and increase their knowledge of different types of services.

After graduating from a training program approved by the State board of nursing and passing the State examination, practical nurses may obtain a State license. Thirty-one States have citizenship requirements; in most cases the practical nurse must be a citizen or an applicant for naturalization. Fees for licenses ranged between $5 and $20 in 1959. Most employers hire only licensed practical nurses. This requirement is a comparatively new development as most legislation covering licensure has been enacted since 1945. By 1960, all States and the District of Columbia had provided for the licensing of practical nurses.

Postgraduate training and in-service education are provided in some hospitals. Such programs usually prepare practical nurses to give nursing care in specialized areas such as psychiatry and operating room technique.

Auxiliary nursing workers generally are given from 1 week to 3 months of training on the job. In some hospitals or institutions, classroom instruction and demonstration may be supplemented by specified practice work. In others, training may be informal and consist of daily instruction by supervisors on the tasks at hand.

The entry jobs held by auxiliary nursing workers in most hospitals and institutions seldom have any formal educational requirements. However, at least a grammar school education is preferred. Usually the only formal requirements are that the applicant be physically able to perform the work and be at least 17 years of age.

Many of the personal qualities required of other health workers apply also to practical nurses and auxiliary nursing personnel. The basic requisites are the desire to help sick people and an aptitude for the work. Also important are tact, patience, understanding, emotional stability, and dependability.

**Employment Outlook**

Throughout the 1960’s, employment opportunities for practical nurses and auxiliary nursing workers should continue to expand rapidly. Factors affecting this rising demand for nursing personnel are the growth in population; increased public interest in good health; new medical discoveries; and the steady uptrend in hospital, medical, and surgical insurance coverage. Moreover, a substantial number of openings will arise from replacement needs as workers retire, die, or leave the nursing field.

As a result of the shortage of professional registered nurses which began during World War II, most hospital and other health organizations have redistributed nursing duties among various personnel with different amounts of preparation and training. Although the number of professional nurses has increased steadily, the gain has been more phenomenal for practical nurses and auxiliary nursing workers. The successful use of these workers as members of nursing teams, under the direction of professional nurses or physicians, indicates even greater utilization of these personnel in most hospitals and health agencies.

Over the past 20 years, the number of practical nurses who have received formal training in approved schools has risen sharply. From September 1959 through August 1960, almost 16,500 practical nurses completed their training. However, leaders in the nursing field state that many more newly licensed practical nurses are needed to help meet the mounting demand for nursing services.

**Earnings**

Average weekly salaries of women practical nurses in hospitals in 15 metropolitan areas surveyed during mid-1960 ranged from $42 a week in Atlanta to $75.50 a week in the Los Angeles–Long Beach area. Women nursing aids averaged between $32.50 in Memphis and $67 in the San Francisco–Oakland area; average earnings of men nursing aids ranged from $36 in Memphis to $68.50 in the San Francisco–Oakland area and in Baltimore. Practical nurses and nursing aids had an average workweek of 40 hours or less in most of the cities surveyed.
Graduates of approved schools of practical nursing who met the civil service requirements and passed a written examination were hired by the Federal Government at $3,760 a year in 1961. Auxiliary nursing workers who qualified for employment in the Federal Government by passing an aptitude test and an oral interview started at $3,500 in 1961. Most were employed in Veterans Administration hospitals.

Practical nurses on private duty usually received three-fourths of the prevailing pay for professional nurses in the same area in 1959. Those working in public health nursing services (non-Federal) averaged $3,210 in 1959, as indicated in a survey made by the National League for Nursing.

Where To Go for More Information


Information about these occupations may also be obtained from:

National League for Nursing, Committee on Careers,
10 Columbus Circle, New York 19, N. Y.
National Association for Practical Nurse Education and Service,
475 Riverside Dr., New York 27, N.Y.
National Federation of Licensed Practical Nurses,
250 West 57th St., New York 19, N.Y.
Skilled Trades and Other Industrial Occupations

The skilled trades and other industrial occupations—skilled, semiskilled, and unskilled—together provided jobs for more than a third of all employed workers in the United States in 1960.

Young persons with mechanical or manual interests and abilities who do not plan to go to college will find most of their employment opportunities among the hundreds of different occupations in this group. Levels of skill vary considerably among these occupations, which range from those of the unskilled laborer to the highly skilled tool and die maker.

The men and women in these jobs perform important functions in industry by helping to transform the ideas of scientists and the plans of engineers into goods and services. Many of them help to operate transportation systems, communication facilities, and atomic installations. Others build homes, office buildings, and factories. Large numbers work in factories where they build, install, control, maintain, and repair the complex machinery needed by our highly mechanized society. Still others repair automobiles, television sets, and washing machines. The efficient operation of the Armed Forces depends on skilled workers in uniform, as well as upon civilian craftsmen who produce and maintain weapons, vehicles, ships, tanks, planes, and communication equipment.

During the past two centuries, the occupational structure of our economy has undergone a major but gradual transformation as a result of the widespread introduction of machinery and mass-production methods. The development of the factory system of production, which emphasized the division of labor and specialization of function, changed our economy and resulted in the appearance of many new skills and trades. New occupations developed and others changed drastically. The manufacturing industries, with their greater potential for division of labor, were particularly influential in these occupational changes. The grouping of labor into such categories as skilled, semiskilled, and unskilled was primarily a result of factory production methods.

Some of the types of work formerly done by skilled workers have been broken down into several simpler jobs, each requiring a much shorter period of training than was originally demanded of the craftsmen. These simpler jobs can be performed by workers who are usually classified in the semiskilled category, although, in some cases, they still retain the titles of skilled workers. (The classification of jobs in terms of skill must always be somewhat arbitrary because job titles sometimes fail to indicate levels of skill.)

In recent decades, the steady advance of technology in the factory and on the construction site has been chiefly responsible for the sharp reduction in the number and proportion of unskilled workers in the work force. On the other hand, the numbers and proportions of skilled and semiskilled workers in the working population have increased.

The United States appears to be on the threshold of a new age of technological progress which may result in major changes in the future occupational composition of the labor force. Rapid advances in the industrial application of scientific knowledge and invention, particularly in the field of electronics, are making possible greater use of electronic, mechanical, hydraulic, pneumatic, and other devices to feed, control, handle, and adjust the machinery and equipment used in factory production processes. These developments (popularly called "automation") have not yet been applied generally in industry and, there-
SKILLED TRADES AND OTHER INDUSTRIAL OCCUPATIONS

fore, it is difficult to assess their impact on employment and occupational skills. However, the numbers of skilled and semiskilled workers are expected to continue to increase substantially during the 1960's despite the increasing rate at which industry is mechanizing and automating its production processes. With respect to skill requirements, it is expected that our increasingly complex technology generally will require workers with higher levels of skill.

Changes in employment and skills in the skilled, semiskilled, and unskilled groups in the 1960's generally will represent extensions of recent trends that have resulted from technological gains. Employment of skilled workers is expected to increase somewhat more rapidly than the Nation's total working population which, it is estimated, will grow by about 20 percent in the 1960's. The semiskilled group is expected to grow at a somewhat slower rate than the skilled worker group, because many simple repetitive operations such as the loading or unloading of machines will be taken over increasingly by automatic and semiautomatic devices. Little change in the number of unskilled laborers is expected.

As a proportion of the working population, the number of skilled workers will increase, while semiskilled workers may remain about the same and may even decline somewhat. The proportion of unskilled laborers in the work force is expected to continue its long-term decline, but the rate of decline probably will not be as rapid as in previous decades.

The reports on the trades and other industrial occupations which follow this introduction are grouped by industry or field of work, rather than by level of skill, since this is the most useful grouping for practical vocational guidance. The occupations which are found in a wide variety of industries or activities, or in industries for which an entire chapter has not been prepared, are included in this section of the Handbook. The great majority of the skilled trades and other industrial occupations, however, are described in the section on Some Major Industries and Their Occupations.

Skilled Workers

The Nation's economic and military strength depends to a great extent on the initiative and competence of its craftsmen. The contributions of physicists, engineers, chemists, and other professional workers to the national security and well-being are transformed into goods and services by a skilled, intelligent, and flexible work force.

Skilled workers make the patterns, models, tools, dies, machines, and equipment without which industrial processes could not be carried out by semiskilled and unskilled workers. They repair the equipment used in industry, as well as the mechanical equipment and appliances used by consumers. They also construct homes, commercial and industrial buildings, and highways.

More than half of the country's skilled workers in 1960 were employed in three broad occupational groupings—building trades, mechanics and repairmen, and skilled machining occupations. At least 15 skilled occupations had more than 100,000 workers each in 1960. Among these were more than a million carpenters and more than three-quarters of a million automobile mechanics. (See chart 19.) Many skilled occupations, such as instrument maker and stonemason, however, have relatively small numbers of workers.

Skilled workers are employed in almost every branch of industry, but the largest numbers are employed in manufacturing and construction. A large majority of employed craftsmen work for private employers; others are self-employed, or work for Federal, State, or local governments. The building trades have a fairly large percentage of self-employed craftsmen. As might be expected, employment of the skilled work force is concentrated in the highly industrialized States, for example, New York, California, Pennsylvania, Illinois, and Ohio. Job opportunities for skilled workers, however, are found in every State. Only a very small proportion of skilled workers are women.
Training, Qualifications, and Advancement

Skilled workers must have a thorough knowledge of the processes involved in their work. They exercise considerable independent judgment and often need a high degree of manual dexterity. In some instances, they are responsible for valuable equipment or products. Workers in skilled occupations usually receive extensive training.

Skilled workers learn their jobs in several different ways. Many acquire their skills through apprenticeship or other formal training programs. Many others, particularly during periods of labor shortage, acquire the skills of their trades through experience on the job, but without participation in a planned training program. Large numbers of young men also acquire skills in the armed services. For others, vocational school training has an important role in developing skills.

Most training authorities agree that the best way to learn a skilled trade is through a formal apprenticeship program. Apprenticeship is a period of systematic on-the-job training, supplemented by related trade instruction, which is designed to familiarize the apprentice with the materials, tools, and principles of the trade. The apprenticeship program provides the worker with a balanced knowledge of his trade and the ability to perform duties competently. The formal apprenticeship agreement stipulates the number of hours of training the apprentice is to receive in the various aspects of the trade. Most apprenticeship programs last from 3 to 6 years.

Apprenticeship has a number of advantages over less formal methods of learning a trade. An apprentice receives broad training and experience which enable him to adjust more easily to changing job requirements, and to work in a wide range of jobs. The completion of an apprenticeship gives the worker a recognized status which is an advantage in finding and holding jobs. Many firms select foremen from among their former apprentices, because they are usually familiar with all aspects of the work being performed.

Many companies have other kinds of training programs which also provide systematic on-the-job training and, frequently, supplementary classroom instruction. In these programs, new workers begin on the simplest tasks under the direction of a foreman or an experienced worker and gradually progress to more difficult work.

Many young persons, in moving from one semiskilled job to another among different employers over a period of many years, acquire sufficient knowledge and skills which eventually enable them to become skilled workers. Others begin learning a skilled trade in vocational, trade, or technical schools. A small proportion of these students move directly into jobs in their trade and, after acquiring experience, qualify as skilled workers. Other young persons, who are already employed in semiskilled or unskilled jobs, move into skilled oc-

![Chart 19](http://fraser.stlouisfed.org/)
skilled occupations through vocational training related to their work.

Large numbers of young men in the Armed Forces acquire skills which enable them to qualify, with little or no additional training, for skilled jobs in civilian life, such as automobile mechanic, electronic technician, airplane mechanic, electrician, or office-machine repairman.

**Employment Trends and Outlook**

Employment in skilled occupations has grown from about 5 million (approximately 1 out of 9 civilian workers), in 1940, to about 8.6 million (approximately 1 out of 8) in 1960. Despite the long-term upward trend, however, employment of skilled labor has fluctuated with changes in business conditions and requirements for national defense. Following the employment decline during the depression of the 1930's, the demand for craftsmen rose sharply as a result of World War II production requirements and by 1944, reached about 7 million. After the war, as industrial activity expanded to meet the accumulated demand for consumer products, employment of skilled workers rose steadily, exceeding 8 million by 1948. Although employment of skilled workers declined during subsequent periods of recession, employment in this group generally tended to move upward in the 1950's.

Continued growth in the number of skilled jobs is expected in the next decade. Even more job opportunities for young persons will result from the need to replace skilled workers who transfer to other fields of work, are promoted, or who retire or die. At least 170,000 skilled workers may be needed each year to replace just those who retire or die.

Among skilled occupations, those concerned with the repair and servicing of machinery and equipment have shown the greatest growth in recent years. The expansion has been due to increasing mechanization and more complex machinery in many manufacturing industries, the growing number and complexity of automobiles, and the greater use of electrical and mechanical appliances in the home. Between 1940 and 1950, employment of mechanics and repairmen doubled, rising by more than 850,000. The number of automobile mechanics, airplane mechanics, office machine repairmen, and television, radio, and appliance servicemen increased rapidly. The building trades, which employed almost a third of all skilled workers (about 3 million) in mid-1960, also grew rapidly. On the other hand, employment declined for some skilled workers, such as blacksmiths.

By the end of the 1960's, employment in skilled occupations is expected to reach nearly 11 million, because of industrial growth and technological advances which increase the need for skilled workers. As in the past, rates of employment growth will differ for workers in many of the skilled occupational groups. For example, employment of mechanics and repairmen should continue to grow more rapidly than the skilled work force as a whole. Many thousands of job opportunities will be available for auto mechanics, industrial machinery repairmen, maintenance electricians, diesel mechanics, business-machine repairmen, and air-conditioning and refrigeration mechanics and repairmen. The number of skilled workers in the building trades also is expected to gain rapidly because of the anticipated large rise in construction activity. Another large area of employment opportunities for skilled workers will be the major skilled machining occupations—tool and die maker, machinist, instrument maker, skilled machine-tool operator, setup man, and layout man. On the other hand, the printing trades, also one of the large groups of skilled workers, probably will increase at a somewhat slower rate than the skilled work force as a whole.

Young people who do not expect to go to college should consider seriously the definite advantages which the skilled trades offer, compared with semiskilled and unskilled occupations. Skilled workers have higher earnings, more job security, better chances for promotions, and more opportunities to open their own business, than most of the workers with lesser skill. Of the 11 occupational groups which make up our labor force, only the professional and managerial worker groups had
higher average annual earnings than craftsmen in 1959.

The greater job security of skilled workers compared with semiskilled and unskilled workers was clearly evident during the 1960–61 recession. Their rate of unemployment was substantially less than that for semiskilled workers, but more than twice as low as that for unskilled workers. Employers were reluctant to lay off skilled maintenance workers. With training and experience in a skilled craft, a worker can handle not only a skilled job but also, if necessary, one requiring less skill.

Many supervisors and men in high administrative positions in industry have come from the ranks of craftsmen. Employers have long recognized the value of executives who have both industrial know-how and administrative ability and thus have drawn many of them from the ranks of skilled workers—especially from among those who have received apprenticeship or other well-rounded training.

In the years ahead, applicants for skilled jobs will have to meet increasingly higher standards. Industry will need craftsmen with higher levels of skill to do the complex work involved in rapidly advancing fields such as electronics, spacecraft, and guided missiles. Young men who acquire a good basic education (including courses in mathematics and the sciences), as well as thorough job training, will be better able to compete for the higher paying skilled jobs than applicants without this training.

Semiskilled Workers

"Operatives," who are usually called semiskilled workers, make up the largest occupational group in the Nation's labor force. About 12 million workers—almost 1 in every 5—were employed in semiskilled jobs in 1960. About 7 million of these semiskilled workers were employed in manufacturing industries (for example, men's and women's clothing, automobiles, automobile parts, food, cotton and wool textiles, machinery, and electrical and electronic equipment). Nearly one-third of all semiskilled workers were women. Semiskilled jobs, such as sewing machine operator and assembler, were by far the largest source of employment for women in manufacturing industries. The broad field of semiskilled jobs will provide hundreds of thousands of employment opportunities for young people looking for jobs in the 1960's.

Truckdrivers are the largest single group of semiskilled workers. Millions of other semiskilled workers operate power-driven machines in factories, for example, power trucks to move equipment and materials, and lathes to shape metal parts. Semiskilled assemblers fit together parts such as tubes, sockets, and wires to make complete television sets and other products. Inspectors check the size, quality, and workmanship of parts and products to make sure they operate properly. Other semiskilled factory workers operate self-powered equipment, such as forklift trucks, which move heavy parts or materials from place to place. Many semiskilled employees work as helpers or assistants to skilled workers. For example, stationary firemen assist skilled stationary engineers in the operation and maintenance of steam boilers. (A detailed discussion of workers in selected semiskilled factory jobs is included in a later section. Further information is available in Factory Jobs: Employment Outlook For Workers in Jobs Requiring Little or No Experience or Specialized Training, BLS Bulletin 1288, January 1961.)

In general, operatives work with their hands. They have had only brief on-the-job training. Usually they are told exactly what to do and how to do it, and their work is supervised closely. They often repeat the same motions or the same jobs throughout the working day.

Semiskilled workers do not need to invest many years in learning a trade. The simplest repetitive and routine semiskilled jobs can be learned in a day and mastered in a few weeks. Even those semiskilled jobs which require a higher degree of skill, such as truckdriver, can be learned in a few months. Adaptability—the ability to learn new jobs and the operation of
new machines quickly—is an important qualification for semiskilled workers.

New employees in semiskilled jobs usually are required only to be physically able to perform the work. At the beginning, they are not expected to be highly proficient, but after a short training period they must work at a standard, fast, and steady pace. A semiskilled worker must be dependable—come to work regularly, pay attention, and follow instructions carefully. Frequently, good eyesight and good coordination are required also.

Employment growth in semiskilled jobs has been greatest in manufacturing industries (such as apparel and automobiles) where production processes are divided and subdivided into step-by-step sequences of relatively simple operations. To reduce costs and increase efficiency, many former skilled jobs in these industries have been replaced by a series of jobs which require workers with much less skill. Mass production industries also have created large numbers of new semiskilled assembly and inspection jobs. Other new jobs for semiskilled workers resulted from the introduction and use of welding as a manufacturing process. Expanded production in manufacturing industries together with the growing use of trucks and buses have been instrumental in making the semiskilled the largest group of workers in the labor force. Between 1910 and 1960, employment of semiskilled workers more than doubled.

Employment of semiskilled workers will continue to increase in the 1960's. As a proportion of the labor force, however, it is expected that semiskilled workers may remain about the same or even decline somewhat. Recent technological advances (popularly called "automation") have permitted great gains in production with little or no increase in employment of semiskilled machine operators. Many loading and handling operations, for example, can be performed more quickly and efficiently with the newer types of semiautomatic transfer equipment, thus reducing requirements for semiskilled operators in such work.

On the other hand, the creation of new jobs—frequently a result of continuing technological advances in processing and products—will favorably affect employment of semiskilled workers. In addition, semiskilled workers will have many job opportunities in plants which will remain relatively unmechanized in the 1960's. The continuing substitution of power equipment for unskilled manual labor—lifting, hauling, digging, and similar heavy physical work—also will create many employment openings for semiskilled workers.

Tens of thousands of job opportunities for semiskilled workers also will become available each year in the 1960's as workers are promoted, transfer out of semiskilled jobs, retire, or die. Replacement needs for semiskilled workers are high because a fairly high proportion of them are young workers and women workers, who tend to change jobs frequently. Many women operatives leave their jobs to marry, raise families, or move to other areas when their husbands change jobs.

Semiskilled workers are more likely to lose their jobs during a business recession, and to remain unemployed for longer periods of time, than craftsmen or white-collar employees. On the other hand, semiskilled workers can move to different jobs at the same level of pay more easily than can highly specialized workers. Semiskilled jobs often pay well. Operatives who are paid on the basis of the number of items they produce are among the highest paid workers in manufacturing, although the average annual earnings of operatives are about $1,000 less than those of skilled workers.

Young men and women who have no training beyond high school will continue to find a major area of job opportunities in factory operative and other semiskilled jobs. However, the most rapid gains in the Nation's employment are in skilled occupations and professional, technical, and other white-collar occupations. If possible, young people with ability should obtain the additional training and education which these occupations require. Young people who take semiskilled jobs, however, are not cut off permanently from advancement if they take advantage of the many educational opportunities available in their communities. They may enter apprentice training programs, or take courses in evening schools, and eventually qualify for better jobs.
Unskilled Workers

Unskilled laborers work in manual occupations which generally require no special training. Frequently, these jobs involve handling and moving objects or materials, for example, loading or unloading, digging, shoveling, hauling, hoisting, wrapping, and mixing. Some of these unskilled jobs require heavy physical work. Unskilled manual laborers are employed mainly in manufacturing plants, construction work, wholesale and retail trade, and transportation jobs.

Employment of unskilled laborers dropped over the past few decades, but has remained relatively stable in recent years. In 1960, employment of unskilled laborers was approximately 3.7 million, only about 5.5 percent of the Nation’s work force.

The long-run decline in the employment of unskilled workers has occurred largely because mechanized equipment has been replacing manual labor. Use of power-driven, material-handling equipment, such as forklift trucks, derricks, cranes, hoists, and conveyor belts, has greatly increased in factories, freight terminals, warehouses, and construction operations.

The substitution of mechanical equipment for unskilled labor in industry is expected to continue in the 1960’s. However, total employment in this occupational group probably will show little change, mainly because new requirements for unskilled laborers in expanding industries are expected to offset the drop resulting from continuing mechanization.
BUILDING TRADES

Building trades craftsmen make up the largest group of skilled workers in the Nation's labor force. Altogether, there were about 3 million such craftsmen in mid-1960—almost a third of all the skilled workers. The more than two dozen skilled building trades vary greatly in size. Several major trades—carpenter, painter, plumber, pipefitter, bricklayer, operating engineer (construction machinery operator), and construction electrician—each comprised more than a hundred thousand workers. (See chart 20.) The more than 1 million carpenters accounted for about 2 out of every 5 skilled building tradesmen. By contrast, only a few thousand workers were employed in each of several trades, such as marble setter, asbestos and insulating worker, and stonemason.

There are several reasons why young men may wish to consider one of the building trades as a career. These trades offer especially good opportunities for those who are not planning to go to college, but who are willing to spend several years in learning a skilled occupation. Well-trained building trades craftsmen can find job opportunities in all parts of the country. Their hourly wage rates generally are much higher than those of most other manual workers. Building trades craftsmen with business ability have greater opportunities to establish their own businesses than workers in many other skilled occupations. Moreover, employment in most building trades has expanded during the past several decades, and is still growing, despite advances in technology.

A principal disadvantage of work in the building trades is the sharp employment fluctuations that result from changes in general business conditions. Another disadvantage is that even during years of high levels of construction activity, annual earnings of workers in the building trades are somewhat limited by the seasonal nature of construction work. Worktime is lost as a result of bad weather and other interruptions. In addition, construction jobs generally are of short duration and building craftsmen must spend time in finding their next job, which may be located at a considerable distance from their homes.

What Are the Building Trades?

Building trades craftsmen are employed mainly in the construction, maintenance, repair, and alteration of homes and other types of buildings, highways, airports, and other structures. The wide range of materials and skills used in construction work has resulted in specialization of various work operations.

CHART 20

EMPLOYMENT IN SKILLED BUILDING TRADES, MID-1960.1...

Thousands of workers

<table>
<thead>
<tr>
<th>Trade</th>
<th>Thousands of Workers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carpenters</td>
<td>0-200 400 600 800 1,000 1,200</td>
</tr>
<tr>
<td>Painters</td>
<td></td>
</tr>
<tr>
<td>Plumbers and pipefitters</td>
<td></td>
</tr>
<tr>
<td>Bricklayers</td>
<td></td>
</tr>
<tr>
<td>Operating engineers 2</td>
<td></td>
</tr>
<tr>
<td>Electricians (construction)</td>
<td></td>
</tr>
<tr>
<td>Structural-ornamental, and reinforcing-iron workers</td>
<td></td>
</tr>
<tr>
<td>Plasterers</td>
<td></td>
</tr>
<tr>
<td>Roofers</td>
<td></td>
</tr>
<tr>
<td>Cement masons</td>
<td></td>
</tr>
<tr>
<td>All others</td>
<td></td>
</tr>
</tbody>
</table>

1 Estimated.
2 Construction machine operators.
Thus, building trades workers who use essentially the same materials or skills have tended to become identified with distinct trades. For example, bricklayers and stonemasons both work with masonry materials. Although operating engineers do not work with particular materials, they have a group of related skills which enables them to handle various types of excavating, grading, hoisting, and other equipment.

The building trades consist primarily of journeymen who generally must have a high level of skill and a sound knowledge of assembly and construction operations. They are often assisted in their work by apprentices, tenders, and laborers.

The work of journeymen may be grouped into three broad classifications—structural, finishing, and mechanical. However, some craftsmen—for example, carpenters—may do finishing as well as structural work. Generally, each building trade is classified in one of these three categories, as follows:

Occupations mainly concerned with structural work: carpenter, bricklayer, stonemason, cement or concrete mason, structural-iron worker, ornamental-iron worker, reinforcing-iron worker (rodman), rigger, boilermaker, and operating engineer.

Occupations mainly concerned with finishing work: lather, plasterer, marble setter, tile setter, terrazzo worker, painter, paperhanger, soft-floor layer, glazier, roofer, and asbestos worker.

Occupations mainly concerned with mechanical work: plumber, pipefitter, millwright, construction electrician, sheet-metal worker, and elevator constructor.

(A detailed description of the nature of the work, training, employment outlook, and other information concerning millwrights and boilermakers appears elsewhere in this Handbook. See index for page numbers.)

Most of these skilled trades are described individually later in this chapter. These descriptions are necessarily brief and incomplete. They do not apply fully to all localities because of local differences in the scope of the various trades. Also, they are not statements or recommendations concerning the work jurisdiction of these trades and are inappropriate for use in jurisdictional negotiations or the settlement of jurisdictional questions.

Where Building Trades Workers Are Employed

Building trades workers are employed mainly by contractors in the contract construction industry. Many others are employed to do maintenance work in industries other than construction, particularly manufacturing. Some building trades craftsmen work directly for business firms or government agencies which have their own construction work force; others are self-employed.

The building trades craftsmen who work in the contract construction industry are employed by general and special-trade contractors. General contractors may be classified as building (residential, commercial, or industrial), highway, or heavy construction contractors, since most general contractors limit their operations to one of these activities. They construct buildings and other structures, such as dams, bridges, and roads, taking full responsibility for the complete job, except for any specified portions of the work that may be omitted from the general contract. General contractors may do a large part of the work with their own crews, but they often subcontract particular phases of the construction job to special-trade contractors.

Special-trade contractors usually do the work of only one trade, such as painting, carpentry, or electrical work, or of two or more closely related trades, such as plumbing and heating, or plastering and lathing. Beyond fitting their work to that of other trades, they have no responsibility for the structure as a whole. The special-trade contractors obtain orders for their work from general contractors, architects, or from property owners. Repair work is almost always done on direct order from the owners, occupants, architects, or rental agents.

There are several hundred thousand contractors (both general and special-trade); most of them operate within a limited geographical area. The great majority are small—generally employing fewer than 10 workers. Some larg-
er firms employ several thousand workers each. Many building trades workers are self-employed. Self-employed journeymen work directly for property owners on small jobs. They may be paid by the hour or the day, or they may be paid an agreed price for the job, either providing the materials and including them in the price or using materials provided by the owner. Self-employment is most common in carpentry and painting, but is found also in other skilled building trades.

In some of the trades, work may be performed away from the construction site. For example, sheet-metal workers may be employed in shops where ducts are fabricated for installation in a building. Many building trades craftsmen are also employed to do maintenance work in factories, stores, mines, hotels, and almost every other type of large business establishment.

The work of skilled building craftsmen is identified with a specific trade, such as carpentry or bricklaying, rather than with an individual contractor or even a broad group of contractors. Thus, a carpenter may be employed mainly by a particular builder but, in the course of a year, he may be employed also by a concrete contractor to build forms for a concrete bridge; by an electrical or plumbing contractor to build a temporary structure at a large construction site; or he may contract to do a small repair job on his own.

The fact that building trades craftsmen are employed in almost every community is an important consideration for young persons interested in a career in the skilled building trades. Once they learn one of the trades they can find jobs not only in their own community but in almost any part of the country. Employment of these workers is distributed geographically, however, in much the same way as the Nation's population. Thus, their employment is concentrated generally in the industrialized and highly populated States, such as California, New York, Pennsylvania, Illinois, Texas, and Ohio.

**Training, Other Qualifications, and Advancement**

Most training authorities, including national joint labor-management apprenticeship committees established for most of the building trades, recommend formal apprentice training as the best way to acquire the all-round proficiency of craftsmen in the building trades. Apprenticeship is a prescribed period of on-the-job training, supplemented by related classroom instruction, which is designed to develop skill by making the apprentice familiar with the materials, tools, and principles of his trade. This type of training provides the apprentice with a balanced knowledge of his field of work and enables him to perform its operations competently. Formal apprenticeship agreements are registered with a State apprenticeship agency or the U.S. Department of Labor's Bureau of Apprenticeship and Training.

In addition to the apprenticeship method, many building trades workers have acquired skills of their trades informally, by working for many years as laborers and helpers, observing the work of experienced craftsmen. Some building trades craftsmen have acquired their skills, or part of their skills, by attending vocational or trade schools, or by taking correspondence school courses.

Generally, apprentices in the building trades are required to be between the ages of 18 and 25, and in good physical condition. (The maximum age limit may be waived for veterans or others with experience or special qualifications.) A high school education or its equivalent, with course work in mathematics and the sciences, is desirable. Often, applicants are given tests to determine their aptitude for a particular occupation. For some skilled building trades, it is important to have considerable manual dexterity, mechanical aptitude, a discerning color sense, and an eye for quickly determining proper alinement of materials.

The formal registered apprenticeship agreement generally stipulates a training period of 3 to 5 years of relatively continuous employment and training, in addition to a minimum of 144 hours a year of related classroom instruction. The journeymen on the job and the foreman explain to the apprentice how the work is done and show him how different operations are performed and how different tools are used. Ordinarily, most of this instruction
is given by a particular journeyman to whom the apprentice is assigned. The apprentice is required to do work of progressively increasing difficulty and with progressively less supervision.

Related classroom instruction varies among the skilled building trades, but usually includes courses such as: History of the trade; characteristics of the materials used; shop mathematics as related to the work of the trade; some basic principles of engineering, where appropriate (particularly for pipework, work on ventilating systems, and electrical work); sketching, elementary drafting, and interpretation of drawings; safety practices; and special-trade theory such as color harmony for painters and elementary sanitation for plumbers. Such related instruction is seldom offered in small communities where there may be only a few apprentices and a small number of journeymen in a particular trade. In these areas, apprentices receive instruction through courses offered in the local high school or by visiting instructors, generally furnished by the State. Other subject matter requirements are met through personal instruction by local journeymen and contractors or, in some cases, through correspondence courses.

The formal registered apprenticeship agreements also stipulate the length of time the apprentice is to be required to work in each major operation of the trade as well as his rate of pay at successive intervals of advancement. The apprentice is paid at an advancing rate, usually starting at 50 percent of the journeyman’s pay. The apprentice’s rate increases at 6-month or 1-year intervals until a rate of about 90 percent of the journeyman’s rate is reached in the final months of training. Often, advanced apprenticeship standing and pay are given to apprentices who have acquired trade skills in the Armed Forces, or through trade school instruction. Advanced standing is granted on an individual basis and is usually determined by a demonstration of trade skill and knowledge.

In most communities, the apprenticeship programs are supervised by joint apprenticeship committees composed of representatives of the local employers or employer groups and the local union. The apprentices sign their apprenticeship agreements with these committees. The committee determines the need for apprentices in the locality and establishes minimum apprenticeship standards of education, experience, and training. Whenever employers cannot provide the variety of experience necessary to give an apprentice all-round instruction in the various branches of the trade, or relatively continuous employment over the entire period of apprenticeship, the committee transfers the apprentice to another employer. Where specialization by contractors is extensive—for instance, in electrical work—it is customary for the joint committee to rotate apprentices among several contractors in the trade at intervals of about 6 months. In some large cities, the local joint apprenticeship committee employs an apprenticeship program coordinator.

In areas where these committees have not been established, the apprenticeship agreement is solely between the apprentice and an employer or employer group. Many journeymen have received worthwhile training under this type of apprenticeship program, but such a program may involve some element of risk for the apprentice. In such instances, there is no joint committee to supervise the training offered, to settle differences over the terms and conditions of apprentice training, or to arrange a transfer in cases of personal disagreements between the the apprentice and the employer. The apprentice’s training depends principally on his employers’ business prospects and policies. If the employer lacks continuous work or does only a restricted type of work, he cannot provide the apprentice with the all-round training needed to develop journeyman skills.

In many localities, craftsmen, most commonly construction electricians and plumbers, are required to have a journeyman’s license to work at their trade. To qualify for such licenses, they must pass an examination, showing a well-rounded knowledge of the job and of State and local regulations.

Building trades craftsmen may advance in a number of ways. For example, a journeyman may become a foreman in charge of a crew. In most localities, small jobs are
run by "working foremen" who work at the trade along with members of their crews. On very large jobs, the foremen do supervisory work only. A craftsman can also become an estimator for a contractor. In this job, he estimates material requirements and labor costs to enable the contractor to bid on the work of a particular construction project. Some craftsmen advance to jobs as superintendents on large projects. Others become instructors in trade and vocational schools, or salesmen for building supply companies.

In addition, many thousands of journeyman have become contractors, particularly in the homebuilding field. Sound journeyman knowledge is a great help in assuring success as a contractor. However, the successful contractor must also have the ability to plan work, to foresee needs and problems, to direct others, and to estimate material and time requirements for jobs on which he is bidding. He also must have a sound knowledge of business practices and financing.

Generally, it is easier to start a small contracting business in the construction industry than it is to start a small business in other industries. For example, only relatively moderate financial investment is needed, liberal credit arrangements make it easier to buy materials, and it is possible to conduct a fairly substantial business from the proprietor's home. Because it is relatively easy to enter the contracting business, competition is usually keen, especially for smaller jobs. For larger jobs, considerable working capital and investment in equipment are necessary. Some States or municipalities require contractors to be licensed.

**Employment Outlook**

A continued upward trend in the employment of skilled building trades workers is expected during the 1960's. The rate of employment increase for these craftsmen is expected to be greater than the estimated 20-percent rise anticipated for the Nation's total working population. In addition to openings resulting from employment growth, many thousands of job opportunities for new workers to enter the building trades will result each year from the need to replace skilled workers who transfer to other fields of work, are promoted to other jobs, or who retire or die.

The favorable employment prospects for these skilled workers in the 1960-70 decade will result primarily from the approximate 50-percent increase anticipated in the level of construction activity, continuing the upward trend of the 1950's. This trend can be illustrated by an examination of construction expenditures. Total construction expenditures (including maintenance and repair) rose more than 75 percent from 1950 to 1960 (actual expenditures not adjusted for changes in price levels). The rate of growth of new construction was even greater over the same period, while expenditures for maintenance and repairs increased nearly 60 percent. Employment growth accompanied the 1950-60 expansion in construction activity. For example, in contract construction, where a majority of building trades craftsmen work, annual average employment rose from about 2.3 million in 1950 to nearly 2.8 million in 1960, or by almost 20 percent.

The same factors which accounted for the rapid expansion in construction activity over the 1950's are expected to spur construction expenditures over the 1960's. These factors include anticipated large increases in population and in the number of households; a continuing shift of families from the cities to the suburbs; increases in government expenditures for highways, schools, and national defense; a rise in expenditures for new industrial plant capacity; higher levels of personal and corporate income; and expanding demand for maintenance, repair, and modernization work.

This large rise in construction activity is expected to result in a substantial increase in the employment of building trades craftsmen. However, employment is expected to increase at a slower rate than expenditures. Continued technological developments in construction methods and equipment will permit greater output per construction worker. The technological changes which can be foreseen at the present time will likely have limited effects on employment in the building trades. The experi-
ence of the past 50 years shows that the skilled building trades generally have been able to adapt to technological changes and still continue to grow.

Employment of building trades craftsmen in maintenance jobs in factories, commercial establishments, schools, and large residential projects is also expected to increase substantially by 1970.

The rates of growth will differ among the various building trades. Employment growth is expected to be most rapid for operating engineers, cement masons, construction electricians, sheet-metal workers, and plumbers and pipefitters. Employment of carpenters will also increase substantially and this trade will continue to be the largest single occupation in the building trades. Painters, paperhangers, stonemasons, tile and marble setters, and lathers probably will be among the building trades which will have the least rapid growth. (See chart 21.)

CHART 21

EXPECTED EMPLOYMENT GROWTH RATES IN SELECTED BUILDING TRADES, 1960–70

<table>
<thead>
<tr>
<th>Building trades</th>
<th>Growth rates related to average for all building trades</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Very much more</td>
</tr>
<tr>
<td>Operating engineers1</td>
<td></td>
</tr>
<tr>
<td>Sheet metal workers</td>
<td></td>
</tr>
<tr>
<td>Electricians (construction)</td>
<td></td>
</tr>
<tr>
<td>Cement masons</td>
<td></td>
</tr>
<tr>
<td>Carpenters</td>
<td></td>
</tr>
<tr>
<td>Plumbers and pipefitters</td>
<td></td>
</tr>
<tr>
<td>Bricklayers</td>
<td></td>
</tr>
<tr>
<td>Structural-, ornamental-, and reinforcing- iron workers</td>
<td></td>
</tr>
<tr>
<td>Roofers</td>
<td></td>
</tr>
<tr>
<td>Plasterers</td>
<td></td>
</tr>
<tr>
<td>Lathers</td>
<td></td>
</tr>
<tr>
<td>Paperhangers</td>
<td></td>
</tr>
</tbody>
</table>

1. Construction machinery operators.

(A more complete statement covering training, other qualifications, advancement, and employment opportunities in each trade is given in the discussions of individual occupations later in this chapter.)

One of the principal sources of job opportunities for new workers will result from replacement needs. Retirements and deaths alone may provide about 65,000 to 75,000 job openings each year. Other openings will result from the need to replace experienced craftsmen who leave the building trades for other fields of work.

In mid-1960, about 103,000 apprentices were in registered apprentice training programs in the construction trades and perhaps more than 20,000 other apprentices were in unregistered programs. Opportunities for young men to receive apprentice training will be available in all parts of the country during the 1960's. In addition, thousands of other workers will be able to enter construction trades informally.

Some indication of the location of future apprenticeship opportunities in the building trades is available from the latest data showing the geographical distribution of registered apprentices in these trades. The following eight States accounted for more than half of the number of registered apprentices in training for selected building trades in mid-1960: California, 14,848; New York, 9,169; Illinois, 8,766; Ohio, 6,013; Texas, 4,532; Pennsylvania, 4,134; Florida, 3,268; and Michigan, 3,018.

Earnings and Working Conditions

Hourly wage rates paid to building trades craftsmen are generally higher than those paid to many other skilled workers. However, because construction work is seasonal and time is lost for other reasons, average annual earnings are not as high as the hourly rates of pay would indicate.

The hourly rates of pay for skilled workers in the building trades vary by trade and locality. Generally, the highest hourly rates are paid in the larger communities. Union minimum hourly rates for journeymen and for helpers and laborers in selected building trades in 52 large cities, as of July 1, 1960, ac-
According to the national survey of building trades workers, averaged as follows:

<table>
<thead>
<tr>
<th>Occupation</th>
<th>Minimum Average Hourly Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>All building trades</td>
<td>$3.66</td>
</tr>
<tr>
<td>Journeymen</td>
<td>3.86</td>
</tr>
<tr>
<td>Asbestos workers</td>
<td>3.90</td>
</tr>
<tr>
<td>Bricklayers</td>
<td>4.17</td>
</tr>
<tr>
<td>Carpenters</td>
<td>3.78</td>
</tr>
<tr>
<td>Cement masons (finishers)</td>
<td>3.75</td>
</tr>
<tr>
<td>Electricians (inside wiremen)</td>
<td>4.00</td>
</tr>
<tr>
<td>Elevator constructors</td>
<td>3.95</td>
</tr>
<tr>
<td>Glaziers</td>
<td>3.53</td>
</tr>
<tr>
<td>Lathers</td>
<td>4.00</td>
</tr>
<tr>
<td>Marble setters</td>
<td>3.91</td>
</tr>
<tr>
<td>Terrazzo workers</td>
<td>3.93</td>
</tr>
<tr>
<td>Tile setters</td>
<td>3.84</td>
</tr>
<tr>
<td>Painters</td>
<td>3.55</td>
</tr>
<tr>
<td>Paperhangers</td>
<td>3.52</td>
</tr>
<tr>
<td>Pipefitters</td>
<td>4.00</td>
</tr>
<tr>
<td>Plasterers</td>
<td>4.06</td>
</tr>
<tr>
<td>Plumbers</td>
<td>4.01</td>
</tr>
<tr>
<td>Roofers, composition</td>
<td>3.61</td>
</tr>
<tr>
<td>Roofers, slate and tile</td>
<td>3.62</td>
</tr>
<tr>
<td>Sheet-metal workers</td>
<td>3.90</td>
</tr>
<tr>
<td>Stonemasons</td>
<td>4.04</td>
</tr>
<tr>
<td>Structural-iron workers</td>
<td>3.96</td>
</tr>
<tr>
<td>Rodmen</td>
<td>3.86</td>
</tr>
<tr>
<td>Helpers and laborers</td>
<td>2.88</td>
</tr>
<tr>
<td>Bricklayers' tenders</td>
<td>3.00</td>
</tr>
<tr>
<td>Building laborers</td>
<td>2.81</td>
</tr>
<tr>
<td>Composition roofers' helpers</td>
<td>2.51</td>
</tr>
<tr>
<td>Elevator constructors' helpers</td>
<td>2.84</td>
</tr>
<tr>
<td>Marble setters' helpers</td>
<td>3.07</td>
</tr>
<tr>
<td>Terrazzo workers' helpers</td>
<td>3.18</td>
</tr>
<tr>
<td>Tile setters' helpers</td>
<td>3.13</td>
</tr>
<tr>
<td>Plasterers' laborers</td>
<td>3.18</td>
</tr>
<tr>
<td>Plumbers' laborers</td>
<td>2.77</td>
</tr>
</tbody>
</table>

Union rates for these occupations are negotiated between trade unions and employers. They do not include overtime, bonuses, or payments for special qualifications or for other reasons.

Construction work frequently requires prolonged standing, bending, stooping, and working in cramped quarters. Exposure to cold, hot, and inclement weather is common, as much of the work is done outdoors or in partially enclosed structures. During the winter, when the buildings are sufficiently enclosed, heat is commonly provided. Many persons prefer construction work to other skilled occupations, because they can work outdoors.

Construction work is generally more dangerous than work in manufacturing, but the risk of injury is lessened considerably when proper work practices are followed. In recent years, the safety record of construction workers in contract construction work has improved as a result of safety programs established by employers and unions.

Forty hours was the standard workweek for a vast majority of union building trades workers in mid-1960. Time and one-half was generally paid for hours worked beyond the standard workday of 8 hours. Time-and-one-half or double-time rates were usually paid for work on Saturdays and Sundays or on holidays. Travel pay to and from work was commonly paid to building trades workers whenever their work was outside a specified local area.

A substantial proportion of organized building trades workers are included in health and insurance programs negotiated between unions and employers. A majority of the building trades workers in major cities are covered by health and insurance programs financed entirely by employer contributions. Pension plans for building trades workers have become more common in recent years.

A large proportion of skilled building trades workers are members of trade unions affiliated with the Building and Construction Trades Department of the American Federation of Labor and Congress of Industrial Organizations.

Where To Go for More Information

Information on opportunities for apprenticeship or other types of construction employment in a particular locality should be obtained from individual construction firms, employer associations, locals of the building trades unions, or the local office of the Bureau of Apprenticeship and Training, U.S. Department of Labor. Many apprenticeship programs are supervised by local joint union-management apprenticeship committees. In these instances, an apprentice applicant may apply directly to the coordinator of the joint apprenticeship committee, if there is one in his locality. In recent years, there has been a trend toward increased use of the local office of the State employment service as a source of information about apprenticeship openings.
For more information on jobs in the building trades, a young man should write to the organizations listed below:

American Federation of Labor and Congress of Industrial Organizations, Building and Construction Trades Department, 815 16th St. NW., Washington 6, D.C.

Associated General Contractors of America, Inc., 1957 E St. NW., Washington 6, D.C.

National Association of Home Builders, 1625 L St. NW., Washington 6, D.C.

For the names of labor organizations and trade associations concerned with specific building trades, see the discussions of individual building trades later in this chapter.

Carpenters
(D.O.T. 5-25.110 through .840)

Nature of Work

Carpenters, the largest single group of building trades workers, are employed in almost every type of construction activity. Their work is commonly divided into two broad categories—"rough" carpentry and "finish" carpentry. Skilled carpenters are able to do both types of work.

In rough work, carpenters erect the wood framework in buildings, including subflooring, sheathing, partitions, floor joists, studding, and rafters. They install heavy timbers used in the building of docks, railroad trestles, and similar heavy installations. Rough carpentry also includes the building of forms to enclose concrete until it is hardened, the making of chutes for pouring concrete, and the erection of scaffolding and temporary buildings on the construction site.

After the rough carpentry is completed, finish carpenters install molding, wood paneling, cabinets, window sash, door frames, doors, and hardware. They also build stairs and lay floors. Carpenters who do finish work must consider the appearance as well as the structural accuracy of the work.

As part of their job, carpenters also saw, fit, and assemble plywood, wallboard, and other materials. They use nails, bolts, wood screws, or glue to fasten materials. They may also install linoleum, asphalt tile, and similar soft-floor coverings. Carpenters use handtools such as hammers, saws, chisels, and planes, and power tools such as portable power saws, drills, and rivet guns.

Carpenters tend to specialize in a particular type of carpentry work because of the wide scope of the work performed in the trade. For example, some carpenters specialize in installing acoustic panels on ceilings and walls; others specialize in the installation of millwork and finish hardware (trimming), laying hardwood floors, or building stairs. Specialization is more common in the large cities; in small communities, carpenters ordinarily do all types of carpentry work. In rural areas, carpenters may do the work of other craftsmen, particularly painting, glazing, or roofing. Carpenters generally work in a particular field of construction, such as home, bridge, or highway construction, or in industrial maintenance.
Where Employed

Most carpenters work in the construction industry and are employed mainly by contractors and homebuilders at the construction site. They work principally on building construction, although many are employed on highway or other nonbuilding projects. A large number do repair, alteration, or modernization work. Many carpenters alternate between wage employment for contractors and self-employment on small jobs. Many others work for government agencies or nonconstruction firms which employ a separate work force for their own construction work. A large number of carpenters do maintenance work in factories, hotels, office buildings, and other large establishments. They are also employed in shipbuilding, in mining, and in the production of many kinds of display materials.

Carpenters are employed in almost every community. Skilled carpenters can obtain jobs in almost any part of the country. Employment of these workers is distributed geographically in much the same way as employment in the building trades generally, with large concentrations of workers in the highly populated and industrialized areas.

Training, Other Qualifications, and Advancement

Most training authorities, including the national joint labor-management apprenticeship committee for the carpentry trade, recommend the completion of a 4-year apprenticeship program as the best way to learn carpentry. A substantial number of workers in this trade, however, have acquired carpentry skills informally, by working for many years as helpers or handymen, observing or being taught by experienced carpenters. Many of these men have also gained some of the knowledge of the trade by taking correspondence or trade school courses.

Apprenticeship applicants are generally required to be at least 17 years of age; a high school education or its equivalent is desirable. Good physical condition, a good sense of balance, and lack of fear of working on structures high off the ground are important assets. Appetites which the apprentice should have include manual dexterity and the ability to solve arithmetic problems quickly and accurately.

Most apprenticeship programs are under the supervision of local joint union-management apprenticeship committees. Generally, the apprentice is employed under a written apprenticeship agreement, and the program is registered with a State apprenticeship agency or the U.S. Department of Labor's Bureau of Apprenticeship and Training.

The apprenticeship program usually consists of 8,000 hours (4 years) of on-the-job training, in addition to a minimum of 576 hours of related classroom instruction. During the apprenticeship period, the apprentice learns elementary structural design and becomes familiar with the common systems of frame and form construction, and to use, care for, and handle safely the tools, machines, equipment, and materials used in the trade. He also learns, among other things, how to build forms for holding cement and rough framing, outside and inside finishing work, and how to fit hardware and layout doors, windows, and partitions.

The apprentice receives related classroom instruction in drafting and blueprint reading, mathematics applicable to layout work, and the use of woodworking machines. Both in the classroom and on the job he learns the relationship between carpentry and the other building trades, because the work of the carpenter is basic to the construction process.

Hourly wage rates for apprentices usually start at about 50 percent of the journeyman rate and increase by about 5 percent in each 6-month period until a rate of 85 to 90 percent is reached during the last period of apprenticeship. If apprentice applicants have had experience or training directly related to the trade, such as training in carpentry in a vocational school or experience in the Armed Forces, they may be given advanced apprenticeship standing.

Carpenters may advance to the position of carpenter foreman, or they may become general construction foremen. Carpenters usually have greater opportunities than most building craftsmen to become general construction foremen, since carpenters are familiar with the entire construction process. The proportion of self-employed among carpenters is higher than
among most other skilled building trades. Some self-employed carpenters are able to become contractors—hiring other journeymen. A knowledge of construction, adequate resources, and a sound knowledge of business principles and practices are basic requirements for success as a contractor.

**Employment Outlook**

Tens of thousands of job openings will be available each year during the 1960's for young men who wish to enter the carpentry trade. These openings will result primarily because of the large rise anticipated in construction expenditures. (See discussion, p. 343.) In addition, a growing number of carpenters will be needed in the maintenance departments of factories, commercial establishments, large residential projects, and government agencies. Technological developments are expected to continue to affect both the number and skill requirements of carpenters during the decade. Construction materials that are processed off the site and materials designed for easier and faster installations have become progressively more important. There has also been a continued trend toward a greater use of factory prefabrication of structural building components as well as entire structures.

Replacement needs will also result in many thousands of job opportunities for new workers each year. Carpenters comprise the largest single group of skilled workers in the country and account for approximately two-fifths of all building trades craftsmen. More than 1 million carpenters were employed in 1960, compared with about 900,000 in 1950. Because of the size of this occupation, replacement needs are great. Retirements and deaths alone may provide from 25,000 to 30,000 job openings annually during the 1960’s. Many other openings will result from the need to replace workers who leave the trade for other reasons.

Young men who obtain all-round training of the kind given under apprenticeship programs will have especially favorable long-range job prospects. They are in much greater demand and have better opportunities for advancement than the many men in the trade who can do only the simpler and more routine types of carpentry work.

**Earnings and Working Conditions**

Union minimum hourly wage rates, as of July 1, 1960, for carpenters averaged $3.78, compared with $3.86 for all journeymen in the building trades, according to a national survey of building trades workers in 52 large cities. Among individual cities surveyed, the minimum hourly rates for carpenters ranged from $2.50 in Charlotte, N.C., to $4.55 in New York City.

Because of the seasonal nature of much of construction work and because of time lost for other reasons, the average annual earnings of carpenters are not as high as their hourly rates of pay indicate.

A large proportion of carpenters are members of the United Brotherhood of Carpenters and Joiners of America. A small number are members of other unions. Union-management contracts covering carpenters often provide health insurance and pension benefits, financed either entirely by employers or jointly by the workers and employers.

Like other building trades, the work of the carpenter is active and is sometimes strenuous, but exceptional physical strength is not required. Many young persons like carpentry because they are able to work out of doors. However, prolonged standing, as well as climbing and squatting, is often necessary. Carpenters risk injury from slips or falls, from contact with sharp or rough materials, and from the use of sharp tools and power equipment.

**Where To Go for More Information**

A young man who wishes to obtain further information regarding carpentry apprenticeships or work opportunities in this trade should direct his inquiry to the carpentry contractors or general contractors in his area; a local of the United Brotherhood of Carpenters and Joiners of America; a local joint union-management apprenticeship committee, if there is one in his locality; or the local office of The Bureau of Apprenticeship and Training, U.S. Department of Labor. In addition, the local office of
the State employment service may be a source of information about apprenticeship opportunities. Some local employment services screen applicants and give aptitude tests.

General information on apprenticeship in this trade is also available from:

Associated General Contractors of America, Inc.,
1957 E St. NW., Washington 6, D.C.
National Association of Home Builders,
1625 L St. NW., Washington 6, D.C.
United Brotherhood of Carpenters and Joiners of America,
101 Constitution Ave., Washington 1, D.C.

Painters and Paperhangers
(D.O.T. 5–27.010 through .920 and 5–28.100)

Nature of Work

Painting and paperhanging are separate skilled building trades, although many craftsmen in these trades do both types of work. Painters prepare the surfaces of buildings and other structures and then apply paint, varnish, enamel, lacquer, and similar materials to these surfaces. Paperhangers cover room interiors with paper, fabric, vinyls, or other materials.

One of the important duties of the painter—especially in repainting—is to prepare the surface. Loose paint must be removed by scraping or by heating with a blowtorch and then scraping. Grease must be removed, nail holes and cracks filled, rough spots sandpapered, and dust brushed off. Often, surfaces must be covered with a prime coat or sealer to provide a suitable surface or base on which to apply the new paint. Paint is applied to many kinds of materials, including wood, structural steel, and clay products, generally by means of a brush, spray gun, or roller.

A painter must be skilled in handling brushes and other painting tools, in order to apply paint thoroughly, uniformly, and rapidly to any type of surface. In addition, he must be able to mix paints, match colors, and must have a knowledge of color harmony. He must also know the characteristics of common types of paints and finishes from the standpoints of durability, suitability for different purposes, and ease of handling and application.

Painters must know how to erect the scaffolding from which they often work, including “swing stages” (scaffolds suspended by ropes or cables attached to roof hooks) and “bosun chairs” which are used to work on tall buildings and other structures.

Painters use spray guns to paint surfaces or objects which are difficult to paint with a brush such as lattices, cinder and concrete block, and radiators. They also use spray guns on large areas which can be sprayed with a minimum of preparation. When using a roller (a rotating applicator covered with soft material), the painter rolls the applicator over the surface to be covered.

The paperhanger first prepares the surface to be covered. In new work, he applies “sizing,” a prepared material which makes the plaster less porous and assures better sticking of the
paper to the surface. In redecorating work, it may be necessary to remove old paper by soaking or, if there are many layers, by steaming. In many cases, it is also necessary for paperhangers to do minor plaster patching in order to get a smooth surface for the covering material.

When the surface has been prepared, the paperhanger measures the area to be covered and cuts the paper to size. He mixes a paste and applies it to the reverse side of the paper. The pastecovered paper is then placed on the wall or ceiling in strips and smoothed into place with a dry brush. The paperhanger matches the adjacent edges of strips of figured paper, cuts overlapping ends, and smooths the seams between strips with a roller or other special tool. When working with wall coverings other than paper, the paperhanger follows the same general procedure, except that he applies an adhesive other than paste.

Where Employed

Most painters and paperhangers work for contractors engaged in new building construction work. Substantial numbers of painters and paperhangers are also employed by contractors to do repair, alteration, or modernization work. Hotels, office buildings, shipyards, utility companies, manufacturing firms, schools and other government units, and other organizations that own extensive property commonly employ maintenance painters. When interior redecorating involves papering, as in hotels or apartment buildings, maintenance painters may also do the paperhanging.

More than 425,000 painters and paperhangers were employed in mid-1960. The geographical distribution of employment in these occupations is similar to that in the building trades generally, with large concentrations of workers in the highly populated and industrialized areas.

Training, Other Qualifications, and Advancement

Most training authorities, including the national joint labor-management apprenticeship committee for the painting and decorating industry, recommend the completion of a 3-year formal apprenticeship as the best way to become a journeyman painter or paperhanger. A substantial proportion of painters and paperhangers, however, have learned the trade informally. They have picked up the trade by working for many years as helpers or handymen, observing or being taught by experienced craftsmen. Workers without formal apprentice training have gained acceptance as journeymen more easily in these crafts than in most of the other building trades.

Apprentice applicants are generally required to be between the ages of 16 and 26 and in good physical condition. A high school education is preferred although not essential. Applicants should have manual dexterity and a discerning color sense. They should not be allergic to paint fumes or to the various materials used in these trades.

Many apprentice training programs are under the supervision of local joint union-management apprenticeship committees. Generally, the apprentice is employed under a written apprenticeship agreement and the program is registered with a State apprenticeship agency or the U.S.
Department of Labor's Bureau of Apprenticeship and Training.

The apprenticeship for painters and paper-hangers generally consist of 6,000 hours (3 years) of on-the-job training, in addition to related classroom instruction. Many apprenticeships combine painting and paperhanging. In a typical 3-year training program, the apprentice learns, among other things, to: use, care for, and handle safely the tools, machines, equipment, and materials commonly used in the trade; prepare surfaces, including sizing, sandpapering, and puttying walls; match and mix colors; apply various types of interior and exterior materials, including stain, whitewash, enamel, oil, and varnish; and erect scaffolding.

In addition, the apprentice receives related classroom instruction in color harmony; paint chemistry; estimating costs; and making, mixing, and matching paints. He also learns the relationship between painting and paperhanging work and the work performed by the other building trades craftsmen.

Hourly wage rates for apprentices usually start at 50 percent of the journeyman rate and increase periodically until the journeyman rate of pay is reached upon completion of apprenticeship. If apprentice applicants have had experience directly related to the trade, such as experience or training in the Armed Forces, they may be granted advanced apprenticeship standing.

Painters and paperhangers may advance to the position of foreman. They may also advance to jobs as estimators for painting and decorating contractors—computing material requirements and labor costs. Some may become superintendents on large contract painting jobs, or they may establish their own business as painting and decorating contractors. To become successful contractors, painters and paperhangers must have a thorough knowledge of the trades, adequate financial resources, and a sound knowledge of business principles and practices.

Employment Outlook

The employment of painters and paperhangers is expected to rise slowly over the 1960's—continuing the trend of the 1950's—despite the anticipated large expansion in construction activities. (See discussion, p. 343.) Most job opportunities will arise from the need to replace experienced workers who retire, transfer to other fields of work, or die.

Technological developments have limited and are expected to continue to limit the employment of painters and affect their skill requirements. New types of paint which are more easily applied and have improved "covering power" have made it easier for inexperienced workers to do work which is acceptable to some customers. Spray painting requires fewer painters to do the same amount of work. Moreover, many items formerly painted at the building site now come from a factory with a prime coat and often with a final coat. Aluminum building products which often require no painting have become increasingly common in recent years.

Employment prospects for paperhangers will continue to be limited by the substitution of paint for wallpaper as a covering for interior walls in residential and commercial buildings. The more widespread use of fabrics, plastics, and other types of wall coverings, however, may improve somewhat the employment outlook for these workers.

Because of the large size of the painter and paperhanger group, replacement needs are very great. Retirements and deaths may result in about 10,000 job openings annually during the 1960's. Many other openings will result from the need to replace experienced workers who leave the trades for other reasons.

Earnings and Working Conditions

Union minimum hourly wage rates for painters and paperhangers in 52 large cities averaged $3.55 and $3.52, respectively, as of July 1, 1960, according to a national survey of building trades workers. In comparison, the average rate for all journeymen in the building trades was $3.86 an hour. Among individual cities surveyed, the minimum hourly rates for painters ranged from $2.45 in Richmond, Va., to $4.45 in New York City. The rates for paperhangers ranged from $2.25 in
Louisville, Ky., to $3.98 in Los Angeles, Calif. The average annual earnings of painters and paperhangers are less than their hourly rates of pay would indicate. These workers lose much work-time because of weather conditions and the brief duration of many jobs.

A large proportion of painters and paperhangers are members of the Brotherhood of Painters, Decorators and Paperhangers of America. A few are members of other unions. Union-management contracts covering these workers often provide health insurance and pension benefits, financed either entirely by employers or jointly by the workers and employers.

Painters and paperhangers are often required to stand for long periods of time, to climb, and to bend at their work. A painter must have strong arms because much of the work is done with arms raised overhead. Painters and paperhangers risk injury from slips or falls from ladders and scaffolds. The number of injuries per million man-hours worked by employees of painting and paperhanging contractors in the contract construction industry has been lower than that for contract construction as a whole, but higher than for all manufacturing industries.

Where To Go for More Information

A young man who wishes to obtain further information concerning painting and paperhanging apprenticeships or work opportunities in these trades should apply to a painting and decorator contractor in his area; a local of the Brotherhood of Painters, Decorators, and Paperhangers of America; a local joint union-management apprenticeship committee, if there is one in his locality; or the local office of the Bureau of Apprenticeship and Training, U.S. Department of Labor. In addition, the local office of the State employment service may be a source of information about apprenticeship opportunities.

General information about the work of painters and paperhangers may be obtained from:

Brotherhood of Painters, Decorators and Paperhangers of America,
217–219 North Sixth St., Lafayette, Ind.

National Association of Home Builders,
1625 L St. NW., Washington 6, D.C.

Painting and Decorating Contractors Association of America,
2625 West Peterson Ave., Chicago 5, Ill.

Plumbers and Pipefitters
(D.O.T. 5-30.010, .026, .210, .410)

Nature of Work

Plumbers and pipefitters are craftsmen who install pipe systems which carry water, steam, air, or other liquids or gases needed for sanitation, industrial production, or other uses. They also alter and repair existing pipe systems and install plumbing fixtures, appliances, and heating and refrigerating units.

Although plumbing and pipefitting are sometimes considered to be a single trade, journeymen in this field tend to specialize in either one craft or the other, particularly in large cities. Water, gas, and waste disposal systems, especially those which must be connected to public utility systems, are installed by plumbers. Such installations are made in residential and commercial buildings, schools, industrial plants, and other structures. Pipefitters install both high- and low-pressure pipes that carry hot water, steam, and other liquids and gases, especially those in industrial and commercial buildings and defense establishments, such as missile launching and testing sites. Pipefitters, for example, install ammonia-carrying pipelines in refrigeration plants, complex pipe systems in oil refineries and chemical and food-processing plants, automatic sprinkler systems, and pipelines for carrying compressed air and industrial gases in many types of industrial establishments.

Some plumbers and pipefitters specialize in either gas fitting or steam fitting. Gas fitters install and maintain the gas fittings and the
central gas main extensions which connect the main gas line with those leading to homes. Steamfitters assemble and install steam or hot water systems for commercial and industrial uses.

Plumbers and pipefitters use a variety of skills when installing pipe systems. For example, they bend pipe and make welded, brazed, caulked, soldered, or threaded joints. After a pipe system is installed, the plumber or pipefitter tests for leaks by filling the pipes with liquid or gas under pressure.

Plumbers and pipefitters use wrenches, reamers, drills, braces and bits, hammers, chisels, saws, and other handtools. Power machines are often used to cut, bend, and thread pipes. Hand-operated hydraulic pipe benders are also used. In addition, plumbers and pipefitters use gas or gasoline torches and welding, soldering, and brazing equipment in their work.

**Where Employed**

Most plumbers and pipefitters are employed by plumbing and pipefitting contractors in new building construction, mainly at the construction site. A substantial proportion of plumbers are self-employed or work for plumbing contractors doing repair, alteration, or modernization work. Some plumbers install and maintain pipe systems for government agencies and public utilities, and some work on the construction of ships and aircraft. Others do maintenance work in industrial and commercial establishments. Pipefitters, in particular, are employed as maintenance personnel in the petroleum, chemical, and food-processing industries where the industrial operations include the processing of fluids through pipes.

Jobs for plumbers and pipefitters are found in almost every community in the country, but they are concentrated in highly populated and industrialized areas.

**Training, Other Qualifications, and Advancement**

Most training authorities, including the national joint labor-management apprenticeship committees for the plumbing and pipefitting industries, recommend a 5-year apprenticeship for plumbers or for pipefitters as the best way to learn all the aspects of these trades. A large number of plumbers and pipefitters, however, have acquired plumbing and pipefitting skills informally, by working for several years with craftsmen, receiving instruction from them and watching them work. Many of these persons have gained some of their knowledge of their trade by taking trade or correspondence school courses.

Apprentice applicants generally are required to be between the ages of 17 and 25, and in good physical condition. A high school education or its equivalent, including courses in mathematics, physics, and chemistry, is desirable. Applicants are often required to take aptitude tests, particularly to determine whether they have the high degree of mechanical aptitude required in this field.

Most apprentice training programs for plumbers and pipefitters are conducted under written agreements between the apprentices and local joint apprenticeship committees, composed of union and management representatives, who supervise the training. The apprenticeship committee determines the need for apprentices in the locality, establishes
minimum apprenticeship standards of training, and, if necessary, schedules a rotating work program. This program is designed to give the apprentice diversified training by having him work for several plumbing or pipefitting contractors. Under formal apprenticeship programs, the apprentice is registered with the appropriate State apprenticeship agency or the U.S. Department of Labor’s Bureau of Apprenticeship and Training.

The apprenticeship program for plumbers or for pipefitters usually consists of 10,000 hours of on-the-job training, in addition to at least 720 hours of related classroom instruction. In a typical 5-year training program, the plumber or pipefitter apprentice learns, among other things, how to use, care for, and handle safely the tools, machines, equipment, and materials used in the trades. They also learn welding and soldering techniques and general repair work; the use of ladders and the erection and dismantling of scaffolding; and the proper use of plastic and glass piping. The plumber apprenticeship program includes training in the installation of waste, vent, and domestic hot and cold water pipes, and the piping in septic tanks, cesspools, and sewers; the testing of plumbing installations; and in estimating jobs and costs of materials required. The pipefitter apprenticeship program includes training in the installation of radiators, pumps, boilers, stokers, oil burners, and gas furnaces; hot water, steam panels, and radiant-heating systems; air-conditioning and powerplant piping systems; and pneumatic control systems and instrumentation. They may also learn boiler replacement.

The apprentice receives related classroom instruction in subjects such as drafting and blueprint reading, mathematics applicable to layout work, applied physics and chemistry, and local building codes and regulations which apply to the trade.

Hourly wage rates of apprentices in this trade usually start at 50 percent of the journeyman rate and increase by about 5 percent in each 6-month period until a rate of 95 percent is reached during the last period of the apprenticeship. If apprentice applicants have prior experience or training directly related to the trade they may, in some instances, be given advanced standing and pay. This experience or training may have been obtained in the Armed Forces or through courses in public or private schools.

In some localities, a journeyman’s license is required for plumbers. To obtain this license, a person must pass a special examination to demonstrate his knowledge of the local building codes. The examination also tests his all-round knowledge of the trade.

Some journeymen plumbers and pipefitters may become foremen for plumbing or pipefitting contractors. Many journeymen go into business for themselves. As they expand their activities, they may employ other workers and become plumbing and pipefitting contractors. In some localities, contractors are required to obtain a master plumber’s license. Basic requirements for success as a contractor are thorough knowledge of plumbing and pipefitting and construction principles, adequate financial resources, and a sound knowledge of business principles and practices.

**Employment Outlook**

Employment of plumbers and pipefitters is expected to rise rapidly over the 1960–70 decade, at a faster rate than over the previous 10-year period. The number of workers in this field increased from less than 280,000 in 1950 to more than 300,000 in 1960. In addition to openings resulting from the increase in employment, many job opportunities for new workers will arise as a result of replacement needs.

The most important factor which will contribute to the rapid rise in employment is the large increase anticipated in construction activity over the 1960’s. (See discussion, p. 343.) Furthermore, plumbing and heating work is expected to become more important in many types of construction. For example, the trend toward more bathrooms per dwelling unit is likely to continue. The installation of appliances such as washing machines and waste disposals which require plumbing work will become more widespread. The number of automatic heating system installations probably will increase. Also, in industry generally, pipe work is becoming more important and plumbers and
pipefitters will be needed for installation and maintenance work. For example, the chemical industry, which uses extensive pipe work in its processing activities, is expected to expand its facilities substantially during the 1960's. Those industries which are automating their production activities will require more pipefitting work. The increasing industrial activities related to atomic energy and the greater use of refrigeration and air-conditioning equipment will also result in more work for plumbers and pipefitters. On the other hand, technological developments, such as the growing use of factory prefabricated plumbing assemblies, may limit, somewhat, the growth in the number of jobs for plumbers and pipefitters.

The need to replace experienced workers who retire, transfer to other fields of work, or die will provide thousands of job openings for new workers each year. Retirements and deaths alone may result in approximately 7,000 to 8,000 job openings annually during the 1960's.

Earnings and Working Conditions

Hourly wage rates for plumbers and pipefitters are among the highest in the skilled building trades and among skilled workers generally. Union minimum hourly wage rates for plumbers and for pipefitters averaged $4.01 and $4.00, respectively, as of July 1, 1960, according to a national survey of building trades workers in 52 large cities. At the same time, all journeymen in the building trades had an average hourly rate of $3.86. Among individual cities surveyed, the union minimum hourly wage rates for plumbers ranged from $3.25 in Charlotte, N.C., to $4.55 in New York City; pipefitters’ rates ranged from $3.25 in Charlotte, N.C., to $4.65 in New York City.

Young people contemplating plumbing and pipefitting as a career should consider the fact that annual earnings of workers in this field are among the highest in the building trades. This is true because plumbing and pipefitting are affected less by seasonal factors than are most other building crafts.

Some union-management contracts covering plumbers and pipefitters provide vacation pay, health insurance, and pension benefits, financed either entirely by employers or jointly by the workers and employers.

A large proportion of plumbers and pipefitters are members of the United Association of Journeymen and Apprentices of the Plumbing and Pipe Fitting Industry of the United States and Canada.

The work of plumbers and pipefitters is active and sometimes strenuous, as is the work in the other building trades. They frequently must stand for prolonged periods and occasionally work in cramped or uncomfortable positions because much of their work is done in relatively inaccessible places. They are less exposed to unfavorable weather conditions than are many other building tradesmen, because most of their work is performed indoors.

Workers in this trade risk the danger of falls from ladders, cuts from sharp tools, and burns from hot pipes or steam. The number of injuries per million man-hours worked by employees of plumbing, heating, and air-conditioning contractors in the contract construction industry has been lower than that for contract construction as a whole, but higher than the average for production workers in manufacturing industries.

Where To Go for More Information

A young man who wishes to obtain further information concerning enrollment in a local plumber or pipefitter apprenticeship program or to locate work opportunities in the field should apply to a plumbing, heating, and air-conditioning contractor in his area; a local union of the United Association of Journeymen and Apprentices of the Plumbing and Pipe Fitting Industry of the United States and Canada; a local joint union-management apprenticeship committee, if there is one in his area; or the local office of the Bureau of Apprenticeship and Training, U.S. Department of Labor. In addition, the local office of the State employment service may be a source of information about apprenticeship opportunities. Some local employment service offices provide such services as screening applicants and giving aptitude tests.
General information about the work of plumbers and pipefitters may be obtained from:

National Association of Home Builders, 1625 L St. NW., Washington 6, D.C.

National Association of Plumbing Contractors, 1016 20th St. NW., Washington 6, D.C.

United Association of Journeymen and Apprentices of the Plumbing and Pipe Fitting Industry of the United States and Canada, 901 Massachusetts Ave. NW., Washington 1, D.C.

**Bricklayers**

(D.O.T. 5–24.000 through .199)

**Nature of Work**

Bricklayers (or brickmasons) are craftsmen who construct walls, partitions, fireplaces, chimneys, and other structures from brick. They may also use other masonry materials, such as concrete, cinder, or gypsum block; structural tile, or terra cotta (a hard-baked brick used for ornamental purposes). They also install the brick linings of industrial kilns and furnaces.

In laying brick, a bricklayer first spreads a layer or “bed” of soft mortar. He applies mortar to the end of the last brick laid or to one end of a brick to be laid. He places the brick on the bed of mortar and works it into the desired position with his hand. Then he cuts off the excess mortar. When necessary, he breaks bricks with a trowel or brick hammer to fit spaces too small for whole bricks. He keeps the courses (rows) of brick level by using a tightly stretched horizontal cord (gage line) as a guide. At fixed points along the wall he checks the surface with a mason’s level to make sure the bricks are lined up. A plumb line is also used to check vertical alignment. Using the point of a trowel or a special finishing tool, he trims the mortar between the bricks to achieve a neat appearance. If two or more thicknesses of brick are being laid, the brickmason lays a “bond” course at regular intervals, that is, he arranges a row of bricks crosswise or in another “bond” pattern in order to tie the bricks together. When the bricklayer works with concrete block, structural tile, or other masonry material, the work is essentially the same.

Bricklaying requires careful, accurate work so that the brick structure will have a neat and uniform appearance and the rows of brick will line up with windows, doors, or other openings without excessive cutting of brick. Craftsmen in this trade mainly use handtools, including chisels, trowels, jointers, and tuck pointers (a special finishing tool used to shape mortar joints), bricklayer’s hammers, gage lines, plumb bobs, and mason’s levels. Power saws are sometimes used for cutting masonry materials. Journeymen bricklayers are usually assisted by hod carriers or helpers who supply them with bricks and other materials, mix mortar, and set up and move scaffolding.

**Where Employed**

The great majority of bricklayers work mainly on new building construction. Some are employed in sewer construction work in which they construct manholes and catch basins. Bricklayers do a considerable amount of alteration work, especially in the larger cities where construction of fire-resistant partitions, storefront remodeling, and similar modernization work, are often done. They also do a substantial amount of maintenance and repair work.

Bricklayers also work for such industrial establishments as factories making glass or steel, where furnaces and kilns require special fire brick and refractory brick linings. For example, in a steel manufacturing plant, the bricklayer lines converters, cupolas, and ladles which hold molten metal. Bricklayers must have additional training to do refractory brick work.

Jobs for bricklayers are found throughout the country. Their employment, however, is concentrated in the more highly populated and industrialized areas.

**Training, Other Qualifications, and Advancement**

Most training authorities, including the National Joint Labor-Management Apprentice-
ship Committee for the bricklaying trade, recommend the completion of a 3- or 4-year apprenticeship program as the best way to learn this trade. A substantial proportion of workers in this trade have acquired bricklaying skills informally, by working for many years as helpers or hod carriers, observing or being taught by experienced bricklayers. Many of these persons have gained additional knowledge of their trade by taking trade school courses.

Apprenticeship applicants are generally required to be between the ages of 17 and 24. A high school education or its equivalent is desirable. Many apprenticeship programs are under the supervision of local joint union-management apprenticeship committees. Generally, the apprentice is employed under a written apprenticeship agreement and the program is registered with a State apprenticeship agency or the U.S. Department of Labor's Bureau of Apprenticeship and Training.

The apprenticeship program generally consists of from 6,000 to 8,000 hours (3 to 4 years) of on-the-job training, in addition to related classroom instruction. In a typical 3-year bricklayer training program, the apprentice learns, among other things, to: use, care for, and handle safely the tools, machines, equipment, and materials commonly used in the trade; lay brick (including mixing and spreading mortar), bond and tie, build footings and foundations; do plain exterior brickwork such as straight wall work; build arches, columns, piers, and corners; plan and build chimneys, fireplaces, and floors; lay stone; point brick and stone; clean stone, brick, and tile with water and acid, and by sandblasting; cut, set, and point cement blocks, artificial stone, glass blocks, and cork; and fireproof. The apprentice receives related classroom instruction in blueprint reading, layout work, and measurements and sketches. In addition, he learns the relationship between bricklaying and other building trades.

A bricklayer must have an eye for straight lines and proportions. Good physical condition and manual dexterity are important assets. Since the other building craftsmen must usually fit their work to his, he should know how the parts of a structure fit together.

Hourly wage rates for bricklayer apprentices generally start at 50 percent of the journeyman rate and increase periodically until 95 percent of the journeyman's rate is reached during the last period of the apprenticeship. If apprentice applicants have had training or experience directly related to the trade as, for example, in the Armed Forces or in a trade school, they may be given advanced apprenticeship standing.

In some areas, formal apprentice training for bricklayers includes brief, preliminary instruction at a vocational school or some other type of prejob training which is designed to give the apprentice sufficient skill in the handling of tools and materials to make him productive at the start of his on-the-job training.

Bricklayers may advance to jobs as foremen. They may also become estimators for bricklaying contractors. Estimators compute material requirements and labor costs. Some journeymen advance to the position of bricklaying superintendent on large construction projects, while others may start their own bricklaying contracting business. Adequate financial resources and a sound knowledge of business principles and practices, in addition to a knowl-
edge of the trade, are basic requirements for success as a contractor.

Employment Outlook

The employment of bricklayers is expected to rise rapidly over the 1960–70 decade, but the rate of growth will probably be slower than it was over the previous 10-year period. Between 1950 and 1960, employment of these craftsmen rose from about 165,000 to more than 250,000. Much of the expected growth in the 1960's will result from the large increase anticipated in construction expenditures. (See discussion, p. 343.) Also, increasing use of structural clay tile for fire-resistant partitions and glass blocks for exterior walls is expected. The rise in bricklayer employment is expected despite a continuation of some technological developments which reduce the amount of brickwork per structure. For example, the introduction of steel-frame and reinforced concrete structures permits the elimination of load-bearing exterior brick walls in buildings and the substitution of light metal panels; the use of prefabricated brick, metal, and glass wall panels in many buildings results in less masonry work; and ornamental brick work is less widely used in building decoration.

In addition to job openings that will result from growth of the trade, many job opportunities for new workers will arise from replacement needs. Retirements and deaths may result in about 5,000 job openings annually during the 1960's. Replacement of workers who leave the trade for other reasons will provide many other job openings.

Earnings and Working Conditions

Union minimum hourly wage rates, as of July 1, 1960, for bricklayers averaged $4.17, compared with $3.86 for all journeymen in the building trades, according to a national survey of building trades workers in 52 large cities. Among individual cities surveyed, the minimum hourly rates for bricklayers ranged from $3.20 in Charlotte, N.C., to $4.80 in New York City.

Although bricklayers generally have the highest hourly wage rates in the building trades, their average annual earnings are not as high as their hourly rates of pay would indicate, because of the highly seasonal nature of the bricklayer's work.

A large proportion of bricklayers are members of the Bricklayers, Masons and Plasterers' International Union of America. Union-management contracts covering bricklayers often provide health insurance, pension, and other benefits, financed either entirely by the employers or jointly by the workers and employers.

The work of the bricklayer is active and sometimes strenuous, like the work in other building trades. It involves stooping to pick up materials, moderately heavy lifting, and prolonged standing. Most of the work is done outdoors.

Where To Go for More Information

A young man who wishes to obtain further information regarding bricklaying apprenticeships or work opportunities in the trade should apply to a bricklaying contractor in his area; a local of the Bricklayers, Masons and Plasterers' International Union of America; the local joint union-management apprenticeship committee, if there is one in his area; or the local office of the Bureau of Apprenticeship and Training, U.S. Department of Labor. In addition, the local office of the State employment service may be a source of information about apprenticeship opportunities. Some local employment service offices provide services such as screening applicants and giving aptitude tests.

General information about the work of bricklayers may be obtained from:

- Associated General Contractors of America, Inc., 1957 E St. NW., Washington 6, D.C.
- Bricklayers, Masons and Plasterers' International Union of America, 815 15th St. NW., Washington 5, D.C.
- National Association of Home Builders, 1625 L St. NW., Washington 6, D.C.
- Structural Clay Products Institute, 1520 18th St. NW., Washington 6, D.C.
Operating Engineers (Construction Machinery Operators)
(D.O.T. 5-23.000 through .999 and 7-23.000 through .999)

Nature of Work

Operating engineers operate, maintain, and repair various types of power-driven construction machinery. These machines include power shovels, cranes, derricks, hoists, pile drivers, concrete mixers, paving machines, trench excavators, bulldozers, tractors, and pumps. Because operating engineers work with many different types of machines—some complex and others relatively simple—the range of skills among these workers is broader than among journeymen in any other building trade. This range of skills may be illustrated by describing the work performed by an engineer who operates a crane and one who operates an earth-boring machine.

The crane operator manipulates various pedals and levers to rotate the crane on its chassis and to raise and lower the crane boom and the loadline. The operator also manipulates a number of different attachments to the crane boom for various construction purposes. For example, he manipulates buckets for excavation work; pile drivers to drive steel beams, wood, and concrete piling into the ground; and wrecking balls for demolition work. Good eye-hand-foot coordination, skill in precision handling of heavy equipment, and judgment in estimating proper load size are among the essential aptitudes needed to do the crane operator's job. In contrast, the operation of earth-boring machines that dig holes for poles or posts is one of the less skilled tasks performed by operating engineers. The operator sets the proper auger (drill) in the spindle, starts the machine, and stops it when the auger has penetrated to the proper depth.

Operating engineers are often identified by the types of machines they operate—for example, craneman, bulldozer operator, or derrick operator. However, the more experienced operating engineers generally can operate several types of construction machines. Operators prefer to work on the more complex types of machines when jobs requiring such equipment are available, because higher wage rates are paid for the operation of such machines.

Where Employed

Most operating engineers are employed on construction work. They work for contractors engaged in highway, dam, airport, and other large-scale engineering projects. On building projects, they are employed in excavating, grading, landscaping and in hoisting concrete, steel, and other building materials. Others are employed by utility companies, manufacturers, and other business firms which do their own construction work, as well as by State and local public works and highway departments. Relatively few operating engineers are self-employed. Those who are self-employed are owner-operators of construction equipment, such as bulldozers and cranes.

In addition to employment in construction work, operating engineers operate cranes, hoists, and other power-driven machinery in factories and mines. In some cases, the duties of operating engineers in nonconstruction jobs are about the same as those in construction work. For example, operation of a crane to unload cars of coal at a factory is very similar to operation of a crane to unload cars of sand and gravel for a street paving job. On the other hand, the nature of the work of a steel pourer (craneman) in a steel mill differs considerably from that of a crane operator in the construction industry.

Operating engineers are employed in every section of the country, but mainly in the larger urban areas. This work, however, may take them to remote locations where highway construction and heavy engineering construction, such as dams, are being done. The geographical distribution of the more than 200,000 operating engineers employed in mid-1960 was much the same as for the building trades generally, with large concentrations of workers in the highly populated and industrialized areas.
Training, Other Qualifications, and Advancement

Formal apprenticeship programs for operating engineers are available in some localities. Most of these programs last from 3 to 4 years. The trend in apprenticeships is toward establishing separate programs to provide training in the operation of one of the following types of equipment: Grading and paving equipment; universal equipment (hoists and shovels); and plant equipment (material mixing and crushing machines).

Many men with mechanical aptitude, however, enter this occupation by obtaining jobs as oilers (operating engineer’s assistant) or as helpers to heavy equipment repairmen. Workers on these jobs gain a knowledge of the machinery, how to keep it in good working order, and how to make repairs. Oilers and helpers must perform their work well and demonstrate initiative before they are given the instruction from experienced operators which is necessary for advancement. They must also demonstrate interest in and ability to learn the correct methods of handling equipment, and to recognize hazards which must be avoided.

Some men with mechanical experience, such as that obtained from operating farm equipment or air compressors, may get jobs operating the simpler construction machines. However, operating knowledge of a broad range of related equipment and attachments is ordinarily necessary to obtain continuous employment. This all-round knowledge is best obtained through a formal apprenticeship program or by working as an oiler or helper, usually for a much longer period of time than it takes to complete an apprenticeship.

Employment Outlook

A continued rapid rise in employment of construction machinery operators is expected during the 1960’s, primarily as a result of the anticipated large increases in construction activity. (See discussion, p. 343.) The growing volume of highway construction, resulting from the Federal Government’s long-range multi-billion dollar highway development program, will be especially important in providing thousands of job opportunities for operating engineers during the 1960’s.

Moreover, the trend in the postwar period toward the increasing use of construction machinery shows every indication of continuing. More specialized and more complex machines, particularly those used in earth moving, as well as smaller machines suitable for small construction projects, are continually being developed and are expected to be used to a greater extent. The increasing mechanization of material movement in factories and mines should also result in growing employment of these workers outside of construction.

In addition to job openings resulting from the expected growth of employment in this occupation, the need to replace experienced construction machine operators who retire, transfer to other fields of work, or die will result in many job opportunities for new workers. Retirements and deaths alone may provide from 4,000 to 5,000 job openings annually during the 1960’s.

Earnings and Working Conditions

The wage rate structure for operating engineers is more complicated than for any other construction trade. Hourly rates are established not only for operators of different types of ma-
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chines, but often for operators of machines of the same type but of different capacity. Moreover, in some cases there are different rates for the same machine, depending upon the type of construction for which it is used. The wage scale also varies among different parts of the country and the operators of machines having the top wage rates in one area do not necessarily receive the top wage rates in other areas.

Shovel operators, who generally are among the highest paid construction machinery operators, had union minimum hourly rates, ranging from $3.18 in Birmingham, Ala., to $5.10 in Newark, N.J., as of July 1, 1960, according to a national survey of building trades workers in 52 large cities. The rates for bulldozer operators ranged from $2.67 in Richmond, Va., to $4.18 in New York City. Average annual earnings of operating engineers are not as high as their hourly rates of pay would indicate, since they lose much worktime because of weather and for other reasons.

A large proportion of operating engineers are members of the International Union of Operating Engineers. Union-management contracts covering these workers, in some areas, provide health insurance and pension benefits, financed either entirely by the employers or jointly by the workers and employers.

The operating engineer's work is performed outdoors. The work is active and sometimes strenuous. The operation of some machines, particularly bulldozers and some types of scrapers, is physically tiring because the constant movement of the machine shakes or jolts the operator.

Where To Go for More Information

A young man who wishes to obtain further information regarding qualifications and training for the job of operating engineer, and the location of present apprenticeship programs, should direct his inquiry to the International Union of Operating Engineers, 1125 17th St. NW., Washington 6, D.C. For information regarding work opportunities, he should apply to general contractors in his area. The local office of the State employment service also is a source of information about employment opportunities.

General information about the work of operating engineers may be obtained from the Associated General Contractors of America, Inc., 1957 E St. NW., Washington 6, D.C.

Electricians (Construction)

(D.O.T. 4-97.010)

Nature of Work

Construction electricians perform the various tasks related to electrical work on construction projects. They lay out, assemble, install, and test electrical fixtures, apparatus, and wiring used in electrical systems. These systems are used to provide heat, light, power, air conditioning, and refrigeration in residences, office buildings, factories, hospitals, schools, and other structures. They also install and connect electrical machinery, equipment, and controls. (Maintenance electricians do work which is similar in many respects to that performed by construction electricians. A discussion of maintenance electricians is presented elsewhere in this Handbook. See index for page numbers.)

Construction electricians install many types of switches, conduits, controls, circuit breakers, wires, lights, signal devices, and other electrical components, following blueprints and specifications. If there is no electrical drawing showing outlets which are to be on each circuit, the electrician splits the incoming electrical service into several circuits, with each circuit protected by a fuse or circuit breaker of the proper rating to prevent overheating of the wire used. The construction electrician should know and follow national electrical code regulations and, in addition, must fulfill State, county, and municipal regulations.

In installing wiring, the construction electrician uses a mechanical or hydraulic bender to shape conduit (pipe or tubing) so that the conduit will fit the contours of the surface to which it is attached, or within the space al-
lotted. The electrician then pulls insulated wires or cables through the conduit. The wire or cable sizes vary from those smaller than the lead in a pencil to those about 3 inches thick. The electrician then connects the ends of the wires or cables to circuit breakers, switch-gear motors, transformers, or other components. When these operations are completed, the electrician tests the electrical circuits to make sure that the entire system is properly grounded, the connections properly made, and that the circuits do not carry excessive current. Wires are spliced (joined) by soldering or other methods.

The electrician furnishes his own handtools, such as pliers, screwdrivers, brace and bits, knives, and hacksaws. The employer furnishes test meters and heavier tools, such as pipe threaders, conduit benders, chain hoists, electric drills, and power fasteners, and ladders. In residential electrical construction work, heavier tools are not usually required.

Electrical work in installations with unusually high electrical power requirements, such as are needed at powerplants, steel mills, and other establishments, may be done by journeymen electricians who specialize in this type of work. However, most construction electricians can do all types of electrical work.

Training, Other Qualifications, and Advancement

Most training authorities, including the national joint labor-management apprenticeship committee for the electrical contracting industry, recommend the completion of a 4- or 5-year apprenticeship program for construction electricians as the best way to learn all the aspects of this trade. Some construction electricians, however, have learned the trade informally. They have acquired skills of the trade by working for many years as helpers, observing or being taught by experienced craftsmen. Many of these persons have gained some knowledge of the trade by taking trade school or correspondence courses, or through special training while in the Armed Forces.

Apprenticeship applicants generally are required to be between the ages of 18 and 24. A high school education or its equivalent, including courses in mathematics and physics, is desirable. Applicants are required to take tests to determine their aptitude for the trade.

All apprenticeship programs are conducted under written agreement between the apprentice and the local joint union-management apprenticeship committee, which also supervises the training. The committee determines

Where Employed

Most construction electricians work for electrical contractors. Substantial numbers are self-employed. Others work for government agencies or business establishments which do their own construction electrical work rather than hire electrical contractors. Although many construction electricians work for the same electrical contractor for several years, job transfers are fairly common. During a single year, a construction electrician may work for an electrical contractor in the construction of new homes or office buildings, for a manufacturing firm in remodeling its plant or offices, or he may do electrical repairs for homeowners or business firms.

Employment of these workers is distributed geographically in much the same pattern as the Nation's population. Thus, employment is concentrated in the highly industrialized and populated areas.
the need for apprentices in the locality, establishes minimum apprenticeship standards and pay, and schedules a diversified, rotating work program. This program is designed to give the apprentice all-round training by having him work for several electrical contractors who engage in particular types of work. Under most programs, the apprentice is registered with a State apprenticeship agency or the U.S. Department of Labor's Bureau of Apprenticeship and Training.

The International Brotherhood of Electrical Workers and the National Electrical Contractors Association have jointly developed an extensive apprenticeship program. They have a national director of apprenticeship who assists the local joint apprenticeship committees.

The apprenticeship program usually requires 8,000 or 10,000 hours (4 or 5 years) of on-the-job training, in addition to a minimum of 144 hours of related classroom instruction each year. In a typical 4-year training program, the construction electrician apprentice learns, among other things, to use, care for, and handle safely the tools, equipment, and materials commonly used in the trade; do residential, commercial, and industrial electrical installations; and maintain and repair installations. In addition, he receives related classroom instruction in such subjects as drafting and electrical layout, blueprint reading, mathematics, and electrical theory, including electronics.

Hourly wage rates of apprentices often start at about 50 percent of the journeyman rate and increase by 5 percent in each 6-month period until 85 or 90 percent of the journeyman rate is reached during the last period of the apprenticeship.

An experienced construction electrician who has learned all the aspects of the craft through apprenticeship can transfer readily to other types of electrical work. For example, many take jobs as maintenance electricians in factories or in commercial establishments and others work as electricians in shipbuilding and aircraft manufacturing.

Because improperly installed electrical work is so hazardous, most cities require electricians to be licensed. To obtain a license, the electrician must pass an examination which requires a thorough knowledge of the craft and of State and local building codes.

Many journeymen electricians become foremen or superintendents for electrical contractors on particular construction jobs. These craftsmen may also become estimators for electrical contractors, computing material requirements and labor costs.

Many journeymen construction electricians go into business for themselves. As they expand their activities, they may employ other workers and become contractors. Success as an electrical contractor requires not only a thorough knowledge of the trade, but also adequate financial resources, and a sound knowledge of business principles and practices. In most large urban areas, a master electrician's license is required in order to engage in an electrical contracting business.

**Employment Outlook**

Over the 1960–70 decade, the number of construction electricians is expected to rise rapidly and at a faster rate than employment in most of the other skilled building trades. Many new jobs should result from the large increase anticipated in construction activity. (See discussion, p. 343.) Other factors which are expected to contribute to the growth of this trade are greater requirements for electric outlets, switches, and wiring in homes to accommodate the increasing use of appliances; and the extensive wiring systems needed for the installation of electronic data-processing equipment and electrical control devices being used increasingly in commerce and industry.

Because this is a large occupation—more than 130,000 construction electricians were employed in mid-1960—many additional job opportunities for new workers will result from the need to replace experienced electricians who transfer to other types of electrical work, leave the field for other reasons, retire, or die. Retirements and deaths alone may result in 3,000 to 3,500 job openings annually during the 1960's.
Earnings and Working Conditions

Hourly wage rates of construction electricians are among the highest in the skilled building trades. Furthermore, because the seasonal nature of construction work affects electricians to a lesser extent than most other construction workers, their annual earnings generally are among the highest in the building trades.

Union minimum hourly wage rates for electricians averaged $4, compared with $3.86 for all journeymen in the building trades, as of July 1, 1960, according to a national survey of building trades workers in 52 large cities. Among individual cities surveyed, the union minimum hourly rates for construction electricians ranged from $3 in Charlotte, N.C., to $4.65 in Los Angeles, Calif.

A large proportion of construction electricians are members of the International Brotherhood of Electrical Workers. Some are members of other unions. Union-management agreements covering construction electricians often provide health, vacation, and other benefits and usually provide for employer contributions to a pension plan. A union may also operate its own pension program.

The work of the construction electrician, like that of other building trades, is active but does not require great physical strength. Frequently, the construction electrician stands for prolonged periods; sometimes he works in cramped quarters. Because most of his work is indoors, the construction electrician is less exposed to unfavorable weather conditions than most other skilled building trades workers. Electricians risk the danger of falls from ladders and scaffolds, cuts from sharp tools, electrical shock, blows from falling objects, and burns from “live” wires. However, safety practices learned during apprenticeship and other types of training have helped to reduce the injury rate for these workers. The number of injuries per million man-hours worked by employees in contract electrical work has been less than for contract construction work as a whole, but higher than that for production workers in manufacturing industries.

Where To Go for More Information

A young man who wishes to obtain further information regarding electrician apprenticeships or work opportunities in the trade should apply to one of the electrical contractors in his area; to a local union of the International Brotherhood of Electrical Workers; to a local joint union-management apprenticeship committee, if there is one in his locality; or the local office of the Bureau of Apprenticeship and Training, U.S. Department of Labor. In addition, the local office of the State employment service may be a source of information about apprenticeship opportunities. Some local employment service offices provide such services as screening applicants and giving aptitude tests.

General information about the work of electricians may be obtained from:

- International Brotherhood of Electrical Workers, 1200 15th St. NW., Washington 5, D.C.
- National Association of Home Builders, 1625 L St. NW., Washington 6, D.C.
- National Electrical Contractors Association, 1220 18th St. NW., Washington 6, D.C.
- National Joint Apprenticeship and Training Committee for the Electrical Industry, 1200 18th St. NW., Washington 6, D.C.

Structural-, Ornamental-, and Reinforcing-Iron (Rodmen) Workers

(D.O.T. 4-84.010, .020, .030, .040, .060, and 7-32.251)

Nature of Work

Structural- and ornamental-iron workers and reinforcing-iron workers (rodmen) erect, assemble, or install fabricated structural metal products in the construction of industrial, commercial, and large residential buildings. Although these are distinct trades, many craftsmen are skilled in, and do the work of, two or all three of the trades.

Structural-iron workers erect the steel framework of bridges, buildings, and other structures including metal storage tanks, and overhead
crane runways that support heavy equipment. They install steel floor decking and the doors and frames of vaults.

In erecting a steel framework or structure, structural-iron workers take the steel shapes already fabricated in shops by other workers and hoist them into place in the proper order. Next, they temporarily connect all the steel shapes with bolts, accurately aline the structure, and then rivet or weld the parts. In the construction of a large building, workers generally do not perform all of these operations. Instead, separate gangs perform a particular operation, such as riveting.

Ornamental-iron workers install metal stairways, catwalks, floor gratings, iron ladders (such as those used extensively in powerhouse and chemical plants), metal window sash and doors, grilles and screens (such as those used in bank tellers' compartments and elevators), metal cabinets, and safety deposit boxes. They also install lampposts, gates, and fences, and decorative ironwork on balconies.

In addition to iron and steel, ornamental-iron workers install aluminum, brass, and bronze metal shapes, frames, and panels. These metal products are usually prefabricated, but may require assembly before installation. They are fastened permanently to a building or other structure by bolting, setting in concrete, or welding.

Reinforcing-iron workers (rodmen) set steel bars in concrete forms to reinforce concrete structures. They place the steel bars on suitable supports in the concrete form and tie the bars together at intersections, so that each bar receives its intended structural load. The bars are placed in the concrete form according to blueprints, specifications, or verbal instructions. The rodmen use steel pliers and other tying tools to wire the rods securely in place. Some concrete reinforcing is in the form of coarse mesh made of heavy steel wires. When using mesh, the rodmen measure the surface to be covered, cut and bend the mesh to the desired shape, place the mesh over the area to be reinforced, and hammer it into place.

Where Employed

Structural-, ornamental-, and reinforcing-iron workers (rodmen) work mainly on new industrial and commercial construction. They do some alteration work. For example, they may install steel stairs in an old apartment or commercial building or add window guards to an existing building for burglarly protection. In addition, they remodel existing structures and do repair work, such as replacement of metal bridge parts. Some highly skilled structural steel workers are able to transfer to jobs in structural steel fabricating shops.

A large proportion of these craftsmen are employed by general contractors on large building projects, by steel erection contractors, or ornamental-iron contractors. Many are employed by large steel companies or their subsidiaries engaged in the construction of bridges, dams, and large buildings. Some work for government agencies, public utilities, or large industrial establishments which do their own construction work. Few of these craftsmen are self-employed.
Structural- and ornamental-iron workers and rodmen are employed throughout the country. However, a large proportion of their jobs are in highly populated and industrial centers where large commercial and industrial structures are constructed.

Training and Other Qualifications

Most training authorities, including the National Joint (labor-management) Ironworker Apprenticeship Committee, recommend the completion of a 3-year apprenticeship as the best way to learn these trades. A few workers with many years’ experience as helpers have become journeymen, but it has been more difficult to achieve journeyman status in this manner in recent years.

Apprenticeship applicants are required to be between the ages of 18 and 30. Good physical condition is required. A high school education or its equivalent is desirable. Apprenticeship programs are under the supervision of local joint union-management apprenticeship committees. Under formal programs, the apprentice is registered with a State apprenticeship agency or the U.S. Department of Labor's Bureau of Apprenticeship and Training.

The apprenticeship program for these trades usually consists of 6,000 hours (3 years), of on-the-job training. On-the-job instruction is given either by the foreman or an experienced journeyman. In a typical combined structural- and ornamental-iron worker’s training program, the apprentice learns, among other things, to use, care for, and handle safely the tools, machines, equipment, and materials commonly used in the trade; read blueprints and working drawings; form, shape, drill, tap, and erect and assemble various metal structures; lay out and assemble steel stairs, fire escapes, grilles, railings, fences, doors, and related metal structures. He also learns arc and gas welding; gas cutting, bolting, and riveting; and how to repair and alter metal structures.

The apprenticeship program generally includes a minimum of 144 hours a year of related classroom instruction in subjects such as drafting, blueprint reading, and mathematics applicable to layout work.

Areawide apprenticeship programs, sometimes covering an entire State or region, are found extensively in this trade. They are supervised by apprenticeship committees composed of representatives of the International Association of Bridge, Structural and Ornamental Iron Workers’ local unions and local management groups.

Hourly wage rates for apprentices start at not less than 60 percent of the journeyman rate and increase periodically until the journeyman rate is reached at the completion of the apprenticeship. In some localities, the starting rate may be as high as 75 percent of the journeyman rate. If apprenticeship applicants have had experience directly related to the trade as, for example, training in ironwork in a factory or in the Armed Forces, they may be granted advanced apprenticeship standing.

Employment Outlook

Employment in these trades is expected to increase substantially by 1970, above the approximate 100,000 workers employed in 1960. In addition to job openings resulting from the growth of employment in these occupations, the need to replace experienced workers who retire, leave the trade for other reasons, or die, will provide several thousand job opportunities for new workers each year. Retirements and deaths alone may result in about 2,000 job openings annually during the 1960’s.

In recent years, these trades have been among the fastest growing of the skilled building trades. A continued rise in employment of these workers is expected, principally because of the large increase anticipated in construction activity over the 1960’s. (See discussion, p. 343.) The job outlook in these trades will also be favorably affected by the increased use of structural steel in smaller buildings. Work opportunities for ornamental-iron workers will result from the growing use of ornamental panels of aluminum, porcelainized steel, or other metals, which are attached to the exterior walls of large buildings, and by the use of metal frames to hold large exterior glass installations.
Earnings and Working Conditions

Union minimum hourly wage rates for structural-iron workers and rodmen averaged $3.96 and $3.86, respectively, as of July 1, 1960, according to a national survey of building trades workers in 52 large cities. The average rate for all journeymen in the building trades surveyed was $3.86 an hour. Among individual cities, the minimum hourly rates for structural-iron workers ranged from $3.25 in Charlotte, N.C., to $4.85 in Newark, N.J. The rates for rodmen ranged from $3 in Charlotte to $4.85 in Newark. The rates for ornamental-iron workers generally are about the same as those for structural-iron workers.

The earnings of ironworkers are often increased by considerable overtime work at premium pay. As with other building trades in which much of the work is done outdoors, these craftsmen lose much working time because of weather and other reasons. Rodmen, in particular, are intermittently out of work because each of their jobs lasts only a few days or weeks.

A large proportion of workers in these trades are members of the International Association of Bridge, Structural and Ornamental Iron Workers. Many union-management contracts covering these trades provide health insurance and pension benefits financed entirely by the employers.

Since the materials used in the structural metal trades are heavy and bulky, above average physical strength and agility are necessary. A good sense of balance is also required because some of the structural work is done at great heights and on narrow footings. Structural-iron work often involves considerable travel. In most localities, the demand for structural-iron work is insufficient to keep local crews constantly employed. Consequently, workers must be brought in from outside the area to handle the occasional large construction projects, such as a steel frame office or factory building. Large contractors may keep a small structural-iron worker crew continually employed, moving them from job to job and city to city.

The use of many safety devices, such as nets and scaffolding, has reduced the frequency of accidents in recent years. The number of injuries per million man-hours worked by employees of contractors doing structural- and ornamental-iron work has been slightly lower than for contract construction work as a whole.

Where To Go for More Information

A young man who wishes to obtain further information concerning apprenticeships or work opportunities in these trades should apply to the large general contractors in his area; to a local of the International Association of Bridge, Structural and Ornamental Iron Workers; or the local office of the Bureau of Apprenticeship and Training, U.S. Department of Labor. In addition, the local office of the State employment service may be a source of information about apprenticeship opportunities.

General information about the work of structural-, ornamental-, and reinforcing-iron workers may be obtained from:

Associated General Contractors of America, Inc.,
1957 E St. NW., Washington 6, D.C.
International Association of Bridge, Structural and Ornamental Iron Workers,
Continental Bldg., Suite 300, 3615 Olive St., St. Louis 8, Mo.

Plasterers
(D.O.T. 5–29.100, .200, and .300)

Nature of Work

The plasterer is the building craftsman who applies plaster to interior walls and ceilings to form fire-resistant and relatively soundproof surfaces which may then be decorated. They also apply stucco to exterior walls, and form and cast ornamental designs in plaster.

In interior work, plaster is applied to gypsum lath or wire lath (backing to which plaster adheres) or directly to masonry. The plasterer uses a hawk (a square plate of wood or metal) to hold small amounts of wet plaster, and a trowel to apply it to the lath. To obtain a uniform surface of plaster, the craftsman ap-
plies a border of plaster of the desired thickness to the top and bottom of the wall section to be covered. When these borders have hardened sufficiently, he fills in the area between them with one or two base coats of plaster. The surface of this area is then leveled to the exact thickness of the borders with a straight-edged tool. A long, flat tool, called a darby, is used to smooth this surface.

Applying the finish coat of plaster is the last operation before painting or paperhanging. This coat is relatively thin and must be applied carefully if the surface is to be smooth. Wall surfaces may be finished to obtain a variety of decorative textures, such as stipple or swirl finishes.

As the plasterer acquires more skill he can do more complex types of plastering work, such as decorative and ornamental plastering. For example, he may be called upon to mold or form intricate ornamental designs such as cornices, paneling, or recesses for indirect lighting. Plasterers who do this type of work must be able to follow blueprints and other specifications furnished by the architect.

In exterior stucco work, the plasterer applies a mixture of portland cement and sand to masonry or metal lath in the same manner as in interior plastering. The finish coat usually consists of a mixture of white cement and sand or a patented finish material which may be applied in a variety of colors and textures.

Apprentices work with the plasterer so that they may acquire a full knowledge of the craft and develop the necessary skills. Laborers (hod carriers) mix base coat materials and carry them to the plasterer; they also erect scaffolding when needed. In many small localities, jour­ney­men plasterers may also perform the work of cement finishers, because the skills of the two crafts are closely related.

In recent years, plasterers have been making increasing use of machines which spray plaster on walls, ceilings, and structural sections of buildings. These machines are particularly desirable when used to apply the newly developed lightweight plasters. Machines used to mix plaster have been in general use for many years.

Where Employed

Most of the approximately 70,000 plasterers employed in mid-1960 were working on new building construction. In addition, plasterers work on extensive building alterations, particularly where special architectural and lighting effects are part of the building modernization. There is a relatively small amount of work for plasterers in the repair and maintenance of older buildings.

Jobs for plasterers are found throughout the country. The geographical distribution of employment in this occupation is about the same as in the building trades generally, with large concentrations of workers in highly populated and industrialized areas.

Training, Other Qualifications, and Advancement

Most training authorities, including the national joint labor-management apprenticeship committee for the plastering trade, recommend completion of a 3- or 4-year apprenticeship as the best way to learn plastering. However, many workers in this trade have acquired some plastering skills by working for many
years as helpers or laborers, observing or being taught by experienced plasterers.

Apprentice applicants in this trade are generally required to be between the ages of 18 and 25. Good physical condition and manual dexterity are important assets. Many plasterer apprenticeship programs are under the supervision of local joint union-management apprenticeship committees. Generally, the apprentice is employed under a written apprenticeship agreement and the program is registered with a State apprenticeship agency of the U.S. Department of Labor's Bureau of Apprenticeship and Training.

Apprenticeship programs generally consist of 6,000 to 8,000 hours (3 or 4 years) of on-the-job training, in addition to at least 144 hours of related classroom instruction annually. In a typical 4-year training program, the apprentice learns, among other things, to use and handle the tools of the trade, and the properties and appropriate handling of the different kinds of materials and mixtures used in plastering; apply scratch (first) coat and brown (second) coat; aline walls and beams to given measurements; apply white coat and sand finish; install acoustical plaster and stucco, and acoustical tile, cork, and similar materials; use machines to apply and finish plaster; and lay out arches and ceilings. He also learns texture finishing.

The apprentice receives classroom instruction in such subjects as drafting, blueprint reading, and mathematics applicable to layout work. In the classroom and on the job, the apprentice becomes familiar with the work of other trades so that he may determine, for example, whether lathing or other preparatory work is satisfactory.

Although advancement opportunities for plasterers are limited, some may become foremen or estimators. Many plasterers are self-employed. Some self-employed plasterers may expand their activities to contracting, and then employ other journeymen. Adequate financial resources and a sound knowledge of business principles and practices, in addition to a knowledge of the trade, are basic requirements for success as a contractor.

Employment Outlook

A continued increase in the employment of plasterers is expected during the 1960's, but the increase will not be as rapid as for the skilled building trades generally. In addition to job openings that will result from the expected growth of employment, the need to replace experienced plasterers who transfer to other fields of work or who retire or die, will provide many job openings for new workers. Retirements and deaths alone may result in about 1,500 job openings annually during the 1960's.

The growth in employment of these workers in the 1960's will result primarily from the anticipated large increase in construction activity. (See discussion, p. 343.) In addition, recent changes in plastering materials and improved methods of applying these materials are increasing the scope of the craft and creating work opportunities for plasterers. For example, improved lightweight plasters are being used increasingly because of their excellent soundproofing, acoustical, and fireproofing qualities. Another development that is expanding job opportunities for plasterers is the marked style trend toward the greater use of curved surfaces and ceilings made of plaster, both as a form of architectural treatment and to achieve special lighting and acoustical effects.

These favorable developments will be offset to some extent by the continuing trend toward wider use of nonplaster (dry-wall) construction.

Earnings and Working Conditions

Hourly pay rates for plasterers rank among the highest in the skilled building trades. However, their annual earnings are not as high as their hourly rates of pay would indicate, because of the seasonal nature of much construction work and because of worktime lost for other reasons.

Union minimum hourly rates, as of July 1, 1960, for plasterers averaged $4.06, as compared with $3.86 for all journeymen in the building trades, according to a national survey of building trades workers in 52 large cities. Among individual cities surveyed, the minimum hourly rates for plasterers ranged from $2.75 in Charlotte, N.C., to $4.95 in New York City.
A large proportion of plasterers are members of unions. They are represented by either the Operative Plasterers' and Cement Masons' International Association of the United States and Canada, or the Bricklayers, Masons and Plasterers' International Union of America. Union-management contracts covering plasterers often provide health insurance, pension, and other benefits, financed either entirely by employers or jointly by workers and employers.

Plastering requires considerable standing, stooping, and lifting. Plasterers work both outdoors, doing stucco work, and indoors, plastering walls and ceilings and forming and casting ornamental designs.

Where To Go for More Information
A young man who wishes to obtain further information regarding plastering apprenticeships or work opportunities in the trade should apply to a plastering contractor in his area; locals of the unions previously mentioned; a local joint union-management apprenticeship committee, if there is one in his area; or the local office of the Bureau of Apprenticeship and Training, U.S. Department of Labor. In addition, the local office of the State employment service may be a source of information about apprenticeship opportunities.

General information about the work of plasterers may be obtained from:

- Bricklayers, Masons and Plasterers' International Union of America,
  815 15th St. NW., Washington 5, D.C.
- Contracting Plasterers' and Lathers' International Association,
  304 Landmark Bldg., 1343 H St. NW.,
  Washington 5, D.C.
- National Bureau for Lathing and Plastering,
  755 NADA Bldg., 2000 K St. NW.,
  Washington 6, D.C.
- Operative Plasterers' and Cement Masons' International Association of the United States and Canada,
  1125 17th St. NW., Washington 6, D.C.

Roofers
(D.O.T. 5-25.220, 7-31.100 through .500, and 7-32.611)

Nature of Work
Roofers apply composition roofing and other materials, such as tile and slate, to the roofs of buildings. They also waterproof and dampproof walls and other building surfaces.

In applying composition roofing, the roofer first places overlapping strips of asphalt and impregnated felt over the entire surface. He then applies a coating of tar, pitch, or other bituminous material to the new surface. This process is repeated until at least three layers of felt are in place. Finally, he applies a surfacing of tar, pitch, and gravel to protect the roofing materials from the weather.

In applying other types of composition roofing, such as roll roofing and asphalt shingles, the roofer overlaps the roofing material and then fastens it to the roof base with nails or asphalt cement. If necessary, he cuts the material to fit corners, pipes, and chimneys. The roofer then cements or nails flashing (strips of metal) wherever two roof surfaces intersect. Flashing is installed to make the intersections (joints) watertight. In another method of applying roofing, the roofer mops a layer of hot asphalt over the entire surface and rakes pebbles over the asphalt.

Roofers also use metal, tile, and slate for the more expensive types of roofs. Metal roofs are constructed by soldering metal sheets together and nailing them to the wood sheathing. In installing tile and slate roofs, the roofer places a covering of roofing felt over the wood sheathing. He punches holes in the slate or tile which he nails to the sheathing. Each row of slate or tile is placed so as to overlap the preceding row. Finally, the roofer covers the exposed nailheads with roofing cement to avoid rusting and water leakage around the nailheads. Handtools usually are used in applying roof surfaces—for example, hammers, roofing knives, mops, pincers, and calking guns.

Roofers also do waterproofing and dampproofing work on parts of structures other than roofs, such as masonry or concrete walls or swimming pools and other tanks. The roofer prepares surfaces to be waterproofed by re-
moving rough projections and roughing glazed surfaces, using a hammer and chisel. He then applies a coat of liquid compound with a brush. He may also paint or spray surfaces with a waterproof material or nail waterproofing fabric to surfaces. In dampproofing work, he usually sprays a coating of tar or asphalt on interior or exterior surfaces to avoid the penetration of moisture.

Where Employed

Roofers work mainly for roofing contractors on new building construction. They also do maintenance and repair work, especially on composition roofing. Some roofers are self-employed, doing either roofing on small, new building work or repairs and alterations. Roofers also work for government agencies or business establishments which do their own construction and repair work.

Jobs for roofers are found throughout the country. Most of the estimated 60,000 roofers employed in mid-1960 had jobs in the highly industrialized and populated States.

Training, Other Qualifications, and Advancement

Most training authorities, including the national joint labor-management apprenticeship and training committee for the roofing industry, recommended completion of a 3-year apprenticeship program, covering all types of roofing work, as the superior way to learn this trade. A substantial proportion of workers, however, have acquired roofing skills informally, by working for many years as helpers or handymen, observing or being taught by experienced roofers.

Apprenticeship applicants generally are required to be at least 18 years old; a high school education or its equivalent is desirable. Good physical condition and a good sense of balance are important assets. Many apprenticeship programs are under the supervision of local joint union-management apprenticeship committees. Generally, the apprentice is employed under a written apprenticeship agreement and the program is registered with a State apprenticeship agency or the U.S. Department of Labor's Bureau of Apprenticeship and Training.

The 3-year apprenticeship program generally consists of a minimum of 1,400 hours of on-the-job training annually, in addition to related classroom instruction. In a typical training program, the apprentice learns, among other things, to use, care for, and handle safely the tools, equipment, and materials commonly used in the trade; work with composition, tar, and asphalt; prepare roof surfaces for covering; apply pitch and other materials; spread gravel; do slate, tile, and terra cotta work; and do dampproofing and waterproofing work.

The trainee receives related classroom instruction in such subjects as blueprint reading and mathematics applicable to layout work.

Hourly wage rates for apprentices usually start at 65 percent of the journeyman rate and increase periodically until 90 percent of the journeyman rate is reached in the final 6 months of the training period. If apprentice applicants have had experience directly related to the trade, for example in the Armed Forces, or as a helper, they may be granted advanced apprenticeship standing.

Roofers may advance to the job of foreman for a roofing contractor. Also, they may enter
business for themselves. Thorough knowledge of the trade, adequate financial resources, and a sound knowledge of business principles and practices are basic requirements for success as a roofing contractor.

Employment Outlook

There will be a few thousand new job opportunities for roofers annually during the 1960's. Most of the new jobs will result from the large increase anticipated in construction activity over the 1960-70 decade. (See discussion, p. 343.) Replacement needs will also provide a few hundred job openings each year. Retirements and deaths alone may result in about 1,200 job opportunities annually. Other openings will result from the transfer of roofers to other fields of work.

Application of roofing on new construction and repair jobs on old structures will provide most of the work for these craftsmen during the 1960's. However, dampproofing and waterproofing are expected to provide an increasing proportion of roofers' work.

Earnings and Working Conditions

Union minimum hourly wage rates, as of July 1, 1960, for composition roofers, averaged $3.61, according to a national survey of building trades workers in 52 large cities. For slate and tile roofers, the rate was $3.62. By comparison, the average for all journeymen in the building trades was $3.86 an hour. Among individual cities surveyed, the minimum hourly rates for composition roofers ranged from $2 in San Antonio, Tex., to $4.40 in Newark, N.J. Slate and tile roofers had hourly rates ranging from $2.35 in San Antonio, to $4.60 in New York City.

The average annual earnings of roofers are less than their hourly rates of pay would indicate. These workers lose much worktime because of weather conditions and the brief duration of many jobs.

A large proportion of roofers are members of the United Slate, Tile and Composition Roofers, Damp and Waterproof Workers Association. Union-management contracts covering roofers often provide health insurance and pension benefits, financed either entirely by the employers or jointly by the workers and employers.

Roofers' work, like that of other building tradesmen, is sometimes strenuous. It involves prolonged standing, as well as climbing, bending, and squatting. These workers risk injuries from slips or falls from scaffolds or roofs. They may have to work outdoors in all types of weather, particularly when doing repair work.

Where To Go for More Information

A young man who wishes to obtain further information concerning roofing apprenticeships or work opportunities in this trade should apply to roofing contractors in his area; a local of the United Slate, Tile and Composition Roofers, Damp and Waterproof Workers Association; a local joint union-management apprenticeship committee, if there is one in his area; or the local office of the Bureau of Apprenticeship and Training, U.S. Department of Labor. In addition, the local office of the State employment service may be a source of information about apprenticeship opportunities.

General information about the work of roofers, may be obtained from:

National Association of Home Builders,
1625 L St. NW., Washington 6, D.C.
National Roofing Contractors Association,
189 West Madison St., Chicago 2, Ill.
United Slate, Tile and Composition Roofers, Damp and Waterproof Workers Association,
6 East Lake St., Chicago 1, Ill.

Cement Masons (Cement and Concrete Finishers)

(D.O.T. 5-26.100 and .200)

Nature of Work

The principal work of cement masons is finishing the exposed concrete surfaces on many types of construction projects. These projects range from small jobs, such as the finishing of patios, floors, and sidewalks, to work on huge
dams, miles of concrete highways, foundations and walls of large buildings, airport runways, and missile launching sites. On small projects, a cement mason assisted by one or two helpers may do all the concrete work; on large projects, crews of several cement masons and many helpers may be employed.

In preparing the site for pouring the concrete mixture (cement plus stones of various sizes, and water), the cement mason makes sure that forms, which hold the concrete, are set for the desired slope and depth of the concrete mixture and are properly aligned. Materials, such as stone and gravel, may be provided as a foundation for the concrete.

The cement mason pours or directs the pouring of the concrete mixture. He usually supervises laborers who level and settle the mixture by tamping it, or by vibrating it with a special machine. The mason levels the surface further with a "straightedge" (a flat tool long enough to extend across the poured concrete mixture). He then works it with a "float" (a rectangular, flat-surfaced handtool) and other handtools to fill depressions and remove high spots and to draw cement to the surface of the mixture in preparation for final finishing operations.

Final finishing is often delayed for several hours until the concrete has hardened sufficiently. While the concrete is still workable, the cement mason uses a trowel to bring the concrete to the proper consistency and obtain a smooth final finish. The final finishing may also be done by means of power-operated trowels.

On most building projects, concrete finishing work generally involves hand operations. On highways and other large-scale projects, however, power-operated floats and cement finishing machines are used extensively, but supplementary hand operations are also necessary, particularly to finish curved surfaces.

Cement masons also do patching work to correct surface defects on concrete structures. Some cement masons specialize in laying a mastic coating (a fine asphalt mixture) over concrete, particularly in buildings where sound-insulated or acid-resistant floors are specified. The mastic is applied while hot, then smoothed with heavy hand tools.

On large jobs, cement masons work in gangs or crews. In such instances, masons perform finishing operations while laborers do routine and heavy work.

The cement mason's knowledge of his materials is essential to the quality of his work. He must be familiar with the working characteristics of various cement and concrete mixes, such as those containing substances to speed or slow the setting time, and those which are used to construct weight-supporting walls or surfaces of specified strengths. In addition, because of the effects that heat, cold, and wind have on the curing of cement, the skilled mason must recognize by sight and touch what is occurring in the cement mixture so that he may be able to prevent defects that could develop.

Where Employed

Cement masons work principally on large buildings, but many are employed on highway or other nonbuilding construction. Cement masons work directly for general contractors
who are responsible for constructing entire projects such as highways, or large industrial, commercial, and residential buildings. They also work for cement contractors who do only the concrete work on a large construction project or who work on smaller projects such as sidewalks, driveways, and basement floors. A small number work for municipal public works departments, public utilities, and manufacturing firms which do their own construction work. Some cement masons are self-employed and do small cement jobs, such as sidewalks, steps, and driveways.

Cement masons are employed in almost every community in the country. The geographical distribution of employment in this occupation is about the same as in the building trades generally, with large concentrations in the highly populated and industrialized areas.

Training and Other Qualifications

Most training authorities, including the National Joint (labor-management) Cement Masonry, Asphalt, and Composition Apprenticeship and Training Committee, recommend the completion of a 3-year apprenticeship program as the best way to learn this trade. A substantial number of workers, however, have acquired some cement masonry skills informally by working for many years on building and road construction jobs as laborers assisting cement masons. Others have worked with specialty contractors constructing sidewalks and doing other types of masonry work. These workers have learned their skills by observing or being taught by experienced cement masons. In the past, when there have been shortages of skilled masons, a number of men with informal training have been given some credit for this experience toward completion of the apprenticeship program. In the future, such credit may depend upon the demand for skilled cement masons in local areas.

Apprenticeship applicants generally are required to be between the ages of 18 and 25. Good physical condition and manual dexterity are important assets. Many apprenticeship programs are under the supervision of local joint union-management apprenticeship committees. Generally the apprentice is employed under a written apprenticeship agreement and the program is registered with a State apprenticeship registration agency or the U.S. Department of Labor's Bureau of Apprenticeship and Training.

The apprenticeship program usually consists of 6,000 hours (3 years) of on-the-job training, in addition to related classroom instruction. During the apprenticeship period, the apprentice learns, among other things, to use and handle the tools, equipment, and materials of the trade. He also learns finishing, layout work, and safety techniques. The apprentice receives related classroom instruction in subjects such as applied mathematics and related sciences, blueprint reading, architectural drawing, estimating materials and costs, and local building regulations. Although a high school education is not required, education above the grade-school level, preferably including mathematics, is needed to understand the classroom instruction.

Employment Outlook

Continued rapid increase in the employment of cement masons is expected over the 1960's, in line with the rate of growth for the skilled building trades as a whole. In addition to openings resulting from the growth of the trade, replacement needs may result in hundreds of other job opportunities for new workers each year.

Cement masons have had one of the fastest rates of employment growth among building trades craftsmen in recent years. The number of cement masons increased from about 30,000 in 1950 to approximately 50,000 in mid-1960. The anticipated large expansion of construction activity is expected to result in continued rapid growth in this occupation in the 1960's. (See discussion, p. 343.) Moreover, the relatively greater use of concrete in construction in recent years is likely to continue. Recent technological developments, such as cement finishing machines, will have some adverse effect on employment prospects in the cement finishing trade. However, the expected increase in the total amount of cement finishing work will be sufficiently great to result in a substantial employment increase in this relatively small building trade.
Earnings and Working Conditions

Union minimum hourly wage rates for cement masons averaged $3.75, compared with $3.86 for all journeymen in the building trades, as of July 1, 1960, according to a national survey of building trades workers in 52 large cities. Among individual cities surveyed, the minimum hourly rates for cement masons ranged from $2.40 in Charlotte, N.C., to $4.65 in Newark, N.J.

Because of the seasonal nature of construction work and because of worktime lost for other reasons, average annual earnings of cement finishers are not as high as their hourly rates of pay would indicate. Cement masons usually receive premium pay for hours worked in excess of the regularly scheduled workday or workweek. Overtime work for these craftsmen often arises, because once concrete has been poured for a job, the work must be completed.

The work of the cement mason is active and strenuous, like the work of skilled building tradesmen generally. Since most cement finishing is done on floors or at ground level, the cement mason is required to stoop, bend, or kneel. Much of his work is done outdoors.

A large proportion of cement masons are union members. They belong either to the Operative Plasterers' and Cement Masons' International Association of the United States and Canada or to the Bricklayers, Masons and Plasterers' International Union of America. Union-management contracts covering cement finishers often provide health, retirement pension, and other benefits, financed either entirely by employers or jointly by the workers and employers.

Where To Go for More Information

A young man who wishes to obtain further information regarding cement mason apprenticeships or work opportunities in the trade should apply to cement finishing contractors in his area; locals of unions previously mentioned; a local joint union-management apprenticeship committee, if there is one in his area; or the local office of the Bureau of Apprenticeship and Training, U.S. Department of Labor. In addition, the local office of the State employment service may be a source of information about apprenticeship opportunities.

General information about the work of cement masons may be obtained from:

Associated General Contractors of America, Inc.,
1957 E St. NW., Washington 6, D.C.

Bricklayers, Masons and Plasterers' International Union of America,
815 15th St. NW., Washington 5, D.C.

Operative Plasterers' and Cement Masons' International Association of the United States and Canada,
1125 17th St. NW., Washington 6, D.C.

Sheet-Metal Workers

(D.O.T. 4-80.010)

Nature of Work

Sheet-metal workers fabricate and install ducts which are used in ventilating, air-conditioning, and heating systems. They also fabricate and install a wide variety of other products made from thin metal sheets, such as roofing and siding, commercial stainless steel kitchen equipment, partitions, sheet-metal shelves in industrial establishments, store fronts, metal framework for neon signs, and chutes used for materials movement. Skilled sheet-metal workers should not be confused with assembly-line factory operatives who also make sheet-metal products, but are trained in only a few specific operations.

In heating or air-conditioning duct work, the sheet-metal worker lays out and plans the job, determining the size and type of sheet metal to be used. The ducts are often fabricated at the sheet-metal shop. Sheet-metal workers cut the metal with hand snips and power-driven shears, as well as other types of cutting tools. They form the metal with bending machines, hammers, and anvils; then weld, bolt, rivet, solder, or cement the seams and joints. However, factory fabricated ducts in standard sizes are often available and these require little
additional fabrication by sheet-metal workers. Some duct fabrication is done at the work site. In the installation of ducts, the component parts are fitted together and assembled. Hangers and braces are installed to support ducts, and joints may be soldered. Some journeymen workers specialize in shopwork or on-site installation work. However, it is essential that skilled workers know all aspects of the trade.

Where Employed

Sheet-metal workers are employed mainly by plants producing heating, refrigeration, and air-conditioning equipment and by contractors engaged in residential, industrial, and commercial building work. In residential construction, these workers may also work for roofing contractors who specialize in metal roofing work.

In addition, many of these craftsmen work for government agencies or business establishments which do their own construction and alteration work. Others are self-employed, mainly on repair work or on smaller types of installations. Some craftsmen are employed in small shops manufacturing specialty products, such as custom kitchen equipment for hotels and restaurants.

Many skilled sheet-metal workers are also employed by railroad, aircraft, or shipbuilding companies. Firms making blowers, exhausts, electrical generating and distributing equipment, food products machinery, steam engines, and turbines also employ skilled sheet-metal workers.

The jobs of the skilled sheet-metal workers are distributed throughout the country in about the same pattern as those of building trades workers generally, with large concentrations of workers in highly populated and industrialized areas.

Training, Other Qualifications, and Advancement

Most training authorities, including the national joint management-labor apprenticeship committee for the sheet metal industry, recommend the completion of a 4- or 5-year apprenticeship program as the best way to learn this trade. Some sheet-metal workers, however, have acquired skills of the trade informally, by working for many years as helpers or handymen, observing or being taught by experienced craftsmen. Many of these persons have gained some knowledge of the trade by taking correspondence or trade school courses.

Apprenticeship applicants generally are required to be between the ages of 17 and 21; a high school education or its equivalent is desirable. Good physical condition and mechanical aptitude are necessary assets. Many apprenticeship programs are under the supervision of local joint union-management apprenticeship committees. Generally, the apprentice is employed under a written apprenticeship agreement and the program is registered with a State apprenticeship agency or the U.S. Department of Labor's Bureau of Apprenticeship and Training.

The apprenticeship program usually consists of 8,000 to 10,000 hours (4 or 5 years) of on-the-job training, in addition to related classroom instruction. In a typical training program, the apprentice learns, among other things, to use, care for, and handle safely...
the tools, machines, equipment, and materials commonly used in the trade; solder; do air-conditioning, heating, and ventilating work; do residential installations such as roofing, gutters, and downspouts; and do architectural and industrial sheet-metal work. He also learns general work processes such as cutting, forming, folding, grooving metal material and bending edges, and punching and drilling holes.

The trainee receives related classroom instruction in subjects such as drafting, blueprint reading, and mathematics applicable to layout work. In addition, he learns the relationship between sheet-metal work and other building trades.

Hourly wage rates for sheet-metal apprentices generally start at 50 percent of the journeyman rate and increase periodically until 90 percent of the journeyman rate is reached during the final portion of the apprentice training period. If apprenticeship applicants have had training or experience directly related to the trade, for example, training in sheet-metal work in a vocational school or experience in a factory or in the Armed Forces, they may be granted advanced apprenticeship standing.

Experienced sheet-metal workers have more job mobility than many other building trades workers because they can transfer their skills from the construction industry to the metal manufacturing industries. Also, they may advance to the job of foreman for a contractor, become superintendents of large projects, or go into business for themselves as sheet-metal contractors. A thorough knowledge of sheet-metal work, adequate financial resources, and a sound knowledge of business principles and practices are basic requirements for success as a contractor.

**Employment Outlook**

Employment of sheet-metal workers is expected to increase rapidly during the 1960's. However, there will be only a couple of thousand job opportunities each year in this relatively small occupation. In addition to job openings arising from the growth of the trade, opportunities for new workers will result from the need to replace experienced sheet-metal workers who retire, transfer to other fields of work, or die.

The increase in the employment of sheet-metal workers is expected mainly as a result of the anticipated large expansion in new residential, commercial, and industrial construction over the 1960's. (See discussion, p. 343.) The expected large increase in the number of permanently installed air-conditioning systems in residential, commercial, and factory buildings will provide more work for sheet-metal workers. In addition, the manufacturing industries which employ skilled sheet-metal workers generally have favorable long-range prospects. The shops which fabricate sheet-metal products used in construction are also expected to require more of these skilled craftsmen in the next 10 years.

Prefabrication is not likely to affect the growth of employment in this occupation as much as in most other building trades, because of the custom nature of much of the work. The prefabrication of ducts and fittings for ventilating installations is limited by the need to tailor these installations to meet a wide variety of structural conditions, such as the dimensions of the building and the space allowed for ducts, and also by the cost of storage space needed to store prefabricated ducts and fittings.

**Earnings and Working Conditions**

Union minimum hourly wage rates for sheet-metal workers averaged $3.90, compared with $3.86 for all journeymen in the building trades, as of July 1, 1960, according to a national survey of building trades workers in 52 large cities. Among individual cities surveyed, the minimum hourly rates for sheet-metal workers ranged from $3.10 in Charlotte, N.C., to $4.65 in New York City.

The average annual earnings of sheet-metal workers often are less than their hourly rates of pay would indicate. Many jobs are of brief duration and sheet-metal workers who do outdoor work frequently lose worktime because of weather conditions.

A large proportion of sheet-metal workers
are members of the Sheet Metal Workers' International Association. Union-management contracts covering sheet-metal workers often provide health insurance and pension benefits, financed either entirely by the employers or jointly by the workers and employers.

Many sheet-metal workers spend considerable time at the construction site, where they may work either indoors or outdoors. Other sheet-metal workers may work primarily indoors, doing fabricating and layout work.

When installing gutters, skylights, and cornices they may work high above the ground level. When installing ventilating and air-conditioning systems, they may work in awkward and relatively inaccessible places. Sheet-metal workers run the risks of cuts and burns from the materials, tools, and equipment used in their trade.

Where To Go for More Information

A young man who wishes to obtain information regarding sheet-metal apprenticeships or work opportunities in this trade should direct his inquiry to sheet-metal contractors or heating, refrigeration, or air-conditioning contractors; a local of the Sheet Metal Workers' International Association; a local joint union-management apprenticeship committee, if there is one in his locality; or the local office of the Bureau of Apprenticeship and Training, U.S. Department of Labor. In addition, the local office of the State employment service may be a source of information about apprenticeship opportunities.

General information about the work of sheet-metal workers may be obtained from:

- Sheet Metal and Air Conditioning Contractors' National Association, Inc.,
  107 Center St., Elgin, Ill.
- Sheet Metal Workers' International Association,
  1000 Conn. Ave. NW., Washington 6, D.C.

Asbestos and Insulating Workers
(D.O.T. 5-33.110 and .210)

Nature of Work

The principal work of asbestos and insulating workers is to cover pipes, boilers, and other equipment with insulating materials, such as cork, felt, asbestos, fiberglass, and magnesia. These materials are installed by pasting, wiring, taping, stud-welding, spraying, or other methods. Asbestos and insulating workers use handtools, such as trowels, brushes, scissors, hammers, saws, pliers, and stud-welding guns. Powersaws are also used to cut insulating materials.

The insulating materials which these workers install serve many purposes. For example, the insulation of pipes, ducts, tanks, vats, stills, towers, boilers, and furnaces retains heat and thus saves fuel. Another function of these materials is to insulate the piping in refrigeration systems to prevent the absorption of heat.

Where Employed

Most asbestos workers are employed by insulation contractors in new industrial and commercial construction. A substantial number are also employed in the alteration and maintenance of insulated pipe work in chemical plants, petroleum refineries, rubber plants, atomic energy installations, shipyards, and other industrial establishments which have extensive steam installations for power and heating. Similarly, some large establishments which have cold storage facilities employ asbestos workers for maintenance work. Asbestos workers are found in almost every part of the country, with large concentrations in the more highly populated and industrialized centers.

Training, Other Qualifications, and Advancement

Most asbestos workers learn their trade through a 4-year "improvership" program that is similar in many respects to apprenticeship programs in other building trades. The improvership program consists of a specified period of on-the-job training in which the new worker learns how to handle the tools of the
trade and to work with the various kinds of insulating materials.

Applicants for improvership programs are generally required to be between the ages of 18 and 30 and in good physical condition. Hourly wage rates under the improvership programs start at about 50 percent of the journeyman's rate and, if the trainee's work progresses satisfactorily, increase by 10 percent each year until 80 percent of the journeyman rate is reached during the final stage of the program. At the end of the 4-year improvership program, trainees are required to pass an examination which demonstrates their knowledge of the trade.

A skilled asbestos worker may advance to the job of foreman, shop superintendent, or estimator, or he may open his own insulation contracting business.

Employment Outlook

Employment in this relatively small building trade is expected to increase rapidly during the 1960's as a result of the anticipated sharp rise in the volume of construction and commercial and industrial building. (See discussion, p. 343.) The increasing use of industrial pipe for numerous manufacturing processes and where air-conditioning and refrigeration are required, will increase the need for asbestos workers for installation and maintenance work. In addition to job openings resulting from the growth of the trade, other opportunities will arise from the need to replace workers who transfer to other fields of work, retire, or die. The expected replacement needs in this relatively small field of work may result in about 400 to 500 job openings annually during the 1960's.

Earnings and Working Conditions

Union minimum hourly wage rates, as of July 1, 1960, for asbestos workers averaged $3.90, compared with $3.86 for all journeymen in the building trades, according to a national survey of building trades workers in 52 large cities. Among individual cities, the minimum hourly rates for asbestos workers ranged from $3.15 in Charlotte, N.C., to $4.75 in New York City.

A large proportion of the workers in this trade are members of the International Association of Heat and Frost Insulators and Asbestos Workers. Union-management contracts covering asbestos workers often provide health insurance and pension benefits, financed entirely by employers.

Where To Go for More Information

A young man who wishes to obtain further information regarding asbestos workers' improvership programs or work opportunities in this trade should apply to an asbestos contractor in his area or to a local of the International Association of Heat and Frost Insulators and Asbestos Workers.

General information about the work of asbestos and insulating workers may be obtained from:

- Insulation Distributor-Contractors National Association, Inc.,
  1425 Chestnut St., Philadelphia 2, Pa.
- International Association of Heat and Frost Insulators and Asbestos Workers,
  1300 Connecticut Ave. NW., Washington 6, D.C.
Nature of Work

Lathers install the supporting backings on ceilings or walls on which plaster or other materials are applied. These supports are usually metal laths (strips of metal or metal wire mesh), or large pieces of perforated gypsum board.

When installing metal laths, the lathers first build a light metal framework (furring) which is fastened securely to the structural framework of the building. The laths are then attached to the furring by nailing, clipping, tying, or machine stapling. After the laths have been installed, the lathers cut openings in them for electrical outlets and heating and ventilating pipes.

The method of installation varies somewhat in other types of lath work. For example, for plaster cornices, the lather builds a framework that approximates the desired shape or form of the cornice. He then attaches metal laths to the framework. Gypsum laths are nailed on studs, or clipped or stapled to the metal furring. Lathers also install metal reinforcements, known as corner beads, which are used as guides by the plasterer and as protection for the finished corner.

When stucco (a mixture of portland cement and sand) is to be applied over wood framework, the lather installs two layers of wire mesh separated by a layer of felt, to act as a base for the stucco.

The tools of the trade include measuring rules and tapes, drills, hammers, chisels, hack-saws, shears, wirecutters, boltcutters, punches, pliers, hatchets, and stapling machines.

Where Employed

Most lathers work for lathing and plastering contractors on new residential, commercial, or industrial construction. They also work on modernization and alteration jobs. Some lathers are also employed outside the construction industry; for example, they make the lath backing for plaster display materials or scenery. Most of the estimated 25,000 lathers employed in mid-1960 had jobs in the larger urban areas.

Training and Other Qualifications

Most training authorities, including the national joint labor-management apprenticeship committee for this trade, recommend the completion of a 2- or 3-year apprenticeship program as the best way to learn lathing. However, many lathers, particularly in small communities, have acquired skills informally, by working for many years as helpers, observing or being taught by experienced lathers.

Apprenticeship applicants generally are required to be between the ages of 16 and 26, and in good physical condition. Aptitude tests are often given to applicants to determine their manual dexterity as well as the other qualifications required for this trade. Many apprenticeship programs are under the supervision of local joint labor-management apprenticeship committees. Apprentices generally must pass examinations which are given at the end of each 6-month period. Apprentices usually are employed under a union apprenticeship agreement and the program is registered with a State apprenticeship agency or the U.S. Department of Labor's Bureau of Apprenticeship and Training.

During the apprenticeship period, the apprentice learns to use and handle the tools and materials of the trade. For example, he installs gypsum and composition board, wall furring, and metal lathing. In addition, he generally receives related instruction in subjects such as applied mathematics, geometry, reading of blueprints and sketches, welding, estimating, and safety practices. Although a high school education is not required, education above grade school level, particularly courses in mathematics, is needed to understand the classroom instruction.

Hourly wage rates for lather apprentices usually start at 50 percent of the journeyman rate. The rate is increased periodically by 5
percent every third or fourth month until a rate of 85 percent is reached in the final quarter of the second year of training.

**Employment Outlook**

A moderate increase in employment in this relatively small building trade is expected over the 1960's. The growth of the trade will result principally from the anticipated large expansion in construction activity over the 1960-70 decade. (See discussion, p. 343.) Moreover, there will be a growing need for lathing work because of the increased use of acoustical tile for sound insulation, the trends toward suspended and other decorative types of ceilings, and the increased use of lightweight plasters as a fireproofing material for structural steel. These developments may largely offset the loss of lathing work resulting from the increasing use of dry walls, particularly in residential construction where these materials are often installed by carpenters. In addition to the expected employment increase, a few job openings will result from the need to replace workers who transfer out of the trade, retire, or die.

**Earnings and Working Conditions**

The average hourly wage rates for lathers are among the highest in the skilled building trades. However, because of the seasonal nature of their work, their average annual earnings are lower than the hourly rates would indicate.

Union minimum hourly wage rates, as of July 1, 1960, for lathers averaged $4, compared with $3.86 for all journeymen in the building trades, according to a national survey of building trades workers in 52 large cities. Among individual cities surveyed, the minimum hourly rates for lathers ranged from $3 in Memphis, Tenn., to $4.65 in New York City.

A large proportion of lathers are members of The Wood, Wire and Metal Lathers International Union. Union-management contracts covering lathers often provide health, life insurance, pension, and other benefits, financed either entirely by employers or jointly by the workers and employers.

**Where To Go for More Information**

For further information regarding lathers' apprenticeships or work opportunities in the trade, a young man should apply to a lathing contractor in his area; a local of the Wood, Wire and Metal Lathers International Union; a local joint labor-management apprenticeship committee, if there is one in his area; or the local office of the Bureau of Apprenticeship and Training, U.S. Department of Labor. In addition, the local office of the State employment service may be a source of information about apprenticeship opportunities.

General information about the work of lathers may be obtained from:

- Contracting Plasterers' and Lathers' International Association,
  304 Landmark Bldg., 1343 H St. NW.,
  Washington 5, D.C.

- National Bureau for Lathing and Plastering,
  755 Nada Bldg., 2000 K St. NW.,
  Washington 5, D.C.

- The Wood, Wire and Metal Lathers International Union,
  6530 New Hampshire Ave., Takoma Park 12, Md.

**Marble Setters, Tile Setters, and Terrazzo Workers**

(D.O.T. 5–24.310, .410, and .510)

**Nature of Work**

Marble setters, tile setters, and terrazzo workers cover interior or exterior walls, floors, or other surfaces with marble, tile, or terrazzo. Craftsmen in each of these distinct trades work primarily with the material indicated by their title.

Marble setters install marble, shop-made terrazzo panels and artificial marble, and structural glass when it is used in the interior of a building. The marble setter does little fabrication work because the marble and other materials are cut to size and polished before they are delivered to the work site. However, he
may do some minor cutting to make the materials fit exactly. In setting marble, he lays out the work, then applies a special plaster mixture to the backing material and sets the marble pieces in place. When necessary, he braces them until the setting plaster has hardened. Special plaster is poured into the joints between the marble pieces, and the joints are “pointed up” (slightly indented) with a trowel or wooden paddle. Bolt holes may have to be drilled if attachments to the marble are necessary. Usually, each marble setter has a helper or general assistant to prepare plaster, carry marble slabs, and clean the surface of the completed work.

The tile setter attaches tile (a thin slab of baked clay, stone, or other material) on walls, floors, or ceilings according to blueprints or other instructions. For walls and ceilings, a plaster coat and then a layer of cement are applied to the surface or other supporting backing, such as plaster board or metal lath. The tiles are then tapped into place with a trowel handle. In laying tile floors, the tile setter adds cement to the fresh concrete subfloor and then lays the tile. He chips the tile with a hammer and chisel or cuts it with pincers to make it fit into irregular areas, into corners, or around pipes.

Small tiles, such as those laid in bathrooms, are available in paper-backed strips and sheets that can be fastened to the floor as a unit, using cement or various types of adhesives. This eliminates the need for the setting of individual tiles. The tile setter is usually assisted by a helper who mixes mortar, sets up scaffolds, supplies the setter with materials, fills the joints after the tile setting is completed, and cleans the completed work.

Terrazzo workers work with terrazzo which, essentially, is a type of ornamental concrete used mainly for floors, in which marble chips are used as the coarsest ingredient. After the terrazzo hardens, it is ground and polished to give a smooth surface in which the marble chips are exposed against the background of other materials.

A terrazzo worker starts his work by laying a base (first course) of fine, fairly dry concrete, leveling this base accurately with a long, flat tool called a straightedge, and tamping it. He then places metal strips wherever there is to be a joint, or a change of color between panels, and imbeds their bottom edges into the first course. If there is to be lettering or an ornamental figure, he also imbeds a shop-made mold. Then he mixes the top course of concrete and marble chips, pours it onto the base course, and rolls and levels it. There is a separate mixture for each color. After the concrete has hardened for a few days, a semiskilled worker grinds and polishes the floor with an electric-powered grinding machine.

The terrazzo worker is assisted by helpers in the mixing and placing of the base course, but he alone does the leveling and placing of the metal strips. Helpers handle sand, cement, marble chips, and all other materials that may be used by the terrazzo workers. They rub and clean all marble, mosaic, and terrazzo floors and perform other work required in helping a terrazzo craftsman. The terrazzo worker generally supervises mixing of the top course which, along with the grinding, governs its final appearance.

Where Employed

Marble setters, tile setters, and terrazzo workers are employed mainly in new building construction and generally in the larger urban areas. Substantial numbers of terrazzo workers are found in Florida and California.

Training, Other Qualifications, and Advancement

Most training authorities, including the national joint labor-management apprenticeship committees which set the training standards in these trades, recommend the completion of a 3-year apprenticeship program as the best way to learn each of these trades. A substantial proportion of tile setters, terrazzo workers, and marble setters, however, have acquired skills of these trades informally by working for many years as helpers, observing or being taught by experienced craftsmen.

Apprenticeship applicants generally are required to be between the ages of 17 and 22; a high school education or its equivalent is desirable. Good physical condition and manual
dexterity are important assets. Applicants should have an eye for quickly determining proper alinements of tile, terrazzo, and marble, and have a good sense of color harmony.

Many apprenticeship programs are under the supervision of local joint union-management apprenticeship committees. Generally, the apprentice is employed under a written apprenticeship agreement and the program is registered with a State apprenticeship agency or the U.S. Department of Labor’s Bureau of Apprenticeship and Training. The apprenticeship programs in each of these trades generally consist of 6,000 hours of on-the-job training, in addition to related classroom instruction. In a typical 3-year training program for terrazzo workers, apprentices learn, among other things to use, care for, and handle safely the tools, equipment, and materials commonly used in the trade; mix, place, tamp, and level terrazzo material and concrete; and select, set, and level metal dividing strips. The apprentice also learns the selection and placement of materials according to the design of the job; the rough and final finishing of bases and coves; and hand and machine rubbing.

The apprentice receives related classroom instruction in blueprint reading, layout work, basic mathematics, and the making of measurement sketches.

Hourly wage rates for apprentices in each of these trades start at about 50 or 60 percent of the journeyman rate and increase periodically until 95 percent of the journeyman rate is reached during the last period of apprentice training.

Skilled and experienced tile, terrazzo, or marble setters may become foremen. Others may be able to start their own small contracting businesses.

Employment Outlook

Employment in these small trades is expected to increase somewhat during the 1960’s, primarily because of the anticipated large growth in new building construction. (See discussion, p. 343.)

Job openings for terrazzo workers are expected to increase faster than for marble setters and tile setters. Because terrazzo is durable and attractive, the number of terrazzo installations, particularly for floors, expanded over the past decade or so, and is expected to grow further during the 1960’s. A small number of skilled terrazzo workers have been recruited from abroad to meet shortages of these workers in some areas.

The anticipated growth in employment of tile setters will be limited by the increased use of competing materials, such as asphalt floor tile, structural glass, plastic tile, and plastic-coated wallboard.

Little change in the employment of marble setters is expected. Despite the relatively higher costs of marble compared with competitive materials, the excellent properties of marble as a building material will insure its continued use and provide work for marble setters, although the supply of quality marble is gradually being depleted.

Earnings and Working Conditions

Union minimum hourly wage rates, as of July 1, 1960, for terrazzo workers averaged $3.93; for marble setters, $3.91; and for tile setters, $3.84; according to a national survey of building trades workers in 52 large cities. These rates compared with the average of $3.86 for all journeymen in the building trades. Among individual cities surveyed, the minimum hourly rates for terrazzo workers ranged from $3 in San Antonio, Tex., to $4.60 in Newark, N.J. For marble setters, the rates ranged from $3 in San Antonio to $4.28 in Peoria, Ill. The rates for tile setters ranged from $3 in San Antonio to $4.28 in Peoria, Ill.

A large proportion of the workers in each of these trades are members of one of the following unions—Bricklayers, Masons and Plasterers’ International Union of America; International Association of Marble, Slate and Stone Polishers, Rubbers and Sawyers, Tile and Marble Setters’ Helpers and Marble Mosaic and Terrazzo Workers’ Helpers; and Operative Plasterers’ and Cement Masons’ International Association of the United States and Canada. Union-management contracts covering these
workers often provide insurance and pension benefits, financed either entirely by the employers or jointly by the workers and employers. Marble setters and terrazzo workers work both indoors and outdoors, depending on the type of installation. Tile setters work mostly indoors.

Where To Go for More Information

To obtain further information regarding apprenticeships or work opportunities in these trades, a young man should apply to tile, terrazzo, and marble setting contractors in his area or to locals of the unions previously mentioned. In addition, the local office of the State employment service may be a source of information about apprenticeship opportunities.

Glaziers

(D.O.T. 5-77.010)

Nature of Work

Glaziers cut, fit, and install plate glass, ordinary window glass, mirrors, and special items such as leaded glass panels. In making a glass installation, the glazier cuts the glass to size or uses precut glass. The glazier puts a bed of putty into the wood or metal sash and presses the glass into place. He fastens the glass with wire clips or triangular metal points and then places and smooths another strip of putty on the outside edges of the glass to keep out moisture.

When installing structural glass, which is used to decorate building fronts, walls, ceilings, and partitions, the glazier (and sometimes the marble setter, see discussion, p. 381) applies mastic cement to the supporting backing and presses the glass into it. The glass may have to be trimmed with a glass cutter if it is not precut to specifications. Glaziers (as well as bricklayers, see discussion, p. 356), install glass blocks for building exteriors, interior partitions, and walls.

In addition to handtools, such as glass cutters and putty knives, glaziers use power cutting tools and grinders.

Where Employed

In mid-1960, only a few thousand glaziers were employed by glazing contractors on new construction, alterations and modernizations, and on replacement of broken glass, particularly for store windows. Others were employed by government agencies or business establishments which do their own construction work.

A large number of glaziers work outside the construction industry. Many are employed in factories where they install glass in sash, doors, mirrors, and partitions. Other workers, using skills similar to those used by glaziers, install glass or mirrors in furniture and ships, or replace glass in automobiles.

Most glaziers are employed in large urban areas. In small communities, glazing is done by persons who also do painting or paperhanging.

Training and Other Qualifications

Most training authorities, including the national joint labor-management apprenticeship committee for the glass and glazing industry, recommend the completion of a 3-year apprenticeship program as the best way to learn this trade. A substantial proportion of glaziers,
however, have learned the trade informally. They have acquired glazing skills by working for many years with glaziers and observing or being taught by experienced craftsmen. In smaller communities, many journeymen painters and paperhangers have learned to do glazier work as part of the apprentice training for their trade.

Apprenticeship applicants generally are required to be at least 18 years of age; a high school education or its equivalent is desirable. Many glazier apprenticeship programs are under the supervision of local joint union-management apprenticeship committees. Generally, the apprentice is employed under a written apprenticeship agreement, and the program is registered with a State apprenticeship agency or the U.S. Department of Labor’s Bureau of Apprenticeship and Training.

The apprenticeship program usually consists of 6,000 hours (3 years) of on-the-job training, in addition to a minimum of 144 hours a year of related classroom instruction. During the apprenticeship, the apprentice learns how to use and handle the tools, machines, and materials of the trade. The program also includes on-the-job training in the glazing of wood and metal sash (frame) in doors, windows, and partitions and other types of openings; setting of store front openings, structural glass, mirrors, showcases, automobile glass, shower doors, and tub enclosures; replacement of glass; and scaffolding.

Hourly wage rates for glazier apprentices usually start at 50 percent of the journeyman rate and increase periodically until the journeyman rate is reached at the completion of training. If apprenticeship applicants have had experience directly related to the trade, they may be granted advanced apprenticeship training.

**Earnings and Working Conditions**

Union minimum hourly wage rates for glaziers averaged $3.53, compared with $3.86 for all journeymen in the building trade, as of July 1, 1960, according to a national survey of building trades workers in 52 large cities. Among individual cities surveyed, the union minimum hourly wage rates for glaziers ranged from $2.45 in Richmond, Va., to $4.25 in New York City. The average annual earnings of glaziers in construction work are not as high as their hourly rates of pay would indicate, since they lose much worktime because of weather and other reasons.

A large proportion of glaziers employed in construction work are members of the Brotherhood of Painters, Decorators and Paperhangers of America. Union-management contracts covering glaziers often provide health insurance and pension benefits, financed either entirely by the employers or jointly by the employers and workers.

**Where To Go for More Information**

A young man who wishes to obtain further information regarding glazier apprenticeships or work opportunities in this trade should direct his inquiry to a glazing contractor or general contractor in his area; a local of the Brotherhood of Painters, Decorators and Paperhangers of America; a local joint union-management apprenticeship committee, if there is one in his locality; or the local office of the Bureau of Apprenticeship and Training, U.S. Department of Labor. In addition, the local office of the State employment service may be a source of information about apprenticeship opportunities.

General information about the work of glaziers may be obtained from the Brotherhood of Painters, Decorators and Paperhangers of America, 217–219 North 6th St., Lafayette, Ind.
Elevator Constructors
(D.O.T. 5-83.350 through .359)

Nature of Work

Elevator constructors (also called elevator mechanics) assemble and install elevators, escalators, dumb waiters, and similar equipment. They also do considerable modernization, maintenance, and repair work. The work is done by small crews (seldom more than six men) consisting of skilled mechanics and their helpers.

In elevator construction work, the crew first installs the guide rails of the car in the elevator shaft of the building. Then they install the car frame and platform, the counterweight, the elevator chassis, and the control apparatus. Next, the car frame is connected to the counterweight with cables, the cab body and roof are installed, and the control system is wired. Finally, the entire assembly, including cables, wire, and electrical control apparatus, is carefully adjusted and tested.

In maintenance and repair work, elevator mechanics inspect elevator and escalator installations periodically and, when necessary, adjust cables and parts and lubricate or replace parts. Alteration work on elevators is important because of the rapid rate of innovation and improvement in elevator engineering. This work is similar to new installation work because all elevator equipment except the old rail, car frame, platform, and counterweight are generally replaced.

To install and repair modern elevators, many of which are electrically controlled, elevator constructors must have a working knowledge of electricity, electronics, and hydraulics. They must also be able to repair electric motors, as well as control and signal systems. Because of the variety of their work, they use many different handtools and power tools.

Where Employed

Most of the estimated 12,000 journeymen elevator constructors employed in mid-1960 worked for elevator manufacturers, doing new installation and modernization work and elevator servicing. Some elevator constructors are employed by small, local contractors who specialize in elevator maintenance and repair. Others work for government agencies or business establishments which do their own elevator maintenance and repair. Elevator constructors are also employed as elevator inspectors for municipal or other government licensing and regulatory agencies. The jobs of elevator constructors are concentrated in the highly industrialized and populated centers of the country.

Training and Other Qualifications

Although elevator constructors are among the more highly skilled building craftsmen, training is comparatively informal and is obtained through employment as a helper for a number of years. The helper-trainee must be at least 18 years of age, in good physical condition, and have a high school education or its equivalent, preferably including courses in mathematics and physics. Mechanical aptitude and an interest in machines are important assets.

To become a skilled elevator mechanic, at least 2 years of continuous job experience, including 6 months’ on-the-job training at the
factory of a major elevator firm, is usually necessary. During this period, the helper must learn to perform all of the operations involved in the installation, maintenance, and repair of elevators, escalators, and similar equipment. The helper-trainee is generally required to attend evening classes in vocational schools. Among the subjects studied are mathematics, physics, electrical and electronic theory, and proper safety techniques.

Opportunities for establishing an individually owned small contracting business in this field are very limited.

**Employment Outlook**

Continued increase in employment of elevator constructors is expected during the 1960's. However, there will be only several hundred job openings annually for new workers in this small occupation.

Increasing numbers of elevator constructors will be needed as the result of the anticipated large expansion in new industrial, commercial, and large residential building. (See discussion, p. 343.) In addition, technological developments in elevator and escalator construction will spur modernization of older installations and thus will contribute to the growing need for these craftsmen. For example, the modern high-speed elevators with automatic control systems require more work and higher skill for the installation and adjustment of electrical and electronic controls.

**Earnings and Working Conditions**

Both the hourly wage rates and the annual earnings of elevator constructors are among the highest in the skilled building trades. These craftsmen lose less worktime because of seasonal factors than do most other building trades workers.

Union minimum hourly wage rates, as of July 1, 1960, for elevator constructors averaged $3.95, compared with $3.86 for all journeymen in the building trades, according to a national survey of building trades workers in 52 large cities. Among individual cities surveyed, the minimum hourly rates for elevator constructors ranged from $3.37 in Richmond, Va., to $4.46 in Newark, N.J. Helpers' rates generally are 70 percent of the journeymen's rates.

Most elevator constructors are members of the International Union of Elevator Constructors. Union-management contracts covering elevator workers often provide health insurance, financed either entirely by employers or jointly by the employers and workers.

Some work operations in elevator construction involve lifting and carrying heavy equipment and elevator parts, but this is usually done by the helpers. Much of the work must be done in cramped or awkward positions. The work is done indoors.

**Where To Go for More Information**

A young man who wishes to obtain further information regarding work opportunities as a helper in this trade should direct his inquiry to an elevator manufacturer, an elevator contractor, or a local of the International Union of Elevator Constructors, if there is one in his locality. In addition, the local office of the State employment service may be a source of information about work opportunities in this trade.

General information about the work of elevator constructors may be obtained from the International Union of Elevator Constructors, 12 South 12th St., Philadelphia 7, Pa.

**Stonemasons**

(D.O.T. 5-24.210)

**Nature of Work**

Stonemasons build the stone exteriors of structures. They work primarily with two types of stones—natural cut stone, such as marble, granite, limestone, or sandstone; and artificial stone which is made to order using cement, marble chips, or other types of masonry materials. Much of the work of these craftsmen is the setting of cut stone for comparatively expensive buildings, such as office buildings, hotels, churches, and public buildings.
The stonemason works from a set of drawings in which each stone has been numbered for identification, except where all pieces are identical. A helper or, in some cases, a derrickman, locates the pieces needed and brings them to the mason; large stones are set in place with a hoist. The stonemason sets the stone in mortar and moves it into final position with a mallet, hammer, or crowbar. He alines the stone with a plumb line and finishes the joints between the stones with a pointing trowel. He may fasten the stone to supports with metal ties, anchors, or by welding.

Occasionally, the stonemason may have to cut stone to size. To do this, he must determine the grain of the stone selected and strike blows along a predetermined line with a stonemason's hammer. Valuable stones are cut with an abrasive saw to make them fit.

Stonemasons also do some stone veneer work, in which a thin covering of cut stone is applied to the exterior surfaces of a building. In one specialized branch of the trade known as alberene stone setting, stonemasons set acid-resistant soapstone linings for vats, tanks, and floors.

The principal handtools of the stonemasons are heavy hammers, wooden mallets, and chisels. For rapid stone cutting, pneumatic tools are used, such as hammers, drills and brushing tools. Special power tools are used for smoothing the surface of large stones. An abrasive saw is used for fine cutting.

Where Employed

Most stonemasons work on new building construction, particularly on the more expensive residential and commercial buildings. A few work for government agencies or business establishments which do their own construction and alteration work. Journeymen stonemasons are employed mainly in the larger urban areas. In many areas where there are no stonemasons, the work is performed by bricklayers who can do stone masonry work.

Training and Other Qualifications

Most training authorities, including the National Joint (labor-management) Bricklaying Apprenticeship Committee, recommend the completion of a 3-year apprenticeship program as the best way to learn the stonemason's trade. A substantial proportion of stonemasons, however, have picked up the trade by working many years as helpers, observing or being taught by experienced stonemasons.

Apprenticeship applicants generally are required to be between the ages of 17 and 24; a high school education or its equivalent is desirable. Good physical condition is an important asset.

The apprentice training program for stonemasons generally requires 6,000 hours (3 years) of on-the-job training, in addition to related classroom instruction. During the apprenticeship, the trainee learns to use, care for, and handle safely the tools, machines, and materials of the trade, and to lay out and install walls, floors, stairs, and arches. The apprenticeship program in this occupation is similar to that for bricklayer. (See discussion, p. 347.)

Employment Outlook

Little increase in the employment of stonemasons is expected during the 1960's, despite the anticipated large expansion in new building construction. (See discussion, p. 343.) Less use of stone masonry work is expected, because modern architectural design has emphasized simple lines, little ornamentation, and large window areas. Replacement needs will provide a small number of job opportunities for new workers each year in this relatively small building trade.

Earnings and Working Conditions

Hourly wage rates for stonemasons are among the highest in the skilled building trades. Their average annual earnings, however, are much less than their hourly rates would indicate since these workers lose much worktime because of weather conditions and the brief duration of many jobs.

Union minimum hourly wage rates, as of July 1, 1960, for stonemasons averaged $4.04 compared with $3.86 for all journeymen in the building trades, according to a national survey of building trades workers in 52 large cities. Among individual cities surveyed, the minimum
hourly rates for stonemasons ranged from $3.55 in Columbus, Ohio, to $4.96 in New York City.

A large proportion of stonemasons are members of the Bricklayers, Masons and Plasterers' International Union of America. Union-management contracts covering stonemasons often provide health insurance, pension, and other benefits, financed either entirely by employers or jointly by the workers and employers.

Most stonemasonry work is done outdoors. The work of the stonemason is active and sometimes strenuous, as it involves lifting moderately heavy materials.

Where To Go for More Information

A young man who wishes to obtain further information regarding apprenticeships for stonemasons or work opportunities in this trade should apply to bricklaying contractors in his area; to a local of the Bricklayers, Masons and Plasterers' International Union of America; to a local joint union-management apprenticeship committee, if there is one in his locality; or the local office of The Bureau of Apprenticeship and Training, U.S. Department of Labor. In addition, the local office of the State employment service serves as a source of information about apprenticeship openings.

General information about the work of stonemasons may be obtained from:

- Associated General Contractors of America, Inc., 1957 E St. NW., Washington 6, D.C.
- Bricklayers, Masons and Plasterers' International Union of America, 815 15th St. NW., Washington 5, D.C.

Construction Laborers and Hod Carriers

(D.O.T. 9-32.01)

Nature of Work

Construction laborers work on all types of building construction and on other types of construction projects, such as highways, dams, pipelines, and water and sewer projects. Their work includes the loading and unloading of construction materials at the work site and the shoveling and grading of earth. Laborers stack and carry materials, including small units of machinery and equipment, and do other work which aids building craftsmen. They also erect and dismantle scaffolding, set braces to support the sides of excavations, and clean up rubble at various stages of construction to provide a clear work area and to reduce hazards.

On alteration and modernization jobs, laborers tear out the old work. They perform much of the work done by wrecking and salvage crews during the demolition of buildings.

When concrete is mixed at the work site, laborers fill the mixer with ingredients. Whether the concrete is mixed on-site or hauled in by truck, laborers pour and spread the concrete, and spade it to prevent air pockets. In highway paving, they handle and place the forms into which wet concrete is poured and cover new pavement with straw, burlap, or other materials to prevent excessive drying.

Bricklayers' tenders and plasterers' laborers, both commonly known as hod carriers, serve journeymen in their respective trades, supplying them with materials, setting up and moving portable scaffolding, and providing the other services needed. Hod carriers must be familiar with the work of the journeymen, have some knowledge of the materials used, and have some degree of judgment. It is customary practice in the building trades for hod carriers to be transferred with the journeymen from one construction project to another.

Building and construction laborers are commonly classified as unskilled workers, but this term can be misleading. Their work covers a wide range of requirements. Some types of construction laborer and hod carrier jobs often require experience as well as a broad knowledge of construction methods, materials, and operations. Rock blasting is an example of a type of work in which "know-how" is important. Construction laborers who work with explosives drill holes in rock, handle explosives, and set charges. These workers must know the effects of different explosive charges under varying rock conditions so that proper measures can be taken to prevent injury and property damage. Construction laborers learn how to handle and
use blasting materials through job experience and instruction from foremen in charge of blasting work. Also, in the construction of tunnels, and dam and bridge foundations, construction laborers must have specific on-the-job experience. They do all the work in the pressurized area of a tunnel, including operations which would be done by journeymen if the job were located elsewhere.

Where Employed

Laborers are employed by all types of construction contractors. A large number of these workers are also employed by State and municipal public works and highway departments and by public utility companies in road repairing and maintenance, and excavating.

The more than 700,000 laborers at work in mid-1960 were employed in every section of the country. Their employment is distributed geographically in much the same way as building trades employment generally, with large concentrations in the highly populated and industrialized centers.

Training and Other Qualifications

No formal training is required to obtain a job as a building or construction laborer. Generally, to be employed in these jobs, a young man must be at least 16 years of age and in good physical condition. A laborer's first job is usually on the simplest type of work, but as he gains experience he does more difficult work. Although laborers work with skilled building craftsmen, they rarely have a chance to work with the journeyman's tools or equipment and, therefore, generally have little opportunity to pick up the skills of a building trade.

Employment Outlook

Continued increase in employment for laborers is expected during the 1960's as a result of the anticipated large growth in the volume of construction activity. (See discussion, p. 343.) Increased mechanization and improved methods of materials handling, however, may limit the rate of growth in the employment of these workers. For example, the employment of laborers is being affected by the increasing use of new types of more efficient grading machinery and mechanical lifting devices.

Earnings and Working Conditions

Because of the seasonal nature of much of construction work and because of worktime lost for other reasons, the average annual earnings of laborers are not as high as their hourly rates of pay would indicate. Union minimum hourly wage rates for bricklayers' tenders and building laborers averaged $3 and $2.81, respectively, as of July 1, 1960, according to a national survey of building trades workers in 52 large cities. Among individual cities surveyed, the minimum hourly rates for bricklayers' tenders ranged from $1.55 in Charlotte, N.C., to $3.80 in New York City. The rates for building laborers ranged from $1.45 in Charlotte to $3.80 in New York City.

Construction work is generally physically strenuous and requires bending, stooping, and heavy lifting. Much of the work is performed outdoors. Many laborers are members of the International Hod Carriers', Building and Common Laborers' Union of America.

Where To Go for More Information

A young man who wishes to obtain further information regarding work opportunities as a
laborer should direct his inquiry to a building or construction contractor in his area, or a local of the International Hod Carriers', Building and Common Laborers' Union of America, if there is one in his area. In addition, the local office of the State employment service is a source of information about work opportunities.

General information about the work of construction laborers may be obtained from:

Associated General Contractors of America, Inc.,
1957 E St. NW., Washington 6, D.C.

International Hod Carriers', Building and Common Laborers' Union of America,
905 16th St. NW., Washington 5, D.C.
PRINTING (GRAPHIC ARTS) OCCUPATIONS

The printing crafts provide a large field of employment for skilled workers in the United States. In 1960, about 333,000 workers were employed in the printing crafts as compositors, photoengravers, electrotypers, stereotypers, pressmen, lithographic workers, and bookbinders. These trades offer especially good opportunities for young men willing to spend several years in learning a skilled craft. Skilled printing workers generally have year-round employment and much better than average earnings. Jobs can be found throughout the country, in small towns as well as big cities. Some printing craftsmen also have opportunities to go into business for themselves.

Nature and Location of the Industry

Printing is basically a means of transferring ink impressions of type, photographs, and illustrations from a press plate to paper, metal, or other materials. The printing process is used mainly by the printing (graphic arts) industry—one of the Nation's major manufacturing industries. The more than 35,000 printing and publishing establishments in 1960 employed about 276,000 printing craftsmen. Government agencies and private firms that do their own printing—such as manufacturers of paper packaging, banks, and insurance companies—employed an estimated additional 57,000 printing craftsmen.

The printing industry consists of a number of divisions. Of these the largest, in terms of printing craftsmen employed, is made up of more than 12,000 commercial or job printing shops which produce printed matter such as letterheads, advertising matter, folders, and pamphlets. Commercial shops also print books, periodicals, limited-run newspapers, and magazines. More than half of all workers employed in commercial shops are in plants with fewer than 100 workers. A few large plants which employ more than a thousand workers each and compete for business on a State or national basis account for about one-sixth of all commercial printing employees.

Newspapers provide the second largest employment field for printing craftsmen. A great majority of the approximately 1,800 daily and 9,000 weekly newspapers throughout the Nation do their own printing. Although some major metropolitan newspapers employ as many as several hundred craftsmen, many smaller dailies and weeklies employ fewer than 15 skilled workers.

Lithographic plants provide the third largest area of employment for craftsmen in the industry. These plants produce items similar to those of commercial plants, but differ in the type of printing process used. About two-thirds of the employment in the lithographic division is in plants with 25 or more employees.

Binderies, which assemble printed materials into books, folders, magazines, and pamphlets also provide many jobs for craftsmen.

Other divisions of the industry employing many craftsmen include firms such as those specializing in printing books, magazines, greeting cards, and business forms. In addition, many shops perform service functions, such as photoengraving, typesetting, electrotyping and stereotyping, and offset platemaking for printing establishments, advertising departments of large firms, and advertising agencies.

Printing jobs are found throughout the country. Almost every small town has a printing shop of some kind—frequently, a small newspaper plant which also may do the community's printing. However, more than half of the Nation's printing employees are in five States—New York, Illinois, California, Pennsylvania, and Ohio. Within these States, most printing activities are in or near manufacturing, commercial, or financial areas, such as New York City, Chicago, Los Angeles, San Francisco,
Philadelphia, Cincinnati, and Cleveland. Other leading centers are Boston, Detroit, St. Louis, Minneapolis–St. Paul, Milwaukee, and Washington, D.C. Employees in book and magazine printing work are highly concentrated in these major urban areas. A much larger proportion of employment in newspaper plants, however, is found outside these centers because of the great number of small local newspapers scattered throughout the country.

**Printing Processes**

A description of the various printing processes is essential to an understanding of the work performed by the printing crafts. Three printing processes are in general use today—letterpress, lithography (offset printing), and gravure. A fourth method, the screen process, although much less extensively used than the other three methods, is increasing in importance. Each method has its own special advantages and requires different types of skilled craftsmen.

In letterpress (relief) printing, the letters and designs to be reproduced are raised above the nonprinting areas of the press plate. When the actual printing is done, ink is applied only to the raised area of the plate by means of an inking roller. Letterpress is the oldest and by far the most common printing process. Practically all newspapers, most books and magazines, and a substantial portion of other printed items are produced by this method. The letterpress process also includes photoengraving (the photomechanical production of plates for illustrations and other copy that cannot be set up in type) and stereotyping and electrotyping, the process by which letterpress plates are duplicated.

In lithography, the press plate is smooth, with both the image and nonimage areas on the same level, instead of on different levels as in the letterpress and gravure processes. Lithography is based on the principle that grease and water repel each other. The image areas of the plate are coated with a greasy substance to which the greasy ink will stick. On the press, the plate is moistened with water before each inking, so that only the image areas take up the greasy ink from the inking roller. In modern lithography, the plates are produced photomechanically, and the method is often referred to as photolithography. The lithographic process can be used to produce practically all items printed by any other process. Lithographic departments have been added to many printing plants which formerly used only the letterpress process. They are called mixed or combination plants to distinguish them from plants using only the letterpress process.

Gravure or intaglio printing is much less widely used than either the letterpress or lithography. In this process, the relative position of the printing and nonprinting areas of the plate is the reverse of that in letterpress. The letters and designs to be printed are etched (cut) into the plate and are below the nonprinting surface. Ink is applied to the entire plate, but the surface is then wiped or scraped, leaving ink only in the depressions. In printing, suction is created, which lifts the ink out onto the paper. Sunday newspaper supplements and mail-order catalogs are well-known examples of gravure printing. Gravure pictures also appear as inserts in many magazines as well as in other forms of printed material. Most printing on metal foil is done by this means.

Screen printing is a process in which inks, or other materials such as paint, varnish, and liquid plastic are forced by the action of a flexible blade through a stencil mounted on a finely woven silk or wire mesh or screen. The shape of the stencil openings determines the design to be printed. This process may be applied to a wide variety of surfaces such as conventional paper, cardboard, wood, glass, metal, plastic, and textiles. Screen printing is used on irregularly shaped surfaces and cylindrical surfaces as well as on flat sheet materials.

**Printing Occupations**

Regardless of the process employed, most printing work goes through at least three stages: Composition, platemaking, and presswork. (See chart 22.) Additional processing in a bindery is needed for materials that must be bound, such as books and magazines. In the past, many printers could perform every operation in the
printers process. Such all-round craftsmen can still be found in small newspaper and commercial shops, but today printing craftsmen are usually more specialized and, therefore, their training is directed to a specific area of printing operations—for example, type composition, photography, platemaking, or presswork. Training, moreover, is largely confined to only one of the basic printing processes—letterpress, lithographic, or gravure.

The largest group of skilled craftsmen is made up of composing room workers, with more than 180,000 employed in 1960. This group includes hand compositors, improvers, typesetting machine operators, and, frequently, proofreaders. Other large groups of skilled printing workers are the lithographic craftsmen and the letterpress and gravure pressmen. Bookbinders, photoengravers, and electrotypers and stereotypers are other important occupations. (These groups are described in detail later in this chapter.) Steel and copper plate engravers, who cut or etch lettering and designs into plates by hand or machine, are employed in small engraving shops.

Another smaller group of skilled workers employed in large plants are maintenance machinists who repair and adjust typesetting machines, printing presses, or bindery equipment.

In the skilled occupations, practically all the workers are men. However, many of the less skilled jobs, especially in the binderies, are held by women. A small but growing number of Negroes are employed in skilled jobs; a greater number are employed in the less skilled occupations. In the several hundred shops which print newspapers, magazines, or other items mainly for the Negro community, the great majority of the jobs are held by Negroes.

Printing establishments also employ a great many persons as executives, estimators, salesmen, accountants, engineers, stenographers, clerks, and laborers. Newspapers and other publishers employ a considerable number of reporters and editors. These occupations are discussed elsewhere in this Handbook. (See index for page numbers.)

**Training and Other Qualifications**

The most common way of entering a skilled printing occupation is through apprenticeship. With rare exceptions, it is the only means by which one may be trained to become a journeyman (skilled worker) in a unionized shop. Formal apprenticeship is also required for journeyman status in many of the larger establishments not covered by union contracts. In some of the smaller shops, however, it is possible to pick up the printing trades by working with printing craftsmen or by a combination of work experience and schooling. Some acquire their first experience in duplicating (letter-service) shops which have lithographic departments.

Printing apprenticeships usually last from 4 to 6 years, depending on the occupation and the shop or area practices. The apprentice training program covers all phases of the par-
PRINTING OCCUPATIONS

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ticular trade and almost always includes class­
room or correspondence study in related tech­
nical subjects in addition to training on the
job. As new methods have been developed and
introduced into the industry, they have been
incorporated into the duties of the traditional
crafts and included in the apprentice training
programs. Apprenticeship applicants are gen­
erally required to be between 18 and 30 years
of age and must pass a physical examination.

In selecting applicants for apprenticeship,
most employers require a high school education
or its equivalent. A thorough knowledge of
spelling, punctuation, and grammar is essential
for some of the printing trades, and a knowl­
dge of the basic principles of chemistry and
physics is becoming increasingly important in
many of the trades. An artistic sense is also
an asset for many kinds of printing work. Most
of the printing crafts require men with good
eyesight, about average physical strength, and
a high degree of manual dexterity. Speed with
accuracy, mental alertness, neatness, patience,
and the ability to work with others are neces­
sary in printing trades. Many employers re­
quire applicants to take one or more of the
specific aptitude tests developed for printing
industry occupations by the U.S. Department
of Labor. These tests are given in the local
offices of State employment services.

About 3,000 high schools, vocational schools,
technical institutes, and colleges offer courses
in printing. These courses may materially help
a young person to be selected for apprentice­
iships and other job openings in the printing
industry. Apprentices are often chosen from
among the young men already employed in
various unskilled jobs in printing establish­
ments, who demonstrate the mechanical apti­
tudes essential for the printing crafts.

Employment Outlook

There will be many thousands of oppor­
tunities for young men to enter the skilled
printing trades in the 1960’s. These openings
will occur as a result of the expected moderate
growth in the employment of skilled printing
workers and because of the need to replace
craftsmen who retire, die, or transfer to other
fields of work. Retirements and deaths may
result in about 6,000 to 7,000 job openings
each year during the 1960’s.

A continued rise in the volume of printed
material is expected because of population
growth, the increasingly high level of education,
the expansion of American industry, and
the trend toward greater use of printed ma­
terial for information, packaging, advertising,
and various industrial and commercial pur­
poses. However, as in the past, employment in
the skilled printing trades as a whole is not
expected to increase as fast as the total output
of printed matter, partly because of new and
improved printing equipment and methods.

A number of technological advances now be­
ing introduced in the industry, mainly involv­
ing type composition and platemaking, will af­
fect printing methods as well as the number
and skills of workers employed. Among these
are developments in photocomposition, “cold
type” compositions, and the use of electronic
devices and controls for engraving and print­
ing. Research is being expanded in several
other areas, including those involving electronic
or magnetic principles. These developments
are not expected to reduce the total employ­
ment of skilled craftsmen. In the past, as new
technical developments with their changed
skill requirements have been introduced into
the industry, they have been incorporated into
the duties of the crafts.

As in the past, there will be differences in
the rates of growth among the various print­
ing crafts. Employment of skilled composing
room workers, the largest group of printing
craftsmen, is expected to increase slowly, de­
spite the continuing increase in the volume of
printing. Composing room occupations are the
most likely to be affected by changes in printing
equipment and by competitive printing meth­
ods. The number of workers in composing room
occupations in the 1940–60 period increased
more slowly than total employment in printing
and publishing in the same period. Employ­
ment of pressmen is expected to increase more
rapidly than composing room workers, while
lithographic craftsmen will show the fastest
rate of growth. These groups have shown the
greatest growth in the past decade or so as
indicated in the employment outlook for individual printing crafts discussed later in this chapter.

At the beginning of 1960, about 13,000 registered apprentices were training in the skilled printing crafts. (A registered apprentice is an employee who, under an expressed or implied agreement, receives instruction in an apprenticeable occupation for a stipulated term and who is employed in an apprenticeship program registered with a State apprenticeship agency or the U.S. Department of Labor's Bureau of Apprenticeship and Training.) In addition, perhaps 8,000 to 10,000 apprentices were in nonregistered programs. A substantial number of persons were also picking up a printing trade while working as helpers, particularly in small printing shops and in duplicating services (lettershops).

An examination of the latest information on the location of registered apprentices indicates the areas in which future apprenticeship opportunities may be found. However, it must be borne in mind that registration is voluntary and that employers in some localities have not registered their apprenticeship programs. The following 10 States and the District of Columbia accounted for 70 percent of the registered apprentices as of January 1, 1960: New York, 2,327; Ohio, 1,069; California, 1,051; Minnesota, 815; Pennsylvania, 721; Michigan, 690; Massachusetts, 558; Illinois, 542; Connecticut, 509; District of Columbia, 354; and Wisconsin, 350.

Earnings and Working Conditions

Earnings of production workers in the printing and publishing industry, including unskilled and semiskilled workers and printing craftsmen, are among the highest in manufacturing industries. In January 1961, production workers in this industry averaged $106.22 a week or $2.81 an hour, compared with $90.25 a week or $2.32 an hour for production workers in all manufacturing in the same month.

The amount an individual printing craftsman can expect to earn varies from one occupation to another. Generally, the wage rates in large cities are higher than in small communities. Wage rates also differ by type of printing establishment. The following tabulation shows the average union minimum hourly wage rates for daywork for selected printing occupations in 53 large cities on July 1, 1960. These rates are the minimum basic rates for the individual occupational classifications. They do not include overtime, other special payments, or bonuses.

<table>
<thead>
<tr>
<th>Earnings and Working Conditions</th>
<th>Average minimum hourly rate, July 1, 1960</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Newspaper</td>
</tr>
<tr>
<td>Bookbinders</td>
<td>$3.18</td>
</tr>
<tr>
<td>Compositors, hand</td>
<td>$3.40</td>
</tr>
<tr>
<td>Electrotypers</td>
<td>3.37</td>
</tr>
<tr>
<td>Photoengravers</td>
<td>3.73</td>
</tr>
<tr>
<td>Pressmen (journeymen)</td>
<td>3.73</td>
</tr>
<tr>
<td>Pressmen (cylinder)</td>
<td>3.37</td>
</tr>
<tr>
<td>Pressmen (platen)</td>
<td>3.34</td>
</tr>
<tr>
<td>Stereotypers</td>
<td>3.37</td>
</tr>
</tbody>
</table>

A standard workweek of 37½ hours was specified in labor-management contracts covering almost half of the organized printing trades workers, although standard workweeks of 36½ hours are also common. A 40-hour workweek was standard in other establishments in the industry. Time and a half is generally paid for overtime, and work on Sundays and holidays is customarily paid for at time and a half or doubletime rates in most printing establishments. In newspaper plants, however, the craftsmen's workweek often includes Sundays and time and a half or doubletime is paid for these days only when they are not part of the employee's regular shift. Nightshift workers generally receive pay differentials above the standard day rates.

The starting wage rates of apprentices are generally from 40 to 50 percent of the basic rate for journeymen in the shop. Wages are increased periodically, usually every 6 months, until, in the final year or half year of training, the apprentice receives from 80 to 95 percent of the journeyman rate. Apprentices with prior experience, civilian or military, or in exceptional cases, technical school training, can obtain credit which will start them above the beginning apprentice pay rate and also reduce the length of time required to become a journey-
man. Apprentices may be upgraded when they show exceptional progress.

The annual earnings of printing craftsmen depend not only on their hourly rate of pay, but also on how regularly they are employed. The printing industry has fewer seasonal fluctuations than most other manufacturing industries and this is one of the reasons why it offers steadier employment and higher average annual earnings.

Paid vacations are typical in the industry. The most common provision is 2 weeks' vacation with pay after 1 year's employment. Many labor-management agreements, however, provide for 3 weeks' vacation with pay after 1 or more years of employment. Other major benefits, such as paid holidays, retirement pay, life and disability insurance, hospitalization, and severance pay are also common. In addition, a number of printing trade unions have for many years operated their own programs providing their members with one or more types of benefits, such as life insurance, retirement, sickness, or disability payments.

The injury-frequency rate in the printing industry is comparable to the average for manufacturing industries. In 1960, the injury-frequency rate was 11.2 disabling work injuries per million man-hours worked in printing and publishing, compared with the average of 11.3 for all manufacturing industries.

A large proportion of the skilled workers in the industry are members of unions affiliated with the AFL-CIO. The two largest unions are the International Typographical Union and the International Printing Pressmen and Assistants' Union of North America. Other printing craft unions include the International Photo Engravers' Union of North America, International Stereotypers’ and Electrotypers’ Union of North America, and International Brotherhood of Bookbinders. Their names indicate the crafts included in their membership. The majority of lithographic workers are in plants under contract with the Amalgamated Lithographers of America, an unaffiliated union which organizes on a plantwide basis and, therefore, includes both skilled craftsmen and other lithographic workers.

Where To Go for More Information

Information on opportunities for apprenticeship or other types of printing employment in a particular locality may be obtained from various sources. Applicants may apply directly to the printing establishments in their areas. The names and locations of local printers can usually be obtained from the classified section of the local telephone directory. In addition, the local unions and employer associations in the printing industry can often provide information regarding apprenticeship openings. In union shops, many apprenticeship programs are supervised by joint union-management committees. In these plants, applicants may apply directly to the coordinator of the joint apprenticeship committee. In recent years, there has been an increasing use of local offices of the State employment services as contact points for apprenticeship openings. Some of these offices provide such services as screening applicants and giving aptitude tests. However, the final selection is made by the employer, the joint apprenticeship committee, or the union.

For general information on the printing industry, applicants may write to the following organizations. (See sections on individual printing occupations for names of labor organizations and trade associations which can provide more information on specific printing trades.)

American Newspaper Publishers Association,
750 Third Ave., New York 17, N.Y.

Book Manufacturers' Institute, Inc.,
25 West 43d St., New York 36, N.Y.

Education Council of the Graphic Arts Industry, Inc.,
1411 K St. NW., Washington 5, D.C.

Lithographers and Printers National Association, Inc.,
1025 Connecticut Ave. NW., Washington 6, D.C.

Printing Industry of America, Inc.,
5728 Connecticut Ave. NW., Washington 15, D.C.

Screen Process Printing Association,
549 West Randolph St., Chicago 6, Ill.
Composing Room Occupations

The printing process begins in the composing room where the manuscript copy is set in type, chiefly by typesetting machines, but also by hand. Machine- and hand-set type, photoengravings, and other materials necessary to complete printing jobs are assembled there and prepared for the pressroom.

In 1960, more than 180,000 skilled workers (more than half of all printing craftsmen) were employed in composing room occupations. These occupations offer good opportunities for young men willing to spend several years in learning a skilled craft. Workers in these occupations usually have year-round employment and better-than-average earnings. The two principal composing room occupations are those of hand compositor and typesetting machine operator. A skilled worker in a closely related occupation is the proofreader (D.O.T. 1–10.07) who compares a trial printing or "proof" with the original copy from which the type was set and marks necessary corrections on this proof to guide the compositor in making changes.

Skilled composing room workers are employed in newspaper plants, commercial printing shops, in periodical and book printing establishments, and in typographical composition shops which specialize in typesetting. They work in almost every community throughout the country, but employment is concentrated in larger commercial and industrial cities, such as New York, Chicago, Philadelphia, Los Angeles, Boston, Washington, D.C., San Francisco, Detroit, St. Louis, Baltimore, and Cleveland.

Nature of Work

Hand compositors (typesetters) (D.O.T. 4–44.010) make up the oldest composing room occupation. An important function of workers in this occupation is to set type by hand for fine printing—for advertisements, for the title pages of books and, in some cases, the text of the book. This type of work requires highly skilled craftsmen with artistic ability because the type must be arranged and spaced to produce a well balanced and pleasing effect. Hand compositors also set type for small jobs when setting type by machine is impractical.

In setting type by hand, the hand compositor, reading from the manuscript copy, first sets each line of type in a "composing stick" (a device which holds type in place) letter by letter and line by line. When this stick is full, he slides the completed lines onto a shallow metal tray called a "galley." Then he assembles and arranges machine- and hand-set type and any needed engravings into pages. In the final step the completed pages are put into proper sequence for folding in the bindery, and locked into forms called "chases" before they are sent to the pressroom or platemaking department. After printing is completed, the hand compositor breaks down the type forms and distributes the individual pieces of type to the proper storage compartments for reuse. In large plants, and in many typographic composition shops, the compositors who specialize in page makeup are called imposers (D.O.T. 4–44.220). These craftsmen (also called lockup men, stonemen, or stonehands) place the pages in the correct order on an imposing stone or table to be locked, by wedges, into a chase. The pages must be placed in such order that, when folded, the printed pages will have the proper numerical sequence.

Typesetting machine operators are craftsmen who operate semiautomatic machines which set type much more rapidly than the hand compositors.

Linotype (or Intertype) machine operators (D.O.T. 4–44.110) reading from the copy clipped to the machine's copy board, select letters and other characters by operating a keyboard (somewhat similar to that on a typewriter) which has 90 keys. As they press the keys, the letters, in forms of metal molds called matrices, are assembled into lines of words. As they complete each line, the operators touch a lever and the machine automatically casts the line of type into a solid metal strip called a "slug." The slugs are then deposited in a galley and are later assembled into the type forms from which either the printing impressions or the plates are made. Nearly all newspaper plants and large commercial shops use these machines and operators to set type. In the smaller plants
the typesetting machine operator maintains and repairs as well as operates the typesetting machine. In the larger plants, maintenance machinists are employed to make all but minor adjustments to the machines.

Other typesetting machine operators work on Monotype machines. One machine is called the Monotype keyboard and the other is the Monotype caster.

**Monotype keyboard operators** (D.O.T. 4-44.120) operate keyboards somewhat similar to those on a typewriter, but which include about four times as many keys. The keyboard machine produces a perforated paper tape which is later fed into the casting machine. The keyboard operator must be able to handle complicated copy in his line of work, such as statistical tables.

**Monotype caster operators** (D.O.T. 6-49.310) operate the casting machines which automatically cast and assemble the type, guided by the perforations in the paper tape prepared by the keyboard machine. As the rolls of perforated tape are fed into the machines the proper matrices (molds) for casting letters are automatically selected by means of the perforations in the tape. Molten metal is forced into the matrix to form the individual characters. The Monotype caster machine, as the name suggests, casts type one letter or character at a time. This permits corrections to be made by hand without the need to reset an entire line. The principal duties of caster operators are to insert the tape, adjust and tend the machine while it is operating, and do necessary maintenance and repair work. Only one caster operator is employed to every two or three keyboard operators. Composition service shops are the largest employers of both Monotype keyboard and caster operators.

**Phototypesetting machine operators** set type on machines which may be similar in appearance, or method of operation, or both, to those which cast type in hot metal. In phototypesetting, however, a photographic process replaces the function of the hot metal, and the final product is a film positive of the type rather than a metal image. In one type of machine, as the operator presses the keys, the individual matrices or mats, which contain small film negatives, are assembled and photographed as a line of type on film. In other types of phototypesetting machines, a perforated paper tape, or a magnetic sound tape, is produced as the operator presses the keys. These tapes are fed into a composing machine which "reads" the tapes and photographs the individual characters indicated on the tape.

In addition to machine operation, the phototypesetter must be familiar with the fundamentals of photography, including darkroom procedures, because he has to develop the film on which the type has been photographed. He also arranges and pastes the developed film on layout sheets. This process, called "stripping," corresponds to page makeup in the hot metal type process. The operator also makes minor repairs on the phototypesetting machine. Since much of this equipment has electronic controls, the operator needs a basic working knowledge of the principles of electronics to make the repairs.

Typesetters also operate photolettering machines which produce lines or individual characters in large-size type such as that used for newspaper headlines and for advertisements. As in phototypesetting, a photographic process is involved, and the final product is a film positive.
Training and Other Qualifications

Apprenticeship is the principal way to become a compositor, especially in unionized shops. Many compositors, however, acquire their skills while working as helpers for several years (particularly in small shops and in the smaller communities) or through a combination of trade school and helper experience.

Generally, such an apprenticeship covers a 6-year period of progressively advanced training, supplemented by classroom instruction or correspondence courses. However, this period may be shortened by as much as 2 to 2½ years for apprentices who have had previous experience or schooling or who show the ability to learn the trade more rapidly. The time and emphasis spent upon any particular phase of training varies from plant to plant, depending upon the type of printing establishment.

A typical apprenticeship program for compositors includes instruction in elementary hand composition, page makeup, lockup, and lineup, and proofreading. After basic training as a hand compositor, the apprentice receives intensive training in one or more specialized fields, such as the operation of typesetting machines, including phototypesetting and teletypesetting machines, as well as specialized work in hand composition and photocomposition.

Apprenticeship applicants generally must be high school graduates and in good physical condition. They are sometimes given aptitude tests. Important qualifications include training in English and mathematics. Imagination and artistic ability are assets for a compositor in layout work. Printing and typing courses in vocational or high schools are good preparation for apprentices, and a general interest in electronics and photography is also helpful.

Apprentices are paid according to a predetermined wage scale, which increases as the apprenticeship period advances. At the beginning of 1960, there were 5,400 registered apprentices in training for skilled composing room jobs.

Employment Outlook

There will be many opportunities for young men to enter the skilled composing room occupations during the 1960's. Because composing room jobs make up a very large occupational field, there will be 3,000 to 4,000 job opportunities for new workers each year just to replace those skilled workers who retire or die.

The anticipated expansion in the volume of printing in the United States during the next decade is expected to result in only a small rise in employment for this group. This was also true in the 1940's and 1950's when employment in the composing room crafts increased much more slowly than the volume of printing produced and the growth of total employment in the printing industry.

Changing technology will significantly affect the skills required of many typesetting machine operators and will tend to limit their employment growth. Since much of the new printing equipment being introduced in composing rooms is controlled and operated by electronic systems, a knowledge of the application of electronic principles to the operation of this equipment is becoming necessary. Also, the greater use of phototypesetting, by which images of lines of type are composed on phototypesetting machines, requires typesetters to learn photographic skills. A technological development which may affect typesetters' employment opportunities is a tape operated line casting machine that permits automatic typesetting by remote control. A tape is punched (perforated) on a special keyboard which may be located in another room or another city. After the tape is punched it may be sent by wire to various locations where it is repunched and used to operate typesetting machines automatically. Even though the volume of printing is expected to increase in the 1960's, these developments, if widely adopted, could reduce the number of new job openings for typesetting machine operators. The apprenticeship programs for composing room craftsmen include instruction in the operation of these new machines and related processes, and thus these skills are becoming part of the present crafts.

Earnings and Working Conditions

As is true for most printing crafts, wages of skilled composing room workers are relatively...
high compared with skilled workers generally. However, there is considerable variation in wage rates from place to place and from firm to firm. The average union minimum hourly wage rate for hand compositors on day shift in 53 large cities was $3.37 in newspaper plants and $3.40 in book and job shops on July 1, 1960. Union minimum wage rates for hand compositors in book and job shops ranged from $2.69 an hour in Springfield, Mass., to $3.91 in San Francisco. In newspaper establishments, the union minimum wage rates for day shift hand compositors ranged from $2.61 an hour in Springfield, Mass., to $3.66 in Minneapolis.

Working conditions for compositors vary from plant to plant. Some heat and noise are made by hot metal typesetting machines. In general, the newer plants are well lighted and clean, and many are air-conditioned. Composing room jobs require about average physical strength. Hand compositors are required to stand for long periods of time, and to do some lifting. Young men with some types of physical handicaps, such as deafness, have been able to enter the trade and do the work satisfactorily. Many compositors work at night on the second or third shift for which they generally receive additional pay.

A substantial proportion of compositors are members of the International Typographical Union.

Where To Go for More Information

- International Typographical Union, 2820 North Meridian St., Indianapolis 6, Ind.
- Printing Industry of America, Inc., 5728 Connecticut Ave. NW., Washington 15, D.C.

See page 397 for additional sources of information.

Photoengravers

(D.O.T. 4-47.100 through .300)

Nature of Work

Photoengravers make metal printing plates of illustrations and other copy that cannot be set up in type. On these plates the printing surfaces stand out in relief above the nonprinting spaces, as do the letters and the accompanying type. Similarly, gravure photoengravers, a specialized type of photoengraver, make gravure plates in which the image is etched below the surface for use in reproducing pictures and type.

In making a photoengraving plate for the letterpress process, the entire job may be done either by one man or by a number of skilled workers, each specializing in a particular operation. These specialized workers are cameramen, printers, etchers, finishers, routers, blockers, and provers. In the large shops, the work is almost always divided among a number of these specialists.

A cameraman starts the process of making a photoengraving plate by photographing the material to be reproduced through a cross-lined screen, which breaks down the copy into thousands of tiny dots. Plates made from line drawings are called line plates and those from photographs are called half-tone plates. After the cameraman develops the negative, the printer prints the image on a metal plate by coating the plate with a solution sensitive to light and then exposing it and the negative to arc lights. The image areas are protected by chemical means so that when the plate is placed in an acid bath by the etcher, only the nonimage areas are etched away, leaving the image areas standing out in relief.

A number of other photoengraving operations are then performed. The finisher carefully inspects and touches up the plate with handtools; the router cuts away metal from the nonprinting part of the plate to prevent it from touching the inking rollers during printing; the blocker mounts the engraving on a suitable base to make it reach the right height; and the prover prints a sample copy on a proof press.
Photoengraver cutting away (routing) metal from nonprinting areas of a plate.

The operations involved in gravure photoengraving are much like those in letterpress photoengraving except that a positive instead of a negative is used in making the plate, and the image areas, rather than the background, are etched away.

Where Employed

More than 17,000 journeymen photoengravers were employed in 1960. The great majority of photoengravers (about 12,000) are employed in commercial service shops where the main business is making photoengravings for use by others. Newspaper and rotogravure shops employ several thousand photoengravers. In addition, book and periodical shops and the U.S. Government Printing Office also employ photoengravers. Many craftsmen have their own shops. Photoengravers’ jobs are highly concentrated in the largest printing centers, particularly New York, Chicago, Philadelphia, and Los Angeles.

Gravure photoengravers work mainly in independent gravure plants. Most of them work for the small number of big firms which handle a large proportion of all gravure work. A few large newspaper and commercial plants also have departments where this work is done. Gravure plants are concentrated in a few States, particularly New York, New Jersey, Illinois, and Ohio.

Training and Other Qualifications

Apprenticeship is the accepted way to become a photoengraver. The apprenticeship program generally covers a 5- or 6-year period and includes at least 800 hours of related classroom instruction. Besides the care and use of tools, the apprentice is taught to cut and square negatives, make combination plates, inspect negatives for defects, mix chemicals, sensitize metal, and to operate machines used in the photoengraving process.

Apprenticeship applicants must be at least 18 years of age and generally must have a high school education or its equivalent, preferably with courses in chemistry and physics and training in art. Credit for previous experience acquired in photoengraving work may shorten the required apprenticeship time. Many employers require a physical examination for prospective photoengravers; the condition of the applicant’s eyes is particularly important because a photoengraver’s duties involve constant close work and color discrimination.

Employment Outlook

The anticipated continued expansion in printing output, the greater use of photographs and other illustrations, and the increasing use of color are expected to result in only a small increase in the number of photoengravers during the 1960’s. Technological changes, such as wider use of phototypesetting and more rapid etching techniques, may result in more work for photoengravers, but the introduction of photographically and electrically made plates may limit the growth of employment of these workers. On the average, employment growth and replacement needs together probably will result in 500 to 800 openings for new workers each year during the 1960’s.
Earnings and Working Conditions

Photoengravers are among the highest paid printing craftsmen. The union minimum hourly wage rate for photoengravers, including gravure, in book and job shops, in 53 large cities ranged from $2.98 in New Orleans to $4.50 in Chicago on July 1, 1960.

The great majority of photoengravers are union members. Nearly all photoengravers are represented by the International Photo Engravers' Union of North America.

Where To Go for More Information

American Photoengravers Association, 166 West Van Buren St., Chicago 4, Ill.
International Photo Engravers' Union of North America, 3605 Potomac St., St. Louis 16, Mo.
Printing Industry of America, Inc., 5728 Connecticut Ave. NW., Washington 15, D.C.

See page 397 for additional sources of information.

Electrotypers and Stereotypers

Nature of Work

Electrotypers (D.O.T. 4-45.010) and stereotypers (D.O.T. 4-45.210) make duplicate press plates of metal, rubber, and plastic for letterpress printing. These plates are made from the metal type forms prepared in the composing room. Electrotypers are used mainly in book and magazine work. Stereotypes, which are less durable, are used chiefly in newspaper work. Electrotyping and stereotyping are necessary because most volume printing requires the use of duplicate printing plates. When a large edition of a book or magazine is printed, several plates must be used to replace those which become too worn to make clear impressions. Also, by means of duplicate plates, printers can use several presses at the same time, and thus finish a big run quickly. This is especially important in publishing daily newspapers. Furthermore, the rotary presses used in many big plants require curved plates which can be made by either electrotyping or stereotyping processes from the flat type forms.

Several steps are required to produce a fine metal plate ready for use in the pressroom. In electrotyping, the first step is making a wax or plastic mold of the type form, coating it with special chemical solutions, and then suspending it in an electrolytic solution containing metal. This leaves a metallic shell on the coated mold, which is then stripped from the mold, backed with metal or plastic, and carefully finished.

The stereotyping process is much simpler, quicker, and less expensive than electrotyping, but it does not yield as durable or as fine a plate. Stereotypers make molds or mats of papier mache (a strong material composed of paper pulp) instead of wax or plastic. This involves placing the moist mat (in newspaper printing, usually a dry mat) on the type form, and covering it with a cork blanket and sheet of fiberboard. The covered form is then run under heavy power-driven steel rollers to im-
press the type and photoengraving on the mat. After the paper mold has been dried, it is placed in a stereotype casting machine which casts a composition lead plate on the mold. In the larger plants, stereotype plates are usually cast automatically in a machine known as an autotype.

In many of the larger plants, electrotypers and stereotypers perform only one phase of the work, such as casting, molding, finishing, or blocking. However, journeymen must know how to handle all the tasks involved in their respective trades.

Many electrotypers work in large plants which print books and periodicals. Stereotypers generally work in newspaper plants, but some are employed in large commercial printing plants. Electrotypers and stereotypers are also employed in independent service shops which do this work for printing firms.

Training and Other Qualifications

Nearly all electrotypers and stereotypers learn their trades through apprenticeship. Electrotyping and stereotyping are separate crafts, and there is little transferability between the two. The apprenticeship program in each trade covers all phases of the work and almost always includes classes in related technical subjects as well as training on the job. Apprenticeship training for electrotypers and stereotypers usually covers a 5- or 6-year period of reasonably continuous employment.

Apprenticeship applicants must be at least 18 years of age and, in most instances, must have a high school education or its equivalent. If possible, this education should include mechanical training and courses in chemistry. Physical examinations and aptitude tests are often given to prospective apprentices. The emphasis placed upon different phases of training varies from plant to plant, however, depending upon the type of printing establishment.

Apprenticeship training for stereotypers includes matrix molding, flat casting, color register, curved routing, and the use of casting machines. Because electrotypers specialize in one or more of the various aspects of the trade, the apprenticeship programs generally tend to provide specialized training for such specific jobs as molding and finishing.

Employment Outlook

Employment of electrotypers and stereotypers is not expected to increase during the 1960's. Although the anticipated growth in the total volume of printing should result in an increasing demand for platemaking, employment in these crafts probably will remain about the same because of technological changes. For example, the increasing use of automatic plate composition eliminates many steps in platemaking, and plastic and rubber plates are being increasingly made outside electrotyping and stereotyping shops.

Earnings and Working Conditions

On July 1, 1960, the union minimum hourly wage rate for electrotypers and stereotypers in 53 large cities averaged $3.47 or more an hour. Union minimum hourly wage rates for electrotypers in book and job plants ranged from $3.01 an hour in Baltimore to $4.05 an hour in Seattle. In newspaper plants, rates for day shift stereotypers ranged from $2.76 an hour in Springfield, Mass., to $3.81 an hour in Chicago.

Much of the work requires little physical effort since the preparation of duplicate printing plates is highly mechanized. However, there is some lifting of relatively heavy, hot press plates.

Nearly all electrotypers and stereotypers are members of the International Stereotypers' and Electrotypers' Union of North America.

Where To Go for More Information

International Stereotypers' and Electrotypers' Union of North America,
752 Old South Building, Boston 8, Mass.
International Association of Electrotypers and Stereotypers, Inc.,
758 Leader Building, Cleveland 14, Ohio.
Lithographers and Printers National Association, Inc.,
1025 Connecticut Ave. NW., Washington 6, D.C.
Printing Industry of America, Inc.,
5728 Connecticut Ave. NW., Washington 15, D.C.

See page 397 for additional sources of information.
Printing Pressmen and Assistants

(D.O.T. 4-48.010, .020, .030, and .060; 6-49.410, .420, and .430)

Nature of Work

The actual printing operation is performed in the pressroom. After the type forms come from the composing room, the press plates from the electrotyping and stereotyping department, or the gravure or lithographic plates have been brought to the pressroom, they are made ready for final printing by the printing pressmen. The pressmen's basic duties are to "make-ready" and then tend the presses while they are in operation.

The object of makeready, which is one of the most delicate and difficult parts of the pressman's work, is to insure printing impressions that are distinct and uniform. This is accomplished by such means as placing pieces of paper of exactly the right thickness underneath low areas of the press plates to level them, and by attaching pieces of tissue paper to the surface of the cylinder or flat platen which makes the impression. Pressmen also have to make many other adjustments—for example, those needed to control margins and the flow of ink to the inking roller. In some shops, they are responsible not only for tending the presses, but also for oiling and cleaning them and making some minor repairs. On the larger presses, pressmen have assistants and helpers.

Pressmen's work may differ greatly from one shop to another, mainly because of differences in the kinds and sizes of presses used. Small commercial shops generally have small and relatively simple presses that are often fed paper by hand. At the other extreme are the enormous web-rotary presses used by the big newspaper and magazine printing plants. These giant presses are fed paper in big rolls called "webs." They print the paper on both sides by means of a series of cylinders; cut, assemble, and fold the pages; and, finally, count the finished newspaper sections which emerge from the press ready for the mailing room. These steps are accomplished automatically by means of many different mechanisms, each of which calls for constant attention while a run is being made. Presses of this kind are operated by crews of journeymen and less skilled workers under the direction of a pressman-in-charge.

Although the basic duties of lithographic (offset) pressmen are similar to those of letterpress and gravure pressmen, a number of differences arise, principally because of the specialized character of lithographic presses. (See p. 407 for further details.)

The duties of press assistants range from feeding sheets of paper into hand-fed presses to helping pressmen makeready and operate large and complicated rotary presses. Workers whose main responsibility is feeding are often called press feeders. The ratio of assistants to pressmen differs from one establishment to another, depending on the size of the plant, the type of press used, and other factors. Many shops are too small to have pressroom assistants.

Training and Other Qualifications

As in the other printing crafts, the most common way of learning the pressman's trade is through apprenticeship. Some workers have

Chief pressman controlling operation of large press from console.
been able to pick up the skills of the trade while working as helpers or press assistants or through a combination of work experience in the pressroom and vocational or technical school training.

The length of apprenticeship and the content of training depend largely on the kind of press used in the plant. The apprenticeship period is 2 years for press assistants and 4 years for pressmen in commercial shops. In newspaper establishments the apprenticeship period is 5 years. The apprenticeship period for pressmen operating web presses is generally 5 years in union shops. On-the-job training includes the care of pressroom equipment, makeready, running the job, press tending and maintenance, and working with various types of inks and papers. In addition to on-the-job instruction, the apprenticeship involves related classroom or correspondence schoolwork. At the beginning of 1960, there were about 3,200 registered apprentices in training and perhaps 2,000 others in unregistered programs.

Individual companies generally choose apprentices from among press assistants and others already employed in the plant. Young men may often work for 2 or 3 years in the pressroom before they are selected to begin 2- to 4-year training periods leading to journeyman status. A high school education or its equivalent is generally required. Mechanical aptitude is important in making press adjustments and repairs. Art courses may also be helpful because the increased use of color presses and the need for pressmen who are able to mix their own inks have made a knowledge of color important. Physical strength and endurance are necessary for work on some kinds of presses, where the pressmen have to lift heavy type forms and press plates and stand for long periods.

**Employment Outlook**

Employment of pressmen is expected to increase moderately in the 1960's. Although the total amount of printing, and the use of color is expected to rise, continued improvements in the speed and efficiency of printing presses may slow somewhat the rate of employment growth in this skilled craft.

The need to replace workers who retire, die, or transfer to other fields of work will also result in job opportunities for new workers. Retirements and deaths alone may result in about 1,000 job openings each year in the 1960's.

**Earnings and Working Conditions**

The earnings of pressmen depend upon the kind of press operated, the type of printing plant, and the geographical area of employment. A survey of union minimum hourly wage rates for daywork in 53 large cities shows that the average minimum hourly rate in effect on July 1, 1960, for newspaper pressmen-in-charge was $3.67; for newspaper pressmen (journeymen), $3.37; for book and job cylinder pressmen, $3.33; for book and job platen pressmen, $3.02; and for book and job press assistants and feeders, $2.75.

Pressrooms are unavoidably noisy; also, there are the usual occupational hazards associated with machinery. Pressmen often have to lift heavy type forms and printing press plates. At times, they work under pressure to meet deadlines, especially in the printing of newspapers and magazines. Many pressmen work night shifts for which the rate of pay is higher than the basic day rate.

A majority of pressroom workers are covered by union agreements. Practically all of the organized letterpress and gravure pressmen are members of the International Printing Pressmen and Assistants' Union of North America.

**Where To Go for More Information**

International Printing Pressmen and Assistants' Union of North America, Pressmen's Home, Tenn.

Lithographers and Printers National Association, Inc.,
1025 Connecticut Ave. NW., Washington 6, D.C.

Printing Industry of America, Inc.,
5728 Connecticut Ave. NW., Washington 15, D.C.

See page 397 for additional sources of information.
Lithographic Occupations

Nature of Work

Lithography (offset printing) is one of the most rapidly growing printing processes, although it is less common than letterpress. Practically all items printed by the letterpress process are also produced by lithography—including books, calendars, maps, posters, labels, office forms, sheet music, and even newspapers. Lithography has special advantages when the copy to be reproduced includes photographs, drawings, or paintings, since it permits greater flexibility in the type of paper that can be used.

Several processes are involved in lithography, and each is performed by a specialized group of workers. The main groups of lithographic workers are cameramen, artists and letterers, strippers, platemakers, and pressmen.

The cameraman (D.O.T. 4-46.200) starts the process of making a lithographic plate by photographing the copy. He is generally classified as a line cameraman (black and white) half-tone cameraman (black and white), or color separation photographer.

After the negatives have been made, they frequently need retouching to lighten or darken certain parts. Thus, it is often necessary for a lithographic artist (D.O.T. 4-46.700) to make corrections by sharpening or reshaping images on the negatives. Highly skilled workers perform this work by hand, using chemicals, dyes, and special tools.

To qualify as journeymen, these artists must be adept in one or more of the various retouching methods or in hand drawing with lithographic crayon. Like cameramen, they are customarily assigned to only one phase of the work and may then be known, for example, as dot etchers, retouchers, crayon artists, or letterers, depending on their particular job.

The stripper (D.O.T. 4-47.300) makes layouts on paper, glass, or film. He arranges and pastes the negatives or positives of type, pictures, and other art work on the layout sheets called flats or “strip-ups,” from which photographic impressions are made for the lithographic press plates. The job of the stripper in the lithographic process corresponds to that of the imposer in the letterpress process.

In photolithography, employees in the plate-making department expose press plates to negatives or positives which are made by the cameramen and corrected by artists. The platemaker (D.O.T. 4-46.300) may cover the surface of the metal plate with a coating of photosensitive chemicals, or the metal plate may come to him with the photosensitive layer applied. The platemaker exposes the sensitized plate through the negative or positive to strong arc lights; this is commonly done in a vacuum printing frame. When a large number of the same images are to be exposed on a single plate, however, the operation is done in a photocomposing machine. The plate is then developed and chemically treated to bring out the image.

The lithographic pressman (D.O.T. 4-48.070) makes ready and tends the lithographic printing presses. He installs the plate on the press, adjusts the pressure for proper printing, cares for and adjusts the rubber blanket which transfers the impression from the plate to the paper, adjusts water and ink rollers for correct operation,
mixes inks, and operates the presses. Basically, the duties of these workers are similar to those of letterpress and gravure pressmen. Some differences arise, however, because of the specialized nature of lithographic presses. In large plants, press feeders and helpers are employed whose duties are also similar to those of assistants and helpers to letterpress and gravure pressmen. (See p. 405.)

Training and Other Qualifications

A 4- or 5-year apprenticeship covering the basic lithographic process is usually required to become an all-round lithographic craftsman. Training emphasis is on the specific occupation in which journeyman status is being sought, although generally, an attempt is made to make the apprentice familiar with all lithographic operations.

Generally, apprenticeship applicants must be in good physical condition, a high school graduate, and at least 18 years of age. Aptitude tests are sometimes given to prospective apprentices. Vocational school training and training in photography or art are helpful in learning these crafts.

Employment Outlook

A rapid rise in the number of lithographic workers is expected during the 1960's. In addition, the need to replace workers who retire, die, or transfer to other fields of work will also provide some job openings. Employment growth and replacement needs together are expected to provide about 1,500 to 2,000 job opportunities for new workers, on the average, each year during the 1960's.

Offset printing has expanded considerably since World War II, particularly in the commercial printing field where a large number of letterpress concerns have established offset departments. In 1960, an estimated 50,000 journeymen lithographic workers were employed. Offset printing employment should show continued rapid growth because of the greater use of photographs, drawings, and illustrations in printed matter, and because of the more widespread use of color in many printed products.

However, new technological developments in the competitive letterpress field, particularly in the platemaking and press departments, may slow somewhat the anticipated increase in lithographic employment.

Earnings and Working Conditions

Union minimum hourly wage rates for lithographic occupations vary within each occupation, depending upon the degree of skill required, the type and size of equipment, and the part of the country in which the worker is employed. For example, according to information on minimum union hourly wage rates in 46 selected cities, during 1960, compiled by the National Association of Photo Lithographers, wage rates for dot etchers or process artists and letterers ranged from $2.74 an hour in Little Rock to $4.20 an hour in San Francisco. Rates for cameramen, which are generally below those for skilled artists, ranged from $2.74 an hour in Little Rock to $4.14 an hour in San Francisco. In many plants, top-grade cameramen earn as much as the highly skilled artists, and cameramen who do multicolor work are paid more than those who do only black and white work. Minimum hourly rates of photocomposition operators ranged from $2.99 an hour in Evansville, Ind., to $4.06 an hour in San Francisco, and vacuum frame platemakers' hourly rates ranged from $2.74 an hour in Little Rock to $4.06 an hour in San Francisco. The wide range of rates for lithographic pressmen—from $1.95 an hour for Multilith machine operators and operators of small presses in Little Rock to $5.15 an hour for first pressmen on large four-color presses in Boston—is due to the many different types and sizes of presses operated.

Many lithographic plants are modern, air-conditioned, and well lighted. Much of the work requires little physical effort since it involves the handling of lightweight materials.

A substantial proportion of all lithographic workers are members of the Amalgamated Lithographers of America (Ind.). A considerable number of offset pressmen and other offset workers belong to the International Printing Pressmen and Assistants' Union of North America.
Where To Go for More Information

Amalgamated Lithographers of America (Ind.),
233 West 49th St., New York 19, N.Y.

International Printing Pressmen and Assistants’
Union of North America,
Pressmen’s Home, Tenn.

Lithographers and Printers Nation’s Association,
1025 Connecticut Ave. NW., Washington 6, D.C.

Lithographic Technical Foundation, Inc.,
131 East 39th St., New York 16, N.Y.

National Association of Photo-Lithographers,
317 West 45th St., New York 36, N.Y.

Printing Industry of America, Inc.,
5728 Connecticut Ave. NW., Washington 15, D.C.

See page 397 for additional sources of information.

Bookbinders and Related Workers

Nature of Work

Many printed items such as books, magazines, pamphlets, and small calendars must be folded, sewed, stapled, or bound after they leave the printing shops. Much of this work is done by skilled bookbinders (D.O.T. 4-49.010 through .040) who numbered about 23,000 in 1960. Many bookbinders are employed in shops whose chief business is bookbinding. However, a considerable number are employed in the bindery departments of large book, periodical, and commercial printing plants and of large libraries.

There are several different kinds of binderies. Edition and pamphlet binderies bind books, magazines, and pamphlets printed in large quantities. Trade or job binderies do bindery work on contract for printers, publishers, or other customers. Blankbook and looseleaf binderies bind ledgers and bookkeeping and accounting volumes.

Edition binding—making books in quantity from big, flat printed sheets of paper—is by far the most complicated. The first step in the process is to fold the printed sheets into sections of 16 or 32 pages, known as “signatures,” so that the sheets will be in the right order. The next steps are to insert any illustrations that have been printed separately, to gather and assemble the signatures in proper order, and to sew them together. The resulting book bodies are shaped with power presses and trimming machines, and fabric strips are glued to the backs for reinforcement. Covers are glued or pasted onto the book bodies, after which the books undergo a variety of finishing operations and, frequently, are wrapped in paper jackets. Machines are used extensively throughout the process.

Skilled bookbinders seldom perform all the different edition bindery tasks, although many journeymen have had training in all of them. In large shops, skilled bookbinders may be assigned to one or a few operations, most often to the operation of complicated machines.

In many binderies, especially large ones, much of the work is done by employees trained in only one operation or in a small number of relatively simple, related tasks. Most of these workers, often classified as bindery workers or bindery hands, are women (hence the common designation, bindery women). Their work...
closely resembles assembly line factory work. About 45,000 women and men were employed in these operations in 1960.

Training and Other Qualifications

A 4- or 5-year apprenticeship which includes on-the-job training as well as related classroom instruction is generally required to qualify as a skilled bookbinder. Apprenticeship programs may vary considerably among the various types of bookbinding shops. When large quantities of books are bound on a mass production (edition) basis, emphasis is on the most modern machine methods. In fine hand binding, emphasis is mainly on hand methods, including artistic designing and decorating of leather covers. For many years, hand bookbinding has been declining in importance.

Apprenticeship applicants usually must have a high school education and be at least 18 years of age. Mechanical aptitude is helpful to the person entering this trade. In the course of the apprenticeship, trainees learn, among other things, to assemble signatures, renovate old, worn bindings, and use various binding machines such as punches, folders, perforators, stitches, and power cutters.

For the less skilled bindery occupations, the training period may last from several months to 2 years. In union shops, apprenticeship programs for women bindery workers generally last 2 years. These formal programs include classroom instruction as well as on-the-job training.

Employment Outlook

Some increase in the employment of skilled bookbinders is expected during the 1960’s. In addition, replacement of skilled workers who retire, die, or leave the industry for other employment will result in several hundred opportunities each year for new workers to learn this trade. There will be considerably more openings for the less skilled bindery workers.

The anticipated expansion of bound printed matter is expected to result in some employment growth for skilled bookbinders. Continued mechanization of bookbinding operations and the declining demand for fine hand bookbinding will tend to limit the growth of this trade. On the other hand, these same trends should result in increased employment for the less skilled bindery workers, most of whom are women. Because there is considerable turnover among these employees, there will be a relatively large number of openings for women workers. Seasonal fluctuations in employment are more common in bindery work than in other printing occupations.

Earnings and Working Conditions

Wage rates for skilled bookbinders tend to be below the average of other printing crafts. A survey of union minimum hourly wage rates in 53 large cities, as of July 1, 1960, showed that the minimum hourly wage rate for bookbinders in book and job establishments was generally more than $2.60 an hour and as high as $3.87 in the San Francisco-Oakland area. The wage rates for bindery women are considerably lower and are among the lowest for printing industry workers. They ranged from $1.40 an hour in Little Rock to $2.43 in the San Francisco-Oakland area.

A majority of bindery workers are members of unions. Most skilled bookbinders are represented by the International Brotherhood of Bookbinders.

Where To Go for More Information

International Brotherhood of Bookbinders, 815 16th St. NW., Washington 6, D.C.
Printing Industry of America, Inc., 5728 Connecticut Ave. NW., Washington 15, D.C.

See page 397 for additional sources of information.
MECHANICS AND REPAIRMEN

Air-Conditioning and Refrigeration Mechanics

Nature of Work

The growing use of air-conditioning and refrigeration equipment throughout the Nation is providing many job opportunities for skilled mechanics who install and repair such equipment in office buildings, factories, homes, food stores, restaurants, theaters, and other establishments. (This chapter does not discuss mechanics who work on railroad, truck, automotive, or marine air-conditioning and refrigeration equipment.)

In installing new air-conditioning or refrigeration equipment, the mechanic puts the motors, condensers, and humidifiers in proper position, following design specifications. He assembles and connects duct work, refrigerant lines and other piping, and then connects the equipment to an electrical power source. He installs electrical controls and checks the electric power entering the motor. After completing the installation and connecting the recording and gaging devices, the mechanic starts the unit and tests it for proper performance and for leaks. He also adjusts the pumps, humidifiers, filters, and other components in order to obtain the most efficient performance.

The mechanic may install air-conditioning equipment ranging from small, self-contained units to large central-plant-type systems. On small installations, he may have to prepare his own working diagrams and do simple layout work, such as measuring and cutting pipe. On large installation jobs, the mechanic must read and interpret blueprints or drawings.

Mechanics engaged in maintenance work regularly lubricate machinery, replenish liquid refrigerant, adjust valves, and examine other parts of the equipment to detect leaks and other defects before trouble develops. When air-conditioning and refrigeration equipment breaks down, the mechanic must diagnose the cause and make the necessary repairs. In looking for defects, he may take the motor apart, removing such parts as springs and brushes. After the cause of the trouble has been located and the defective part repaired or replaced, the mechanic reassembles the unit. He also may make electrical repairs in connection with his work. The mechanic uses tools and equipment, such as electric drills, soldering torches, pipe benders, hammers, screwdrivers, pliers, and testing devices, such as leak detectors and test lights.

Where Employed

A considerable number of these mechanics are employed in shops which specialize in the repair and maintenance of commercial, industrial, and home air-conditioning and refrigeration equipment. Others work for construction
companies, air-conditioning or refrigeration equipment manufacturers, heating and air-conditioning contractors, and dealers. Some are employed by department stores, hotels, restaurant and food store chains, factories, warehouses, and other establishments large enough to require full-time maintenance men. Many mechanics have opened their own repair shops.

Because of the widespread use of air-conditioning and refrigeration equipment, these workers are employed in all parts of the country. However, they are employed mainly in the large cities where most of the large commercial and industrial establishments are located. New York, Texas, California, Pennsylvania, Ohio, and Illinois lead in the number of these workers.

Training, Other Qualifications, and Advancement

Most air-conditioning and refrigeration mechanics start as helpers and acquire the skills of their trade by working for several years with experienced craftsmen. Apprentice training is another way of learning this trade and is growing in importance as air-conditioning and refrigeration equipment becomes more complex. The apprenticeship programs, which generally last 4 or 5 years, include both on-the-job experience and classroom instruction. Apprentices are given training in the installing and connecting of refrigeration equipment, gas lines, liquid lines, air-control lines, and other kinds of piping. They are also taught to do layout and assembly work and to install and connect electrical circuits and controls. Apprentices are given classroom instruction in mathematics, electrical controls, blueprint reading, compression refrigerating systems, heat transfer and insulation, and related subjects.

Employers prefer to hire high school graduates who have had courses in mathematics, physics, and blueprint reading. Mechanical aptitude and the ability to understand and work with electricity are other important qualifications.

Young persons interested in advancing to higher level air-conditioning and refrigeration jobs as technicians or foremen are frequently advised by training authorities to attend a technical institute. (Additional information about air-conditioning and refrigeration technicians appears in the chapter on Technicians. See index for page number.) In these schools, students are taught to design and construct as well as to install, operate, maintain, and repair all types of air-conditioning and refrigeration equipment. They also take courses in mathematics, physics, electricity, and mechanical drawing.

Although great strength is not needed in this occupation, good physical condition is important because a mechanic is often required to lift and move heavy equipment.

Employment Outlook

A demand for many thousands of additional mechanics who can install, maintain, and repair air-conditioning and refrigeration equipment is expected in the 1960's. Many job openings will also arise as workers retire, die, or transfer to other fields of work.

A rapid growth in the number of jobs for mechanics is anticipated because of the continued increase in the use of air-conditioning and refrigeration equipment. Air conditioning for industrial, commercial, and home use is becoming more and more widespread. The use of air conditioning in offices, stores, and theaters is increasing tremendously. In homes, the number of centrally installed air-conditioning units doubled between 1957 and 1960. The use of refrigeration as a means of preserving food and other perishable items has grown greatly in recent years. Refrigeration also is becoming increasingly important in the manufacture of such products as synthetic rubber, oil, high-test gasoline, medicine, and drugs.

Earnings and Working Conditions

Information collected from a small number of employers in selected cities on the East Coast and in the Midwest and from union-management contracts, shows that the earnings of these workers compare favorably with those of other service mechanics. The rates of pay for skilled mechanics depend on such factors as
the size of equipment they work on, the type of work performed, and the type of establishment in which they are employed. For example, in mid-1960 in some establishments, skilled mechanics performing maintenance and repair work on small equipment were receiving from $2 to slightly more than $3.25 an hour; men working on equipment of higher horsepower were being paid about $3.75 an hour. Mechanics doing installation work generally were receiving from $3 to more than $4 an hour. Air-conditioning and refrigeration mechanics working on commercial equipment frequently earned more than those employed on household equipment, even when the equipment was of the same size. Apprentices usually start at about 50 percent of the journeyman's hourly pay rate and receive increases each year, moving up to 75 to 90 percent of the journeyman's rate during the last year of apprenticeship.

Although most employers try to maintain the same work force throughout the year, they may have to lay off some mechanics during the winter months. In air-conditioning and refrigerator contractor shops which also install and repair heating equipment, the mechanics may work on heating equipment during the winter months. Most mechanics work a 40-hour week. However, during the summer months they must often work overtime or at irregular hours when refrigeration or air-conditioning equipment breaks down. Overtime work in most shops is paid for at time and one-half the regular rate.

Mechanics are sometimes required to work at great heights while installing new equipment. They may also work in awkward or cramped positions in order to reach motors or other parts of the equipment they are repairing. Common hazards in this trade include electrical shock, torch burns, and those associated with the handling of heavy equipment.

Many air-conditioning and refrigeration mechanics belong to labor unions. Some of these unions are the United Association of Journeymen and Apprentices of the Plumbing and Pipe Fitting Industry of the United States and Canada; the International Brotherhood of Electrical Workers; the Sheet Metal Workers' International Association; and the International Union of Electrical, Radio and Machine Workers. Most employer-union contracts covering air-conditioning and refrigeration mechanics provide benefit programs such as paid holidays and vacations; hospitalization, medical and surgical insurance; and retirement pensions.

**Appliance Servicemen**

(D.O.T. 5-83.043)

**Nature of Work**

When washing machines, refrigerators, toasters, and the dozens of other appliances used in homes today do not run properly, appliance servicemen repair them. The repair of large and complicated appliances such as refrigerators and washing machines (which may have as many as 30 electrical connections in the control unit alone) is considerably more difficult than the repair of small appliances such as toasters and food mixers. However, all the work performed by appliance servicemen involves finding why appliances are not operating properly and then installing new parts or making adjustments.

To learn why an appliance is not operating properly, appliance servicemen first find out from customers what happened when it was last turned on. They often check the appliance by starting it and listening for loud humming, grinding, or other unusual noises, which might tell them what part of the appliance is not working properly. Sometimes servicemen look specifically for common signs of trouble, such as cracks in rubber hose, or they turn gears or other moving parts of appliances to see if they are jammed or too tight. Appliance servicemen find other causes of trouble by using special tools and testing devices.

After servicemen find what is wrong with appliances, they make the necessary repairs. Frequently, this involves replacing parts, such as electric cords, that receive extra hard wear.
Appliance serviceman finding leak in refrigerator cooling system.

Sometimes servicemen clean parts; for example, they remove lint that has clogged a washing machine drain. In removing old parts and putting in new parts, appliance servicemen use not only handtools, such as screwdrivers, pliers, and wrenches, but also special tools designed for particular appliances.

An important part of the work of appliance servicemen is dealing personally with customers. They often answer customers' complaints about their appliances. Appliance servicemen frequently advise customers about the care and use of their appliances, because many breakdowns are caused by improper use. For example, they may remind housewives how many pounds of clothing can be washed at one time in automatic washing machines, or how to stack dishes in dishwashers.

The work of appliance servicemen has considerable variety. They drive light trucks or automobiles, some of which are equipped with two-way radios. They give estimates to customers on the costs of repair jobs and keep records of parts used and hours worked on each repair job. Also, they sometimes order parts and sell new or used appliances.

Where Employed

Approximately 150,000 appliance servicemen were employed in 1960. They worked in almost every city and town because the appliances they repair are used everywhere. About 105,000 servicemen were employed by appliance, furniture, and department stores, and by other firms that sell and service appliances. Independent repair shops, many of which were owned and operated by servicemen, employed about 25,000 of these workers. Another 15,000 servicemen were employed by gas and electric companies. A few thousand worked for the manufacturers of appliances who operate service centers in most large cities. Some appliance servicemen are employed by companies that install and maintain coin-operated washing machines in apartment houses and self-service laundries.

Training, Other Qualifications, and Advancement

Appliance servicemen are usually hired as helpers and acquire their skills through on-the-job training and work experience. Inexperienced men are given relatively simple work assignments. In some companies, they work for the first few months mainly helping to install appliances in customers' homes, driving service trucks, and learning street locations. In other companies, they begin to learn the skills of appliance servicemen by working in the shop, where they rebuild used parts such as washing machine transmissions. Gradually, trainees learn how motors, gears, and other appliance parts operate. They progress from simple repair jobs, such as replacing a switch, to more difficult jobs, such as adjusting automatic washing machine controls. In addition to practical experience on the job, trainees frequently receive classroom instruction given by appliance manufacturers and local distributors. Many trainees take correspondence courses in basic electricity to increase their skills in appliance repair.

Trainees are usually supervised closely for 6 to 12 months. By this time, most of them can repair several kinds of appliances on their own, and they may be given responsibility for their own service trucks and for expensive stocks of appliance parts and tools. Appliance servicemen usually need up to 3 years' on-the-job experience.
to become fully qualified. Many experienced servicemen attend training classes (often on company time) and study service manuals to become familiar with new appliances and the best ways to repair them.

Employers generally prefer applicants who are high school graduates and who have had high school or vocational school courses in electricity or in physics. They must understand, in a practical way, how to use equipment that measures electricity and be able to use such measurements in solving equations or formulas that tell whether electrical currents in appliances are flowing properly. Also important in servicing appliances is a knowledge of wiring diagrams which show electrical connections between appliance parts.

Employers also look for men who can get along well with customers. Employers emphasize that mechanical skills are only part of the qualifications for servicemen's work. Servicemen must be tactful and courteous. Sometimes this is difficult, for example, when explaining to a customer the right way to operate an appliance that has been used incorrectly. Servicemen also are expected to dress neatly and to avoid getting grease or dirt on floors and furniture.

Appliance servicemen can be promoted to foreman, assistant service manager, or service manager. Preference is given to men who have shown ability to get along well with other servicemen and with customers. A general knowledge of bookkeeping and other subjects related to managing a business is also helpful in getting ahead. Servicemen who work for appliance manufacturers may advance to other higher paying jobs. They may teach servicemen to repair new models of appliances. They may also write service manuals. Because of their experience in repairing appliances and dealing with all types of customers, appliance servicemen often become successful appliance salesmen. Experienced appliance servicemen may open their own repair shops.

**Employment Outlook**

Employment of appliance servicemen is expected to grow rapidly during the 1960's. Most new employment opportunities in this expanding occupation will occur because more appliances will be used and many new appliances will be more complex and require greater maintenance and repair. Some job openings will occur each year as a result of the need to replace servicemen who are promoted or who transfer to other fields of work. Other opportunities will arise because of the need to replace workers who die or retire.

Appliances have become an essential part of our daily living. Some homes now have as many as 20 appliances. During the 1950's increasing numbers of basic gas and electric appliances such as refrigerators, washing machines, air conditioners, ranges, vacuum cleaners, food mixers, and heating pads were purchased. In addition, new appliances (electric can openers, for example) were introduced, and their use spread rapidly. Appliances that were not widely used 10 years ago, such as dishwashers, have become more popular.

Growing population and increasing numbers of young married adults, who spend large amounts of their incomes for furniture and appliances, will continue to stimulate demands for appliances during the 1960's. Appliance sales will also increase with rising incomes and standards of living. New and more complicated appliances, such as electronic ovens, as they become popular, will also result in the need for more appliance servicemen with higher levels of skill. Refrigerators and ovens that are set into walls or cabinets and other modern appliances that are more convenient and easier to operate, will be more widely used. Air conditioners will also be installed in many more homes during the 1960's.

Because the increasing complexity of many modern appliances has made appliance repair work more difficult, manufacturers are designing appliances with more durable parts that will need fewer repairs and appliances that can be taken apart and fixed more easily. In addition, appliance manufacturers and other employers are increasing the efficiency of servicemen through more widespread and more effective training. Despite
these improvements, large numbers of servicemen will be needed each year.

Mechanically inclined young men who are not planning to attend college will find many opportunities in the growing appliance repair field. Servicemen who have a working knowledge of electricity, and especially those who know electronics, will be able to find a variety of good jobs almost everywhere. In addition, there will be more year-round jobs for servicemen. One reason is that more people are expected to sign yearly service contracts with companies which agree to keep their appliances in good operating condition.

Earnings and Working Conditions

National wage data are not available for appliance servicemen. Information obtained from several large employers in mid-1960 indicated that appliance servicemen generally receive from $95 to $115 for a 40-hour workweek. Some highly skilled men earned up to $125 a week. Trainees usually were paid from about $65 to $80 a week. Appliance servicemen who worked on large appliances generally earned more than those who worked only on small appliances. In shops where only small appliances were repaired, men often received a daily bonus when they repaired more than a certain minimum number of appliances. Many appliance servicemen work more than 40 hours a week and receive higher rates of pay for the overtime hours.

Many appliance servicemen working for manufacturers' service centers, gas and electric companies, and other employers received paid vacations and sick leave, health insurance, and other benefits, as well as credit toward retirement pensions. Some of these companies also sponsored employee savings funds and contributed money to the accounts of employees who participated.

The shops in which appliance servicemen work are relatively quiet, well lighted, and adequately ventilated. While repairing small appliances, servicemen usually sit at benches. Working conditions outside the shop vary considerably. Servicemen sometimes work in narrow spaces, uncomfortable positions, and places that are not clean. Servicemen who work with large appliances may spend 1 or 2 hours a day driving in all kinds of weather between customers' homes and the shops where they work.

Appliance repair work is generally safe, although accidents are possible while the serviceman is driving, handling electrical parts, or lifting or moving large appliances. Few accidents occur because inexperienced men are warned to use tools cautiously and to follow simple precautions against electric shock, such as keeping hands dry while handling electric wires.

The work of appliance servicemen is often performed with little direct supervision. This feature of the job may appeal to many young people.

Automobile Mechanics
(D.O.T. 5-81.000 through .999)

Nature of Work

The more than three-quarters of a million automobile mechanics who keep the millions of automobiles, trucks, and buses in the United States in good running order make up the largest repair occupation. These skilled workers maintain and repair mechanical, electrical, and body parts of passenger cars, trucks, and buses. They may also service other gasoline-powered equipment such as tractors. Automobile mechanics make inspections and tests to determine the causes of faulty operation, and repair or replace defective parts to restore the vehicle to proper operating condition. Typical maintenance and repair jobs done by mechanics are tuning the engine, replacing piston rings, aligning the front wheels, and adjusting or relining the brakes. Repair manuals and other technical publications provide instructions for these and other repair operations.

Auto mechanics in the smaller shops are usu-
Mechanics and Repairmen

Photograph by U.S. Department of Labor

Automobile mechanic adjusting valve lifters during major tuneup on car engine.

ally qualified to perform a variety of repair jobs, although a large number of other automobile mechanics specialize in particular types of repair work. For example, some mechanics do only alignment and steering work, or work on certain types of automatic transmissions. These mechanics usually work in shops with different departments or in shops that specialize in particular types of repair. These specialists, however, usually have an all-round knowledge of automotive repair and may be occasionally called upon to do other types of work. (*Body and fender repairmen* are specialists who do the shaping, finishing, and replacing of sheetmetal, and repairing or replacing of trim or glass.)

In making repairs, the mechanic uses many different kinds to tools and equipment. These may range from simple handtools, such as screwdrivers, wrenches, and pliers, to complicated and expensive machines and equipment which help the mechanic find out why an automobile is not operating properly and assist him in making repairs. Some of the more common examples of such equipment are wheel alignment machines, spark plug testers, engine analyzers, and headlight aimers.

Mechanics usually work by themselves. In large shops, however, a skilled mechanic may be assisted by a helper or an apprentice, and usually works under the supervision of a foreman or service manager. Before actually doing the work, mechanics in small shops may be required to prepare estimates of the cost of repairs, including materials and labor. In larger shops, the shop foreman, service salesmen, or service manager generally prepares the cost estimate and tells the mechanic which repairs to make.

Where Employed

In 1960, about one-third of the auto mechanics were employed in the service departments of new and used car dealers. Another third were employed in repair shops which make all kinds of repairs or specialize in particular types such as battery and ignition repairs, body and fender work, radiator service, and transmission and brake repair work and adjustments. A considerable number of automobile mechanics are employed in gasoline service stations where they perform relatively minor repairs and adjustments. Many mechanics work for organizations which repair and maintain their own fleets of motor vehicles. Included in this group are Federal, State, and local governments and trucking, bus, taxi-cab, bakery, and dairy companies. Some mechanics are employed by manufacturers of motor vehicles to make final adjustments and repairs at the end of assembly lines.

Most auto mechanics work in shops employing from one to five mechanics. However, some of the largest repair shops employ more than 100 mechanics. Generally, dealers' service departments in large cities have larger staffs of mechanics than independent shops and shops in the smaller communities.

Because motor vehicles are used throughout the Nation, automobile mechanics are employed in every section of the country, from the largest cities to the smallest towns. In 1960, about half of the mechanics worked in eight States: California, New York, Texas, Pennsylvania, Ohio, Illinois, Michigan, and New Jersey.
Training, Other Qualifications, and Advancement

Most auto mechanics learn the trade through on-the-job experience. Young men usually start as helpers, lubrication men, or car washers, and gradually acquire the necessary knowledge and skills by working with experienced mechanics. Although a man can perform the simpler types of repair work after a few months’ training and experience, it generally takes him at least 3 or 4 years to become a qualified all-round mechanic. The learning period will depend on the individual’s capabilities and the extent of his formal schooling in automotive repair. Additional training is usually required for mechanics who wish to become specialists. However, body repairmen, who do not have to learn to repair the operating parts of the vehicle, can learn their trade in as little as 3 years if they have a knack for handling metal.

One of the best ways for a young man to become an all-round auto mechanic is through an apprenticeship training program, which usually lasts 4 years. Some apprenticeship programs also allow the trainee to specialize in such work as truck or bus repairs, or auto-body repairs.

A large number of automobile mechanics receive training while they are members of the Armed Forces. Before they can qualify as fully trained mechanics in civilian life, however, they may be required to attend special training courses or to serve part of an apprenticeship period.

Experienced mechanics employed by automobile and truck dealers are sometimes sent to manufacturers’ training centers to learn about new features found in automobiles, such as fuel injection, power steering, or air conditioning.

For beginning jobs, employers prefer young high school graduates who have some understanding of automobile construction and operation and who like mechanical work. Courses in science and mathematics are desirable since they give a young man a better understanding of the operation of the automobile. Shop courses in auto repair which are offered by many high schools and vocational schools are valuable. Practical experience gained from working on automobiles as a hobby is also helpful to a young man who wishes to become a mechanic.

Most mechanics are required to have their own handtools. A beginner is usually expected to accumulate about $100 worth of tools. Experienced mechanics usually have over $500 invested in their tools. Special tools for servicing units like automatic transmissions, and major pieces of test equipment, are ordinarily furnished by the employer.

Capable and experienced automobile mechanics have several advancement possibilities. A mechanic in a large shop may advance to a supervisory position, such as repair shop foreman, service salesman, or service manager. Many experienced mechanics open their own independent repair shops or gasoline service stations and some mechanics may become car or truck salesmen, or manage a dealer’s parts department.

Employment Outlook

Thousands of training opportunities are expected to be available each year during the 1960’s for young people who want to learn to become automobile mechanics. These opportunities will arise because there will be a need for additional automobile mechanics to service the growing number of motor vehicles. A considerable number of job openings will also be created by retirements, deaths, and transfers of automobile mechanics to other fields of work. In this large occupation, retirements and deaths alone will probably create, on the average, about 12,000 openings each year during the 1960’s.

The number of motor vehicles in the United States has increased very rapidly during the past several years. Passenger car registrations increased from 40 million to 59 million and bus and truck registration from 9 to 12 million in the period from 1950 to 1959. Further increases in motor vehicle registrations are expected in the years ahead. Expected increases in population, consumer purchasing power, and in the number of families and two-car families will greatly increase the demand for motor vehicles in the 1960’s. In addition, the continuation of farm mechanization is expected to increase the
number of tractors and other gasoline-powered farm equipment.

Employment of automobile mechanics over the next decade will also depend on the number of repairs required per vehicle and the amount of work that the average mechanic can do. During the 1950’s, the addition of such features as air suspension, power brakes, and power steering to automobiles, to make them more comfortable and easier to operate, also increased their complexity and maintenance requirements. Despite this increased complexity, mechanics have been able to increase the number of repairs they can do. New and improved automobile servicing equipment helps in locating and repairing the defects that cause faulty operation. Greater emphasis on replacement rather than on repair of defective parts, better shop management, specialization in a single type of repair, and better training methods have all contributed toward increasing the amount of work the mechanic can do.

Although mechanics will be able to service more vehicles in less time during the 1960’s, the expected increase in motor vehicles and their growing complexity will result in many thousands of additional job opportunities each year.

**Earnings and Working Conditions**

Average hourly earnings of skilled automobile mechanics in 61 large communities were more than $2.60 an hour in late 1959 and early 1960. Average earnings ranged from about $2.05 in Fort Worth to $3 in San Francisco. These earnings do not include extra pay for overtime work that mechanics may earn. Many mechanics receive holidays and vacations with pay.

Most skilled auto mechanics and body repairmen in automobile dealer repair shops are paid a percentage of the labor cost charged to the customer. Each repair job is assigned a fixed labor charge and the most highly skilled mechanics can earn considerably more than the average because they are able to make repairs in less time. This is especially true in body work, in which there are great differences in skill between the very best repairman and the average repairman. A few body repairmen in large cities earn more than $10,000 a year.

Apprentices are paid a percentage of the journeymen’s rate. This percentage ranges from 55 percent of the skilled worker’s rate in the apprentice’s first 6 months of work to between 85 and 90 percent in the last 6 months of the apprenticeship period.

Many automobile mechanics work between 40 and 48 hours each week. Some work more than 48 hours a week.

Modern automotive repair shops are well ventilated, lighted, and heated, but older shops may not have such advantages. Most shops have lifts that raise the vehicle so that work can be done without stooping.

Generally, the mechanic’s work is performed inside a shop during the day. However, in cases where breakdowns occur on the road, the mechanic may have to work out of doors. In many jobs, the mechanic must handle greasy tools or dirty parts.

Many auto mechanics are members of labor unions. A large number of unionized mechanics are employed in shops of the larger new car dealers and the maintenance departments of truck and bus companies. Mechanics are highly organized in West Coast cities and in other large cities such as Chicago, Minneapolis–St. Paul, St. Louis, New York City, and Cleveland. Among the unions to which automobile mechanics belong are the International Association of Machinists; the International Union, United Automobile, Aircraft and Agricultural Implement Workers of America; and the International Brotherhood of Teamsters, Chauffeurs, Warehousemen and Helpers of America (Ind.).

**Business Machine Servicemen**

**Nature of Work and Where Employed**

Business machine servicemen repair and maintain typewriters, adding machines, calculators, cash registers, accounting-statistical machines, and the many other types of machines used in business offices. They do much...
of the work in the offices where the machines are used. These servicemen may maintain this equipment on a regular basis, returning at frequent intervals to inspect the machines, to clean and oil them, and make minor adjustments or repairs. They may also be called to an office to check a defective machine.

On service calls, repairmen usually question the operator about the condition of the machine. They may have to explain to operators how various features of the machines can best be used or what not to do to prevent machine damage. Some servicemen are expected to sell supplies used with the machines, such as paper, inks, or stencils, or to sell contracts for servicing machines regularly.

While inspecting business machines, the serviceman usually checks the operation of various parts of the equipment to make sure that they work properly or to find the source of trouble. For example, he may strike the keys of a typewriter, move the carriage of a calculator, or rotate the drum of a duplicating machine. In addition, he may check type for alignment and rollers for dryness or compactness. If necessary, covers of machines may be removed to check levers, gears, belts, or spacing mechanisms.

When overhaul or major repair is necessary, the equipment is generally brought to the shop of the servicing company. Here, servicemen take the machine apart; inspect components; remove and replace worn bearings, cams, and other defective parts; and install new belts and feed rolls where necessary. If the machine has electric motors or controls, these also are inspected.

Common handtools such as screwdrivers, pliers, and adjustable wrenches are used in this work. In addition, tools designed for special purposes and gages, meters, and other test equipment are frequently used.

Business machine servicing offers considerable variety in work assignments. Like some other types of repair work, it requires analytical and reasoning ability. Most repair jobs present new problems, and many persons find considerable satisfaction in being able to find the cause of the trouble and to put the machine back in good working order.

Business machine servicemen are employed in several types of firms. Manufacturers of business machines employ more than half of these workers in their sales and service offices throughout the country. About 40 percent of the servicemen work in small, independent, local establishments; some of these shops mainly do repair work, whereas others combine sales and service. The remainder are employed in large organizations which have enough machines to justify employing full-time servicemen. The Federal Government, for example, employed about 750 of these workers in late 1960.

Business machine servicemen employed in manufacturers’ branch offices work only on the manufacturer’s products. In the large branch offices, in some companies, they may specialize in servicing one or two of the types of machines the manufacturer sells. In other companies, even in the larger branches, the men are “combination” servicemen, and work on the full line of company equipment. In manufacturers’ branches in the smaller cities, where fewer servicemen are needed, most of them are “combination” servicemen, since it is impractical to have the men specialize on one type of machine.

Servicemen employed in independent dealers’ and repair shops usually work on more than one type of business machine because these shops repair and service many makes and models. Most of these shops are small and employ only a few servicemen. However, in some of the larger independent shops, most of the servicemen may specialize on typewriters and adding machines of various makes which provide most of the shop’s business, while a few other men repair the more complicated machines.

Business machine servicing jobs are found throughout the country. Even relatively small communities usually have at least one or two shops which repair machines. However, most business machine servicemen work in large cities, especially in those with large numbers of office workers and where most of the calculators, accounting-bookkeeping and statistical machines are used.
Typewriter Servicemen (D.O.T. 5–83.127). An estimated 20,000 servicemen were engaged mainly in repairing and maintaining typewriters in late 1960, making this the largest business machine repair occupation. Typewriters are the most widely used business machines. They are used in almost every business office, as well as by many individuals in their homes. The operation of electric typewriters and mechanical typewriters differs slightly, but the two types are enough alike that the servicemen who specialize in the repair of mechanical typewriters can usually learn to repair the electric machines after a brief period of additional training.

Typewriter servicemen are employed both in the sales and service branches of typewriter manufacturers and in independent, local repair shops (which frequently sell typewriters as well as repair them). Many servicemen operate their own shops. Typewriter servicemen are found in almost every sizable community throughout the Nation.

Adding Machine Servicemen (D.O.T. 5–83.122). In late 1960, about 3,500 business machine servicemen were engaged mainly in the servicing of adding machines. These machines are simpler to repair than most other business machines. In some cases, servicing of both adding machines and calculators is done by the same employee. The repair of adding machines and simpler calculating machines often provides experience for advancement to work on more difficult equipment such as bookkeeping and accounting machines. In independent repair shops, adding machines are serviced by men who also repair typewriters.

Adding machine servicemen are employed both in manufacturers’ sales and service branches and in independent, local repair shops. Other sources of employment are Federal, State, and local governments, and a few large banks and other firms which used large numbers of adding machines.

Calculating Machine Servicemen (D.O.T. 5–83.123). More than 4,500 calculating machine servicemen were employed in late 1960. These machines, which have complex mechanisms, add, subtract, divide, multiply, and perform combinations of these operations. Calculating machine servicemen require more training than typewriter or adding machine servicemen. In some shops, servicing of calculators is combined with the servicing of other business machines, particularly adding machines and accounting-bookkeeping machines.

Men who service calculators are usually employed in manufacturers’ sales and service branches. However, a few work in independent, local repair shops, most of which are small and employ only a few workers. The Federal Government also employs a few hundred calculating machine servicemen.

Cash Register Servicemen (D.O.T. 5–83.124). Cash register repair and maintenance was the main work of more than 5,000 business machine servicemen in late 1960. Next to typewriters, cash registers are the most widely used business machines. The simplest models merely record transactions, add up receipts, and provide a change drawer. The more complicated cash registers simultaneously record several different kinds of information on each transaction (such as identification of the clerk, department, type of merchandise, payment given, and change due), provide printed receipts, and dispense change to the customer.

The great majority of servicemen primarily engaged in repairing cash registers are employed in the sales and service branches of the few manufacturing firms making these machines. Some of the repair work, especially in smaller towns, is done in independent shops which also repair other business machines.

Accounting-Bookkeeping Machine Servicemen (D.O.T. 5–83.121). In late 1960, the repair of accounting-bookkeeping machines was the main job of more than 3,000 business machine servicemen. These machines perform a variety of operations. Some post entries and some do billing, but others combine the functions of typewriters and computing devices. All models have keyboards, like those on typewriters and adding machines. These machines are used in firms which have a great deal of accounting and bookkeeping work, such as department
stores, large retail and wholesale businesses, and banks. Many of the newer models are adjusted to fit the accounting procedures used in an individual customer's office. Servicemen set up the controls or programs for such machines from plans which have been devised by the customers and manufacturers' salesmen.

Most accounting-bookkeeping machine servicemen are employed in the sales and service branches of companies manufacturing this equipment. Only a few work in independent repair shops.

Data-Processing Equipment Servicemen. In 1960, more than 12,000 men were employed in maintaining and repairing accounting-statistical machines. These are the most skilled business machine servicemen. About half of them are employed in servicing electromechanical accounting-statistical machines (D.O.T. 5–83.126). These machines record, tabulate, and analyze great masses of accounting and statistical data. They include card punches, sorters, and tabulators, as well as special purpose machines used in punched card systems.

New lines of electronic accounting-statistical machines (computers) which process tremendous amounts of data with great speed came into use in the 1950’s. Most of these machines are manufactured by the same firms which make the electromechanical accounting-statistical machines (D.O.T. 5–83.126). These machines record, tabulate, and analyze great masses of accounting and statistical data. They include card punches, sorters, and tabulators, as well as special purpose machines used in punched card systems.

Dictating Machine Servicemen (D.O.T. 5–83.135). About 1,000 men were employed to repair and service dictating machines in late 1960. These machines are used in business offices to record dictation on cylinders, discs, or sleeves which can be played back for typing. The new electronic models reproduce the voice much more faithfully than the older acoustic-type machines. Servicing is still largely a matter of mechanical aptitude, since the mechanical sections of dictating machines break down more frequently than the electronic parts; however, the servicemen must have a working knowledge of electricity and electronics. Besides the standard office dictating machines, there are many special types, such as devices which record telephone conversations or conferences, which are maintained by dictating machine servicemen.

Dictating machine servicemen are employed mainly in the larger communities either in the sales and service branches of the manufacturers of dictating machines or by their distributors. In small towns, typewriter and adding machine repairmen may also learn to service dictating machines.

Duplicating and Copying Machine Servicemen (D.O.T. 5–83.125). More than 2,500 servicemen were employed in late 1960 to repair duplicating and copying machines. These machines are used to make one or more paper copies of any printed or written information. The serviceman adjusts, oils, repairs, or replaces machine parts, such as rollers, belts, or gears. He must also clean the machine so that it functions properly and produces clear copy. He must be able to determine whether poor copy is a result of mechanical defects, improper use of machines, or other factors.

Most of these servicemen are employed in the branch sales and service offices of manufacturers. Those who work for independent dealers generally work on more than one make of equipment.
Qualifications, Training, and Advancement

Employers prefer applicants for beginning jobs as business machine servicemen to be under 30 years of age. Men up to the age of 40 may be considered by some employers provided they have had training or experience which can be useful in machine servicing work.

Trainees are usually required to have at least a high school education; this qualification is particularly important after the serviceman has acquired his basic skills and is looking for promotion to a supervisory job or work on more complex equipment. Some companies will accept applicants with less than a high school education, provided they can demonstrate superior mechanical aptitude or have had qualifying mechanical experience.

Applicants for the trainee jobs are frequently required to pass one or more tests. Mechanical aptitude is the characteristic most frequently tested. Applicants may also be tested for manual dexterity, general intelligence, and knowledge of mathematics or electricity.

Employers look for applicants who have a pleasant, cooperative manner. Most machine servicing is done in customers' offices and a serviceman's ability to do his work with the least interference with office routine is very important. A neat appearance and ability to converse effectively are also desired characteristics.

Young men entering the business machine servicing field generally begin as trainees and acquire their skills through on-the-job training, work experience, and instruction in manufacturers' training schools. Business machine servicemen who are hired for work in a manufacturer's branch office are trained to service only the company's line of machines. Independent shops, who look for men who can service many makes of machines, will either hire men with previous experience on one or more types of machines or will give a new man informal training on several different makes. Formal apprentice training programs of from 2 to 4 years are conducted by some manufacturers and independent shops.

Men hired as trainees in manufacturers' branch offices are usually sent to company schools for periods lasting from several weeks to several months, depending on the type of machine they are learning to service. They then receive from 1 to 3 years of practical experience and on-the-job training before they are considered skilled workers. During this period, they may occasionally go back to factory schools for additional courses. Even after becoming skilled workers, they may return to school for special instruction in new business machine developments.

Men in independent shops generally learn the trade by working with experienced servicemen who instruct them in the skills of the trade. Occasionally, men employed by an independent dealer who is authorized to sell and service a manufacturer's products will be sent to the manufacturer's school for a few weeks. In most cases, however, men in independent shops receive no formal training.

Length of training depends on the kind of shop in which a man is employed and the type of machine he is learning to service. In independent shops, the time required to become a skilled serviceman tends to be somewhat longer than in manufacturers' branches, because of the greater variety of machines the serviceman...
must become familiar with and the generally informal nature of the training.

Servicemen who will work on simple business machines require less training than those who will work on more complex equipment. Typically, it takes from 1 to 2 years for a man to learn to repair an ordinary adding machine or a typewriter. Calculating machines require from 2 to 4 years of training and experience. Cash register repairmen learn their job in from 2 1/2 to 3 1/2 years, the last 6 months of which are usually spent in the company school. Skilled accounting-bookkeeping machine repairmen generally must have at least 4 to 5 years of training and experience. The first 1 or 2 years may consist of servicing adding machines, calculators, or cash registers, since this is considered valuable background for servicing accounting-bookkeeping machines.

Most accounting-statistical machines contain electrical equipment; many have electronic components. The companies which manufacture and service these machines, therefore, often require that applicants have some knowledge of electricity or electronics. In qualifying for a job in the maintenance of the complex electronic data-processing machines, college or technical institute courses in engineering are helpful, though not essential. Young veterans who have had electronics training in the Armed Forces are specially desired by employers in this field. Men hired as trainees generally spend their first 2 months in on-the-job training. If they prove satisfactory, they are sent to a company school for a period of from 3 to 10 months. After completing the course, they work under supervision until they acquire enough skill to service and repair on their own. This period usually lasts from 12 to 18 months.

Servicemen in manufacturers' sales branches frequently have the opportunity to move into sales jobs, where their earnings are usually greater. In some cases, service and sales work are combined. Many of these men also have the opportunity for promotion to supervisory jobs, such as foreman or service manager; men in large independent shops have similar opportunities. Experienced men sometimes open their own repair shops; men who work in the branch offices of some manufacturers are sometimes given sales franchises from the company and become independent dealers.

Employment Outlook

The rapidly growing business machine service field will provide several thousand job opportunities for young men each year during the 1960's. The 45,000 servicemen employed in late 1960 was more than double the number working in 1950. The greater employment of servicemen has been due to the increasing use of many types of office machines to do all kinds of clerical work in our expanding commercial and industrial establishments. More complicated equipment, requiring additional maintenance, has also increased the need for these servicemen.

Opportunities for jobs in the servicing of electronic business machines will be particularly favorable in the next decade. The use of such machines has expanded tremendously in recent years, and demand for this equipment is expected to be even greater in the future. There will also be an increasing need for servicemen to work on other types of business machines which are becoming more complex. Electrically driven mechanical equipment, such as typewriters and adding machines, is rapidly taking the place of nonelectrical mechanical machines which do the same work. Cash registers, bookkeeping machines, and other specialized equipment are designed to provide much more detailed information than in the past. All of these developments indicate that there will be many well-paying jobs available for servicemen who have good mechanical ability. The best opportunities, however, will be for those who have, in addition, a knowledge of electricity or electronics.

Business machine servicemen have year-round employment—steadier than that in many other skilled trades. The office machines serviced by these men must be maintained continuously, even when business slackens, since business records must be kept, correspondence carried on, and statistical reports prepared. Men who establish themselves in the business machine service field can expect continuing employment for many years.
Earnings and Working Conditions

National wage data are not available for business machine servicemen. Information obtained from a number of employers indicates that in mid-1960, earnings of experienced servicemen generally ranged from $80 to $130 a week depending on the type of machine they serviced, where they were employed, and their length of service with employers. Wages were lowest for men who repair only typewriters or adding machines; the earnings of these workers usually ranged from $80 to $100 a week. Cash registers, calculators, accounting-bookkeeping machines, and nonelectronic accounting-statistical machines require more skill to repair; consequently, the men who work on them receive somewhat higher pay rates, generally from $90 to $120 a week. Highest rates are paid to men who service electronic data-processing machines. The most highly skilled electronic computer servicemen were earning as much as $185 a week in mid-1960.

In addition to their salaries, servicemen in some companies receive commissions for selling supplies or service contracts. Many servicemen employed by manufacturers and independent dealers are covered by group life and hospitalization insurance plans, and pension plans.

Servicemen trainees begin at wages considerably below these levels; they receive pay increases as they become more and more skilled during the training period. Starting wages generally ranged from $60 to $80 a week in late 1960. Men with previous electronics training in the Armed Forces or civilian technical schools generally receive somewhat higher beginning wages.

Servicing of business machines is cleaner and lighter work than the work in most other mechanical trades. The occupation is comparatively free from the danger of accident. Servicemen generally dress like office workers, since the work is clean and often performed in the offices where machines are used. Many of these jobs involve considerable traveling within the area served by the employer.

Diesel Mechanics

(D.O.T. 5-83.931)

Nature of Work

Diesel mechanics keep bulldozers, tractors, and other diesel-powered equipment that is widely used on highways, on farms, and in industry, in good operating order. Many diesel mechanics specialize in maintenance and repair of diesel equipment; others specialize in rebuilding engines. Those who do maintenance and repair work perform the periodic cleaning, adjusting, and tuneups that are necessary for efficient operation of diesel engines. When diesel equipment is not operating properly, these mechanics (or their supervisors) find out the cause of the trouble. The mechanics then repair or replace broken or wornout parts or make any necessary adjustments. In addition to engine maintenance and repair, diesel mechanics may work on other parts of diesel-powered machinery. For example, some mechanics who repair diesel-powered trucks and buses work on brake and steering systems.

Mechanics who specialize in rebuilding diesel engines that have been operated for many hours or miles, take the entire engine apart, examine all of the parts for defects, and repair or replace defective parts. They then reassemble and adjust the engine.

Many of the men who repair the larger diesel engines, such as those used to run locomotives or electric generating equipment in industry, are specifically trained for this type of work. However, because the basic parts of the diesel engine and the gasoline engine are similar, smaller diesel engines such as the type used in buses, trucks, and farm equipment are often repaired by workers who have had previous training or experience in the repair of automobile and truck gasoline engines. (See statement on Automobile Mechanics, p. 416.)

Diesel mechanics use handtools such as pliers, wrenches, and screwdrivers in their work. In addition, they may use complex electronic test-
Diesel mechanics using hoist to replace crankshaft of rebuilt diesel engine.

Diesel mechanics learn their skills in several different ways. Most young men who become diesel mechanics first work as mechanics repairing gasoline-powered automobiles, trucks, and buses. They usually start as helpers to experienced gasoline engine mechanics and become skilled by working with them for 3 to 4 years. When employed by firms that use or repair diesel-powered equipment, they are given 6 to 18 months’ additional training in the maintenance and repair of such equipment. While learning to fix diesel engines, many of these men find it helpful to take courses in the repair and maintenance of diesel equipment offered by vocational, trade, and correspondence schools.

Some diesel mechanics, such as those employed by railroads, learn their trade through formal apprenticeship programs. These programs, which generally last 4 years, give trainees a combination of classroom training and practical experience in fixing the particular types of diesel engines used by their employers. Apprentices receive classroom instruction in blueprint reading, hydraulics, welding, and other related subjects. In their practical training, they learn about valves, bearings, injection systems, starting systems, cooling systems, and other parts of diesel engines.

Other young men learn to be diesel mechanics through less formal training programs. They are generally hired as trainees by employers who use or repair large quantities of diesel-powered equipment. These trainees are taught to do all kinds of diesel repair jobs by experienced mechanics.

Experienced diesel mechanics employed by companies that sell diesel-powered equipment are sometimes sent to special training classes conducted by diesel engine manufacturers. In these classes, mechanics learn to maintain and repair the latest diesel engines, using the most modern equipment.

However, large numbers of these workers are employed in California, New York, Illinois, and Texas, which have extensive construction programs and farming activities requiring great numbers of diesel-powered machines.

Training, Other Qualifications, and Advancement

Many diesel mechanics are employed in the service departments of distributors and dealers that sell diesel-powered farm and construction equipment and trucks. Diesel mechanics are also employed by companies and government agencies that repair and maintain their own fleets of diesel-powered equipment. This group includes local and intercity bus lines, construction companies, trucking companies, shipping lines, electric power plants, railroads, and Federal, State, and local governments.

Because diesel engines are widely used in American industry and commerce, diesel mechanics are employed in all parts of the country.
Employers generally look for diesel mechanic trainees and apprentice applicants who have a high school education. Young men who have taken courses in physics, machine-shop work, and mathematics are given preference in hiring because they are likely to have a better understanding of the operation of diesel equipment. Courses in automobile repair, which are offered by many high schools and vocational schools, are also valuable. Employers also look for young men who have both mechanical aptitude and an interest in the accurate work required to make precise adjustments of diesel engines.

Many diesel mechanics are required to have their own handtools. A beginner is usually expected to accumulate $100 worth of tools. Experienced mechanics usually have over $500 invested in their tools.

There are several advancement possibilities for capable and experienced diesel mechanics. Those who work for organizations that operate or repair large fleets of diesels, such as bus lines or diesel equipment distributors, may advance to supervisory positions of master mechanic or service manager. Some diesel mechanics who are in charge of the engine departments of ships may become marine engineers. To be licensed as a marine engineer by the U.S. Coast Guard, the diesel mechanic must have 3 years' experience in the operation and maintenance of diesel engines on ships, pass a written examination, and meet other requirements.

**Employment Outlook**

An increasing number of diesel mechanics will be needed in the 1960's to maintain and repair the growing number of diesel engines used in American industry and commerce and on the roads and farms of the country. In addition to the new jobs expected to develop because of the more widespread use of diesel engines, many job openings will result as diesel mechanics retire, die, or transfer to other fields of work.

The use of diesel engines to power farm and construction machinery, electric generators, trucks, buses, trains, and ships has been increasing. For example, the number of diesel-powered trucks and buses in the United States increased from about 150,000 in 1956 to approximately 200,000 in 1959. The number of diesel-powered locomotives in 1960 was almost double the 15,000 in use in 1950, despite a decline in the total number of railroad locomotives.

It is expected that the economic advantages of the diesel engine as a source of power will result in its increasing use in the future. Most industries which use diesel engines in large numbers are expected to expand their activities considerably during the 1960's. The Federal Government's vast highway development program will require large numbers of additional diesel-powered bulldozers, cranes, and other construction machinery. Farm mechanization is expected to continue, resulting in the use of many new harvesters, tractors, and other diesel-powered equipment. The number of diesel-powered trucks and buses will increase. In addition, diesel-powered taxicabs, which are in limited use today, are expected to be used on a much larger scale.

Most new job openings in this field will be filled by mechanics who have had experience in repairing gasoline engines. Companies that are replacing gasoline engine equipment with diesel-powered equipment usually retrain their experienced mechanics to service the diesel equipment. Companies which buy additional diesel engines to meet expansion needs usually hire experienced diesel mechanics. Men who have had school training but no practical experience in diesel repair work may be able to find jobs only as trainees.

**Earnings and Working Conditions**

National wage data are not available for diesel mechanics. However, wage data collected from a few employers and union contracts indicate that these workers were earning from $2.35 to $2.80 an hour in early 1960. Diesel mechanics employed in some local and intercity bus company repair shops earned between $2.35 and $2.75 an hour in October 1959. Those employed by railroad companies to repair diesel locomotives were paid approximately $2.60 an hour in early 1960.

The weekly work schedule of diesel mechanics ranges from 40 to 48 hours a week. Many of
them work nights or on weekends, particularly if they work on diesel equipment that is used in serving the public such as buses, or in electric light and power plants. Diesel mechanics generally receive a higher rate of pay when they work overtime hours, evenings, or weekends.

Many diesel mechanics also receive vacations and holidays with pay. In addition, they may receive health and life insurance benefits which are at least partially paid for by their employers.

Most of the larger repair shops are pleasant places in which to work, but some of the small shops have poor lighting, heating, and ventilation. Occasionally, diesel mechanics who work for bus lines or construction companies may have to make repairs outdoors where the breakdowns occur. If proper safety precautions are not taken, there is some danger of injury to men working on heavy parts supported on jacks or hoists. In most jobs, the mechanics handle greasy tools and engine parts. It is often necessary for them to stand or lie in awkward or cramped positions for extended periods of time.

Many diesel mechanics belong to labor unions. Some of the unions to which they belong are the International Association of Machinists; the Amalgamated Association of Street, Electric Railway and Motor Coach Employees of America; The Sheet Metal Workers’ International Association; the International Union, United Automobile, Aircraft and Agricultural Implement Workers of America; and the International Brotherhood of Electrical Workers.

Industrial Machinery Repairmen
(D.O.T. 5-83.641)

Nature of Work

The great variety of machinery and equipment used in American industry is kept in good operating condition by industrial machinery repairmen (often called maintenance mechanics). When breakdowns occur, repairmen must quickly determine the cause of the trouble and make the necessary repairs. They may completely or partly dismantle a machine in order to repair or replace defective parts. After the machine is reassembled, they make the necessary mechanical adjustments to insure its proper operation.

Much of a repairman’s time is spent in preventive maintenance. By regularly inspecting the equipment, oiling and greasing machines, and cleaning and repairing parts, he prevents trouble which could cause a breakdown of the machinery. He also may keep maintenance records of the equipment he services.

The types of machinery on which industrial machinery repairmen work depend to a great extent on the particular industry in which they are employed. For example, in the apparel industry, these skilled workers may be employed to repair industrial sewing machines. They may take sewing machines apart in order to repair belts, adjust treads, or replace motor bearings.

In printing and publishing establishments, skilled industrial machinery repairmen may...
MECHANICS AND REPAIRMEN

Maintain and repair equipment such as printing presses and folders.

Repairmen often follow blueprints, lubrication charts, and engineering specifications in maintaining and repairing equipment. They may also use parts catalogs to order replacements for broken or defective parts. Occasionally, repairmen may sketch a part which is to be replaced by the plant’s machine shop.

Industrial machinery repairmen use wrenches, screwdrivers, pliers, and other hand-tools, as well as portable power tools. They also may use welding equipment in repairing broken metal parts.

Where Employed

Industrial machinery repairmen work in almost every industrial plant that uses large amounts of machinery and equipment. Metalworking establishments, in particular, employ large numbers of these workers. For example, in 1960, the machinery manufacturing industry had about 55,000 maintenance mechanics and the automobile industry, about 9,500. Other manufacturing plants such as textile mills, petroleum refineries, and paper and pulp mills, also employed many of these skilled craftsmen.

Because industrial machinery repairmen work in a wide variety of industrial plants, they are employed in every section of the country. However, the largest numbers of these workers are in New York, Pennsylvania, California, Ohio, Illinois, Michigan, New Jersey, Massachusetts, and other heavily industrialized States.

Training and Other Qualifications

Most workers who become industrial machinery repairmen start as helpers and pick up the skills of the trade informally through several years of experience. Others learn the trade through formal apprenticeship programs, and this method of entering the occupation will become more important as machinery becomes more complex. Apprenticeship training usually lasts 4 years and consists of both on-the-job training and related classroom instruction. Apprentices learn the use and care of the tools of the trade, and the operation, lubrication, and adjustment of the machinery and equipment which they will maintain. Classroom instruction is given in shop mathematics, blueprint reading, safety, hydraulics, welding, and other subjects related to the craft.

Mechanical aptitude and manual dexterity are important qualifications for workers in this trade. Good physical condition and agility also are necessary, because industrial machinery repairmen are sometimes required to lift heavy objects or do considerable climbing in order to repair equipment located high above the ground.

Employment Outlook

Many thousands of industrial machinery repairmen will be needed in the 1960’s. The anticipated use of more machinery and equipment such as machine tools and assembling equipment in manufacturing industries during the next decade will result in continued moderate growth in the employment of industrial machinery repairmen. Also, as automatic equipment becomes more widespread and is used to make continuous production lines, breakdowns mean greater losses of production and make repair work and preventive maintenance more essential.

In addition to the many new job openings for industrial machinery repairmen that will be created by industrial expansion, thousands of new workers will be needed in the next decade to replace those who retire, die, or transfer to other fields of work.

Earnings and Working Conditions

Average straight-time hourly earnings of industrial machinery repairmen employed by a wide variety of manufacturing and nonmanufacturing establishments in 47 large metropolitan areas ranged from $2.13 in Portland, Maine, to $3.12 in Detroit, Mich. More than half of the repairmen covered by these surveys, conducted between September 1959 and June 1960, earned at least $2.80 an hour.

Industrial machinery repairmen are not usually affected by seasonal changes in production. During slack periods, when production workers...
are laid off, repairmen are often retained; many companies use machine repairmen to do major repair and overhaul jobs during such periods.

Because motors and other parts of machines are not always readily accessible, maintenance mechanics may work in stooped or cramped positions close to the floor or from the tops of ladders. Industrial machinery repairmen are subject to such common shop injuries as cuts and bruises. However, in recent years, accidents have been reduced by the use of goggles, metal-tip shoes, metal helmets, and other safety devices. Repairmen must frequently work on dirty and greasy equipment. Lighting and ventilation are usually good.

Most industrial machinery repairmen belong to labor unions. Some of the unions to which these workers belong are the United Steelworkers of America; the International Union, United Automobile, Aircraft and Agricultural Implement Workers of America; the International Association of Machinists; and the International Union of Electrical, Radio and Machine Workers. Most employer-union contracts covering industrial machinery repairmen provide for fringe benefits such as paid holidays and vacations, health insurance, life insurance, and retirement pensions.

**Instrument Repairmen**

(D.O.T. 5-83.456, .971, .972, .975, and .980)

**Nature of Work**

The many different instruments used to measure and control speed, heat, pressure, weight, time, electrical current, flow of gas, and other quantities are installed and serviced by instrument repairmen. Instruments serviced by these workers are used in refining oil, in constructing missiles, in generating and distributing electricity, in manufacturing steel, and in hundreds of other activities. Automatic pilots which keep airplanes on courses and voltmeters which measure electricity are examples of common instruments. Instrument repairmen (also called instrument mechanics, instrument servicemen, instrument men, and instrument technicians) usually specialize in particular kinds of instruments. For example, they may service either electronic or pneumatic instruments or only timekeeping instruments.

To locate and correct trouble, instrument repairmen visually inspect instruments or use special testing equipment. They use testing equipment such as pressure and vacuum gages, speed counters, and electrical measuring instruments, for example, voltmeters, ammeters, and potentiometers. They compare the readings shown on such testing equipment with the reading that would be shown if the instruments were operating properly. They also look for electrical leaks, short circuits, and broken wires. They visually inspect instruments for loose or broken parts, rust, and other causes of trouble.

Instrument repairmen often take instruments apart in order to replace worn or dam-

Instrument repairmen are becoming more important with the increasing use of instruments.
aged parts, or to rewire, straighten, or resolder such parts. They use handtools such as drills, wrenches, and pliers. They also use soldering irons and micrometers. When workers install instruments or small parts, they use watchmaker tools such as eyeloops and jeweler’s screwdrivers. Sometimes they operate drill presses, grinders, polishers, and other machine tools to make new parts or to change standard parts to fit particular instruments. As guides in their work, instrument repairmen frequently use instruction books that describe how to install, operate, and maintain instruments. They also use schematic diagrams, assembly drawings, and blueprints. When instruments are reassembled, repairmen give them final checks for proper operation.

Instrument repairmen also try to prevent trouble. At regular intervals they look for and correct defects which would cause breakdowns and result in production losses or inconvenience. They also clean, lubricate, and adjust instruments. Repairmen often check instruments in shops after removing them and installing spares. In preventive maintenance work, they follow schedules that tell when particular instruments are to be checked and serviced.

Instrument repairmen who install instruments also advise operators how to use and care for them. In addition, they test new instruments after putting them in place. Sometimes instrument repairmen modernize older instruments by putting in new parts.

Some highly trained instrument repairmen assist scientists and engineers in research and development laboratories. They select and arrange instruments for tests and experiments. They also change instruments to meet special requirements or to get better results. Sometimes they operate laboratory equipment to obtain samples or readings that will be used by technicians and professional workers.

Where Employed

More than 50,000 instrument repairmen were employed in 1960 by gas and electric utilities, by petroleum and chemical plants, by manufacturers of instruments, paper products, metals, rubber, missiles, automobiles, electrical equipment, and by air lines. Several thousand of these repairmen work for government agencies, mainly the Air Force, Navy, and Army. Although instrument repairmen are employed in almost every city, most of them are employed in large cities where large numbers of instruments are used.

Training, Other Qualifications, and Advancement

Most instrument repairmen are hired as trainees and learn their trade while working on the job. Some companies have formal training programs for instrument repairmen; in other companies, trainees learn by working with experienced men. Formal training programs often include specialized courses in instrumentation theory, mathematics, and blueprint reading, in addition to actual work experience. These courses may be given by local schools during or after working hours.

Several instrument manufacturers offer specialized training to instrument repairmen employed by companies which buy their products. These training courses last from 1 week to 9 months, depending upon the number and complexity of the instruments which these workers are learning to service. Courses are given in design, theory, maintenance, and operation of instruments. Students learn to check instruments step by step and the reasons why each step is needed. They also learn where to find information about instrument servicing.

Young men who are interested in becoming instrument technicians or engineering assistants in research and development work can train for instrument repair work in technical institutes and junior colleges. The broad programs offered by these schools last about 2 years and emphasize science, mathematics, and shopwork.

A few instrument repairmen start as apprentices. Apprenticeship programs, which generally last 4 years, emphasize on-the-job training in repairing and maintaining instruments. Apprentices also study mathematics, physics, electronics, chemistry, blueprint reading, and instrumentation theory.

Armed Forces technical schools also offer
training in instrument servicing. Young men who expect to enter the Armed Forces may wish to investigate opportunities for training and work experience while in military service. Skills acquired in this trade in the Armed Forces often qualify men for civilian jobs as instrument repairmen and for other maintenance occupations.

To become a fully qualified instrument repairman usually takes at least 4 or 5 years of study and on-the-job training. However, the time required varies considerably depending upon individual ability, the complexity of the instruments being serviced, and whether the training is full time. Some full-time courses for instrument repairmen last 12 weeks. Many companies have training programs which last 2 or more years. Some employers reduce the length of on-the-job or apprentice training for employees who attend courses given by instrument manufacturers.

Men hired as trainees or apprentices generally must be high school graduates. Courses in algebra, trigonometry, physics, chemistry, electricity, electronics, machine shop practice, and blueprint reading are considered useful. Some employers give tests to applicants to determine their mechanical aptitude. Instrument repairmen who meet the public are expected to be neat in appearance and to get along well with people. Other important qualifications are ability to work alone with little supervision, and good hand-eye coordination which is needed while handling delicate instrument parts.

Well-trained instrument repairmen may advance to positions of increasing responsibility. They can become group leaders or foremen in maintenance departments. They can advance to jobs as service representatives in branch offices of instrument manufacturing companies. Some instrument repairmen become technicians or engineering assistants. Because the use of electronic components in instruments will increase, a basic knowledge of electronics will help young men advance in the instrument field.

**Employment Outlook**

Employment of instrument repairmen will increase rapidly during the 1960's, as the use of instruments grows. A few thousand job openings are expected every year in this small but increasingly important occupation. Repairmen will also be needed to replace those who are promoted, who transfer to different jobs, or who leave their jobs because of illness, disability, retirement, or death.

In these and other applications, instruments have become essential. They improve efficiency of workers, and help make production automatic. They enable closer control of product quality and reduce waste. They free scientists and engineers for more creative work by speeding up experiments. Aircraft and missiles require control instruments, especially as flying speeds and distances increase. More instruments are being used for inspection, as precision products become more common.

Increasing numbers of instruments and growing complexity of instruments will require greater numbers of instrument repairmen to install them and keep them operating efficiently.

**Earnings and Working Conditions**

Average hourly earnings of instrument repairmen employed in petroleum refineries were $3.12 in July 1959. Information obtained from a small number of collective bargaining agreements in various companies (gas and electric, chemical, instrument, steel, paper, aircraft, and electronics) shows that most instrument repairmen in 1960 earned between $2.70 and $3.15 an hour. Instrument repairmen employed by Federal Government agencies in Washington, D.C. in 1960 received from $2.70 to $2.90 an hour, about the same rates received by non-government repairmen in this area.

Most instrument repairmen work a 40-hour, 5-day week. Those employed in petroleum refineries and chemical plants, which operate 24 hours a day and 7 days a week, may work on
any of three shifts or rotate among shifts. They may also be called to work on Sundays and holidays with emergency crews. They receive premium pay for night and holiday work. Most companies provide holiday and vacation pay. Many provide additional benefits, such as life insurance, hospitalization, medical and surgical insurance, sickness and accident insurance, and retirement pensions.

Instrument repairmen may service instruments on factory floors amid noise, oil and grease. They may also work at benches in quiet, clean, well-lighted repair shops. Those employed by instrument manufacturers may have to travel often.

Many instrument repairmen belong to unions, including the International Association of Machinists; International Brotherhood of Electrical Workers; International Brotherhood of Pulp, Sulphite, and Paper Mill Workers; International Chemical Workers Union; International Union of Electrical, Radio and Machine Workers; International Union, United Automobile, Aircraft and Agricultural Implement Workers of America; Oil, Chemical and Atomic Workers International Union; and Utility Workers Union of America.

Where To Go for More Information

For more information on job opportunities, training, and other questions, write to:

Foundation for Instrumentation Education and Research, Inc.,
527 Lexington Ave., New York 17, N.Y.
Instrument Society of America,
313 Sixth Ave., Pittsburgh 22, Pa.

Inquiries concerning positions with the Federal Government should be made at the regional offices of the U.S. Civil Service Commission.

Jewelers and Jewelry Repairmen

(D.O.T. 4–71.010, .020, and .025)

Nature of Work

Jewelers make rings, pins, necklaces, bracelets, and other precious jewelry by hand. They frequently use precious or semiprecious jewels or synthetic stones and set them in gold, silver, or platinum; they also create fine pieces of jewelry, using only these metals. Jewelers also repair jewelry, make rings larger or smaller, reset stones, and refashion old jewelry.

In making jewelry, jewelers may follow their own design or one by another person who specializes in design work. The metal is formed to follow the design either by melting and casting it or by using small hand and machine tools such as drills, files, saws, soldering irons and jewelers' lathes. Jewelers' work is often very fine and delicate and must be done with precision, as the materials used are extremely expensive.

As a rule, jewelers specialize in making a particular kind of jewelry, or in a particular operation such as making models and tools for jewelry, polishing, or stone setting. A few, after years of experience, become all-round jewelers, capable of making and repairing any kind of jewelry. Costume jewelry and some kinds of precious jewelry are mass produced by factory workers using assembly-line methods. Highly skilled jewelers are needed to make the models.
and tools necessary to this large-scale production.

Many jewelers not only make and repair jewelry but have stores where they sell jewelry and, often, silverware, china, glassware, and other merchandise. However, an increasing number of the newer retail jewelry stores are owned or operated by merchants who are not jewelers. When repair work is brought to these merchants, the articles are sent to a "trade shop" specializing in this work.

Where Employed

Probably between 15,000 and 25,000 jewelers and jewelry repairmen were employed in 1960. Most of them worked in retail jewelry stores, either as owners or employees, or in trade shops that serve these stores. Some were employed in factories manufacturing either precious or costume jewelry. A few worked for department stores and wholesale jewelry firms.

Although most small towns have at least one store that sells and repairs jewelry, most of the Nation's 25,000 retail jewelry stores, as well as the trade shops that service these stores, are located in and near large cities. The chief centers of precious jewelry manufacturing are the New York City metropolitan area, followed by the Providence, R.I., area. The majority of all precious jewelry manufacturing plants in the country are in New York, Rhode Island, New Jersey, Massachusetts, and Pennsylvania.

Training and Other Qualifications

Young persons generally learn the jewelry trade either by serving a formal apprenticeship or through informal on-the-job training while working for an experienced jeweler. Jewelry repair, which is usually less complicated than jewelry making, can be learned in a short time by individuals already trained in filing, sawing, drilling, and other basic mechanical skills. Courses in jewelry repair are sometimes given in trade schools which teach watchmaking and watch repairing.

Formal apprenticeship in this trade takes from 2 to 4 years, depending on the type of training. For example, 3 years are required to become a colored stone setter and 4 years to qualify as a diamond setter. Throughout the apprenticeship, training on the job is supplemented by trade school instruction in design, quality of precious stones, the chemistry of metals, and other related subjects. First work assignments may be to set up work for soldering or to do simple soldering or rough polishing. As apprentices gain experience, they advance to more difficult work. On completion of the apprenticeship, they become journeymen jewelers.

High school education is desirable for young people seeking to enter the trade. Courses in chemistry, physics, mechanical drawing, and art are particularly useful. Personal qualifications important for success in this field are mechanical aptitude, finger and hand dexterity, and good eyesight. Artistic ability is necessary for work in jewelry design. For those planning to become retail jewelers, the ability to deal with people and manage a business is also important. Because young people entering this trade work with precious stones and metals, they must be bonded. Bonding requires an investigation of one's personal background for such traits as honesty, trustworthiness, and respect for the law.

Employment Outlook

Skilled all-round jewelers with artistic talent and mechanical ability will probably be able to find employment readily through the mid-1960's. Specialized jewelry craftsmen, such as stone setters and modelmakers, will also have favorable employment prospects, especially in manufacturing shops. Inexperienced jewelers and those of only average ability, however, may encounter difficulty in finding desirable employment.

Persons planning to open their own jewelry stores should expect to face considerable competition in most parts of the country and should be prepared to make a substantial financial investment. As in the past, retail jewelers who can also repair watches will have an advantage over those who can work on jewelry only, especially in the smaller cities and towns.

In the long run, little expansion from current
levels of employment of skilled jewelers and jewelry repairmen is expected in either jewelry manufacturing or retail trade. The anticipated growth in the number of retail jewelry stores is not likely to result in a comparable increase in employment of jewelers, as many of the new stores will be owned and managed by people other than jewelers. Most openings for skilled jewelers will arise from the need to replace those who retire, die, or transfer to other fields of work. Such openings are expected to be relatively few, however, because the occupation is a small one and jewelers traditionally work at the trade well beyond the normal retirement age, or as long as they retain good eyesight and steady hands.

**Earnings and Working Conditions**

More than three-fourths of the skilled jewelry workers employed by precious jewelry manufacturers in the New York City area are covered by a union contract between their employers and the International Jewelry Workers' Union. Under the agreement, effective from 1960 to 1963, apprentices start at $1.25 an hour. They receive increases of 5 cents an hour every 3 months for the first 9 months, and then a 10-cent increase every 3 months until they reach the applicable minimum rate for journeymen. The minimum hourly rates for journeymen are $2.40 for setters of colored stones, $2.55 for all-round jewelers on handmade work, and $2.80 for modelmakers and diamond setters.

Skilled workers in the precious jewelry manufacturing shops of the New York City area have a 35-hour workweek and are paid time and one-half for all work done before or after the regular workday. Some workers may be subject to unemployment during the post-Christmas and post-Easter seasons when sales decline. On the other hand, retail jewelers and jewelry repairmen often work more than 35 hours, especially during the Christmas season and other peak periods.

**Maintenance Electricians**

(D.O.T. 4-97.420)

**Nature of Work**

Maintenance electricians (electrical repairmen) are skilled craftsmen who are responsible not only for the maintenance and repair of many different types of electrical equipment, but also for the modernization of such equipment to increase its efficiency. Equipment worked on by these skilled workers includes motors, transformers, generators, circuit breakers, controls, and lighting equipment used in industrial, commercial, and public establishments. A large part of a maintenance electrician's work consists of periodically inspecting equipment to detect and repair defective equipment before breakdown occurs. When trouble does develop, the electrician must quickly find and repair the faulty circuit or equipment in order to prevent production losses and inconvenience. In emergencies, it also is his responsibility to advise management whether immediate shutdown of equipment is necessary, or if continued operation would be hazardous.

In his daily work, the maintenance electrician performs many different jobs. For example, he may install new electrical equipment or he may make repairs by replacing units or parts such as wiring, fuses, transformers, coils, or switches. While doing installation or repair work, the electrician may connect wires by splicing or by using mechanical connectors. He may measure, cut, bend, thread, and install conduits through which wires are run to outlets, panels, and boxes. He also may adjust equipment controls and check and adjust instruments.

In testing electrical equipment and wiring, the maintenance electrician uses such devices as test lamps, ammeters, volt-ohm meters, and oscilloscopes. He sometimes works from blueprints and other specifications when doing repair or installation jobs. He may make mathematical computations relating to load capacities and connections of electrical wiring and equipment. The many different tasks performed by maintenance electricians call for the use of
a variety of handtools and power tools such as pliers, screwdrivers, drills, reamers, and conduit bending and threading tools.

Although all of these craftsmen possess the same basic skills and use the same tools, the nature of their work depends largely on the size of plant and the particular industry in which they are employed. In large plants, for example, these workers may specialize in the maintenance and repair of electrical machinery such as transformers, motors, and welding machines. In small plants, the electrician usually is responsible for all types of electrical work. The maintenance electrician in manufacturing plants usually repairs or maintains the electrical equipment operated in connection with the production of a specific item. For example, steel mills and aluminum plants require a large number of electricians to keep their rolling mills, heavy cranes, and other electrical and electronic equipment in good working order. In large office buildings or apartment houses, skilled electricians are needed to maintain or repair wiring; motors; and compressors used in the operation of elevators, refrigerators, lights; or other electrical equipment and fixtures.

Where Employed

Nearly 250,000 maintenance electricians were employed throughout the country in 1960. More than 110,000 of these craftsmen were engaged in servicing the equipment and machinery used in manufacturing plants. About 18,000 of these workers were employed by manufacturers of primary metal products; 29,000 in factories producing transportation equipment; 11,000 in chemical and allied products plants; 7,000 in factories producing nonelectrical machinery; 5,000 in plants producing paper and allied products; and the remainder were widely distributed among other manufacturing industries.

Of the more than 130,000 maintenance electricians working in nonmanufacturing establishments in 1960, about 50,000 were working in retail and service enterprises; approximately 35,000 were employed by Federal, State, and local governments; 13,000 by railroads, 7,500 by wholesale trade establishments; and 10,000 were employed in maintaining and repairing electrical equipment in mines. Other nonmanufacturing establishments employed the remainder of these skilled workers.

The jobs of maintenance electricians are found all over the country. Large numbers of these workers are employed in heavily industrialized States such as New York, California, Pennsylvania, Illinois, and Ohio.

Skilled workers in this trade have the advantage of being able to transfer to maintenance electrician jobs in many different industries. With some retraining they may also transfer to construction electrician jobs.

Training, Other Qualifications, and Advancement

Maintenance electricians can learn the skills of their trade through formal apprenticeship programs, or by informal on-the-job training, accumulating experience through a series of jobs in their trade. However, training authorities generally agree that apprenticeship programs give the worker more thorough knowledge of the trade and greater job opportunities during his working life.

The apprenticeship program for maintenance electricians usually lasts about 4 years. Apprentices are given on-the-job training and re-
lated technical classroom instruction in such subjects as mathematics, electrical and electronic theory, and blueprint reading. Such training may include motor repair; wire splicing; commercial and industrial wiring; installation of light and power equipment; installation and repair of electronic controls and circuits; and welding, brazing, and burning.

A young man employed in a plant as a helper to a skilled maintenance electrician may gradually acquire the skills of this craft by observing the skilled worker and working under his instructions. Other electricians learn the trade by working in the maintenance department of a plant and picking up some of the job fundamentals. By moving from job to job over a long period of time, they eventually acquire sufficient experience to qualify as skilled craftsmen.

A young man interested in becoming a maintenance electrician should include courses in mathematics (such as algebra and trigonometry), physics, electricity, and basic science in his high school or vocational school curriculum. Because electrical work is subject to constant change, many experienced electricians must continue to acquire technical knowledge and learn new skills. For example, some maintenance electricians who entered the trade some years ago now must learn basic electronics in order to service the new electronic equipment being introduced in the Nation's industrial establishments, and large commercial and residential buildings.

In selecting apprentice applicants or trainees, employers look for young men who have manual dexterity and who are interested in learning how electrical equipment functions. These young men need good color vision because electrical wires are frequently identified by their different colors. Although great physical strength is not essential, agility and good health are important.

Some maintenance electricians must be familiar with local building codes. In addition, a growing number of cities and counties require these craftsmen to be licensed. Maintenance electricians' licenses can be obtained by passing a comprehensive examination which tests their knowledge of electricity.

Skilled maintenance electricians may become foremen who supervise the work of other maintenance electricians or other maintenance personnel. Occasionally, they may advance to jobs such as plant maintenance superintendent.

**Employment Outlook**

A substantial increase in the number of maintenance electrician jobs is expected in the next decade, resulting in job opportunities for several thousand new workers each year. The anticipated industrial growth of the country and the long-term trend toward increased use of electrical and electronic equipment are expected to provide favorable employment prospects for these skilled craftsmen. Many new workers also will be needed to replace the workers who retire, die, or transfer to other fields of work. Retirements and deaths alone may result in about 3,500 to 4,500 new job openings a year during the 1960's.

The number of maintenance electricians has increased rapidly with the doubling of electric power production every 10 years since 1900. In the next decade, production is expected to double again. About half of the electric power generated today is consumed by industrial concerns, and a considerable portion of the remainder is used in homes, and in large office, hotel, and apartment buildings. Since well over half of the electricity is used in establishments which employ maintenance electricians, it is expected that the anticipated expansion in electrical power production will continue to result in increased employment of these workers.

**Earnings and Working Conditions**

In general, the earnings of maintenance electricians compare favorably with those of other skilled craftsmen. The average straight-time hourly earnings of maintenance electricians in establishments in 43 cities and areas ranged in 1959–60 from $1.87 in Greenville, S.C., to $3.16 in Detroit, Mich., Birmingham, Ala., and Charleston, W. Va. In most of the cities surveyed, however, average straight-time hourly earnings for these craftsmen ranged from $2.50 to $3.
In establishments which operate an apprenticeship program, apprentices start at about 60 percent of the journeyman's basic hourly pay rate. They receive increases every 6 months, moving up to 85 to 90 percent of the journeyman's rate during the last year of their apprenticeship.

During a single day, an electrician employed in a plant may repair electrical equipment both in a clean air-conditioned office and on the factory floor, surrounded by the noise, oil, and grease of machinery. Maintenance electricians may be called upon to climb ladders, work on scaffolds, or work in awkward or cramped positions when installing or replacing electrical equipment and performing other repair jobs.

Because they often work around high-voltage industrial equipment, maintenance electricians must be alert and accurate in carrying out their duties. Errors in wiring installations could have dangerous consequences both to the electrician and the operating employees. The safety principles which are now part of all training programs have greatly reduced the frequency of accidents. All well-trained maintenance electricians are taught to use protective equipment and clothing, to respect the destructive potential of electricity, and to handle small electrical fires.

Various labor unions have maintenance electricians in their membership. Many of these craftsmen are members of the International Brotherhood of Electrical Workers. Among other unions to which maintenance electricians belong are the International Union of Electrical, Radio and Machine Workers; the International Association of Machinists; the International Union, United Automobile, Aircraft and Agricultural Implement Workers of America; and the United Steelworkers of America. Most of the labor-management contracts covering maintenance electricians provide major benefit programs which may include paid holidays and vacations; hospitalization, medical and surgical insurance; life insurance; and retirement pensions.

Where To Go for More Information

The National Joint Apprenticeship and Training Committee for the Electrical Industry, 1200 18th St. NW., Washington 6, D.C.

The State Supervisor of Trade and Industrial Education or the local Director of Vocational Education in the State and/or city in which a person wishes to receive training will have lists of training institutions.

Millwrights

(D.O.T. 5-78.100)

Nature of Work

Millwrights are skilled workers who move and install heavy industrial machinery and other equipment. These workers must have a thorough knowledge of the complex industrial equipment on which they work because they frequently take apart, move, put together, and aline this equipment. Millwrights use hoists, cranes, jacks, crowbars, wood blocking, and other rigging devices to move heavy equipment. In assembling machinery, they fit bearings, aline gears and wheels, connect belts, and attach motors. In doing this work, they use wrenches, screwdrivers, pliers, hammers, and other handtools. After moving and erecting equipment, millwrights secure it firmly at the new site. To aline and level equipment, they use measuring devices such as micrometers, calipers, squares, plumb bobs, and levels. Millwrights often work from blueprints when preparing platforms on which machines are to be mounted or when laying out or installing plant equipment.

In addition to moving and installing equipment, millwrights often repair and maintain conveyors, cranes, hoists, scaffolds, pumps, blowers and other industrial equipment. Such work may include oiling and greasing machinery, replacing worn or broken belts, and welding metal parts. Millwrights sometimes work as part of a maintenance team of pipefitters and machinery repairmen in keeping a production line operating.
MECHANICS AND REPAIRMEN

Millwrights guiding machine into position as it is lowered by hoists.

Where Employed

Most millwrights are employed in industries that use heavy machinery and other equipment. The principal employers of the more than 70,000 millwrights at work in 1960 were the steel, machinery, automobile, paper, woodworking, chemical, and construction industries. The steel, machinery, and automobile industries, which are particularly dependent upon massive equipment in their manufacturing operations, together employed about 30,000 of these skilled workers.

Other millwrights are employed by companies that specialize in moving and installing industrial machinery on a contract basis. Some also work for machinery manufacturers who employ millwrights to install their products in customers' plants.

Millwrights work in every State. However, about half of them are employed in the heavily industrialized States of Ohio, Michigan, Pennsylvania, New York, and Illinois.

Training and Other Qualifications

Millwrights learn the trade by picking up the skills informally or through apprenticeship programs. Those workers who pick up the trade work as helpers to skilled millwrights over a period of years until they acquire sufficient knowledge and experience to be classified as skilled workers. Most training authorities agree that apprenticeship programs give young persons a more thorough preparation for his skilled trade. Apprenticeship programs generally last 4 years. Apprentices are given shop training in dismantling, moving, erecting, and repairing machinery and other equipment. They are also trained in floor layout, the installation of machinery and other equipment, rough carpentry, welding, and the use of structural steel, wood, and concrete. The apprenticeship program includes related classroom instruction in shop mathematics, blueprint reading, hydraulics, electricity, and safety. Many companies require that apprentice applicants be high school graduates between the ages of 18 and 26.

High school courses in mathematics, mechanical drawing, and machine shop practice are useful to young men interested in becoming millwrights. Because millwrights often put together and take apart complicated machinery, mechanical aptitude is helpful to young men entering the trade. Strength and agility are other important qualifications for millwright work, which often requires considerable lifting and climbing.

Employment Outlook

Employment opportunities for millwrights will increase moderately in the 1960's, providing a few thousand job openings in this trade each year. The building of new plants, the addition of new machinery, changes in plant layouts, and the maintenance of increasing amounts of heavy and complex machinery and other equipment in the 1960-70 decade are all expected to increase employment opportunities for millwrights.
The paper and pulp industry is an example of an industry which is expected to expand and further mechanize its operations. Millwrights will be needed in greater numbers in this industry to install, move, and maintain papermaking machines, cranes, conveyors, and other industrial equipment.

In addition to new job openings which will be created by industrial expansion and increased mechanization, many thousands of workers will be needed during the 1960's to replace millwrights who retire or die. Job vacancies will also be created as millwrights transfer to other lines of work.

**Earnings and Working Conditions**

The earnings of millwrights depend upon the city where they are employed as well as the type of business in which their employer is engaged. Average hourly earnings of millwrights employed in manufacturing and non-manufacturing industries in 28 large metropolitan areas in 1959–60 ranged from $2.16 in Providence to $3.10 in Detroit. More than 70 percent of these workers earned at least $2.80 an hour.

Millwrights employed by companies doing contract installation work and by construction companies usually have higher hourly wage rates than those employed in manufacturing industries. For example, the union wage rates for millwrights working in the building trades in 28 large cities in July 1959 ranged from $3 an hour in Charlotte to $3.94 an hour in Philadelphia. The average was $3.57 an hour.

The wage rates for apprentices generally start at approximately 50 percent of the skilled worker's rate and progress to the full rate by the end of the training period.

Millwrights, most of whom work in factories, ordinarily work year-round. Millwrights who work for construction companies and for companies that move and install machinery on a contract basis may have periods of unemployment between jobs.

The work of millwrights involves certain hazards. For example, there is danger of being struck by falling tools or other objects or by machinery that is being moved. There also is the danger of falling from high work places. In addition, millwrights are subject to the usual shop hazards, such as cuts and bruises. In recent years, accidents have been reduced by the use of protective devices, such as safety belts, metal hats, and shoes with metal toes. Millwrights must frequently work on dirty and greasy equipment.

Most millwrights belong to labor unions. Among the unions to which these workers belong are the International Association of Machinists; United Brotherhood of Carpenters and Joiners of America; United Steelworkers of America; International Union, United Automobile, Aircraft and Agricultural Implement Workers of America; International Brotherhood of Pulp, Sulphite and Paper Mill Workers; and the International Union of Electrical, Radio and Machine Workers. Employer-union contracts covering millwrights usually include provisions for benefits, such as paid vacations; hospitalization, medical, and surgical insurance; life insurance; sickness and accident insurance; and retirement pensions.

**Television and Radio Servicemen**

(D.O.T. 5–83.416)

**Nature of Work**

Young persons who are interested in the rapidly growing field of electronics and who, for various reasons will not attend college, will find many opportunities for employment as television and radio servicemen. These skilled workers use their knowledge of electrical and electronic parts and circuits to install and repair a growing number of electronic products. Of these, television sets are by far the most prominent; other major electronics products are radios (including home, automobile, and 2-way mobile radios), phonographs, high-fidelity sound equipment, tape recorders, and public
address systems. Many servicemen specialize in repairing one kind of equipment, for example, color television sets or automobile radios.

Most of the skilled work done by television and radio servicemen involves diagnosing trouble in equipment and making necessary repairs. Equipment may operate poorly, or break down completely, because of worn-out tubes, broken solder connections, burned resistors, dirt, moisture, or other basic troubles that affect all electronic equipment. When servicemen turn on television sets or other equipment that needs repair, signs of poor performance, such as no picture or no sound, may tell them what is wrong. Their job is to check and eliminate each possible cause of trouble, beginning with the simplest and most common cause—tube failure. In other routine checks, they look for loose or broken connections and for parts that are charred or burned (a sign that too much electricity is passing through the parts).

When simple, routine checks do not locate causes of trouble, servicemen use meters and electronic test equipment to trace the flow of electricity through wires and other parts. They work back from the point where trouble appears, measuring voltage, for example, until an unusual or irregular measurement indicates that part of the set causing trouble. A commonly used meter is the vacuum tube voltmeter. Multimeters, oscilloscopes, signal generators, and other specialized instruments also are used.

Servicemen spend much time talking with customers, particularly in homes, where most servicing is done. They advise customers what is wrong with sets and whether sets must be taken to shops for repair. They explain, in general, what must be done to fix sets and give estimates of the costs of repairs. After sets are repaired in homes or returned from shops, servicemen explain what has been done. They may make additional comments as needed to satisfy the customer and may further adjust the equipment to put it in good operating condition.

Work usually done by television and radio servicemen in homes or other places where equipment is used includes making simple electrical checks with a voltmeter, changing tubes, and making simple adjustments such as focusing the picture. Servicemen who make customer service calls carry tubes and other components that are replaced frequently. Apprentices or less experienced television servicemen install antennas on roofs or in attics and run wires from antennas to sets.

Radios and other equipment small enough to be carried to shops by customers, usually are repaired by servicemen in the shops. Television sets are repaired in shops when they develop troubles which appear only after sets have been operating for a few hours, or when the troubles can be located only with test equipment ordinarily kept in shops. Television and radio servicemen in shops often refer to wiring diagrams and instruction books (service manuals) that list parts, show connections within sets, and describe causes of trouble associated with unusual symptoms.

Television and radio servicemen use soldering irons, wire cutters, long-nosed pliers, wrenches, screwdrivers, magnifying glasses, and hammers when they remove, adjust, or replace parts, components, or complete equipment such as car radios. Such work may be time-consuming and may require patience as
well as great care to avoid damaging fragile parts, such as printed circuit boards.

Where Employed

An estimated 90,000 television and radio servicemen were employed in mid-1960. Many were self-employed. Others worked in independent local service shops, in stores that sell and service consumer electronic products, and in factories and service branches operated by manufacturers of these products.

Some servicemen are employed in almost every city, wherever television sets and radios are used. Most of them, however, work in large cities where large numbers of television sets, radios, and other electronic equipment are used and manufactured.

Training, Other Qualifications, and Advancement

School training in electronics usually is required to become a highly skilled television and radio serviceman capable of working on various types of equipment. Vocational or trade school training in electronic subjects has helped many men to qualify as expert television and radio servicemen. Correspondence school courses also may be helpful. Young men who enter military service may wish to investigate opportunities to get training and work experience in servicing electronic equipment, because such experience often is valuable in civilian electronics work, including television and radio servicing. From 2 to 3 years’ combined training and on-the-job experience are required to become a qualified television and radio serviceman. Men without previous training may be hired as helpers or apprentices if they show aptitude for the work or, like the amateur (“ham”) radio operator, have a hobby in electronics.

Many employers and manufacturers conduct training programs at factories or through local distributors for television and radio servicemen, especially when new models or new products are introduced. Servicemen also keep up with new developments by studying manufacturers’ instruction books and technical magazines covering electronics service work.

Television and radio servicemen need a good background in mathematics and physics in order to understand the equipment they work on. They must know how electronic components work, and why they function as they do. They must be able to understand technical publications. Television and radio servicemen must also be tactful and courteous in dealing with customers.

Other essential qualifications of television and radio servicemen are ability to manipulate small parts and tools, good hand-eye coordination, normal hearing, and excellent eyesight and color vision. Often these servicemen work with delicate wires and parts that are identified only by color codes.

Television and radio servicemen may advance within the service field and become foremen or service managers. They may also be promoted to other higher paid work, such as technical writing, sales engineering, design, and training. Many become owners of independent television and radio service shops. Others may combine a sales and service business.

Young persons interested in advancing to higher level positions as electronic technicians or supervisors can improve their opportunities by taking trade school, correspondence, technical institute, or other types of advanced courses in electronic engineering, television engineering, automatic controls, engineering mathematics, and other subjects related to electronics.

Television and radio servicemen often are able to transfer to jobs as electronic mechanics or servicemen in manufacturing industries or government service.

Employment Outlook

Television and radio servicemen will continue to have good employment opportunities in the 1960’s. A few thousand job openings probably will become available each year. Most of these openings will occur because of the growing number of electronic products in the home. Others will result from replacement of servicemen who transfer to other jobs, are promoted, or who retire or die.

In 1960, almost 9 of every 10 households had
television sets. As population increases, the number of television sets will also increase. In addition, the number of homes with two or more television sets and radios is expected to continue to grow. Greater use of television sets is also expected in business and industry, and schools and other institutions. For example, using television sets which show pictures sent from cameras set up in several different locations, a factory guard can check several places at the same time, or a nurse can watch patients in several different rooms at once.

Most automobiles and many taxicabs and trucks are equipped with radios. Two-way radios are often used by companies to keep in touch with drivers. Growing numbers of motor vehicles thus will result in increasing demand for radio service work.

In recent years, improvements in television sets and radios (such as the use of transistors in place of tubes) have tended to reduce the amount of service this equipment requires. Similar developments in the future may slow down employment growth expected to result from increasing use of consumer electronic products. In the long run, however, technological developments will increase employment opportunities for those television and radio servicemen with a broad knowledge of electrical and electronic circuits.

Earnings and Working Conditions

According to limited information, most full-time employed skilled television and radio servicemen in 1960 earned from $100 to $115 a week, but some earned as much as $130 a week. Starting pay was about $60 to $70 a week.

Television and radio servicemen employed in local service shops or dealer service departments commonly work a 6-day, 48-hour week. In large shops, including manufacturers’ service branches, they usually work a basic 40-hour week. Servicemen often work at night and on weekends, and for more than 8 hours a day. Usually they receive extra pay for overtime or night work.

Television and radio service is performed in shops and homes where working conditions are usually pleasant. Inside (shop) servicemen work at benches provided with stools. Outside servicemen may spend an hour or more a day driving between shops and customers. Some physical strain is involved in lifting and carrying sets. Perhaps the greatest hazard is the risk of falling from roofs while installing antennas. Electrical shock is another hazard, but it has rarely caused serious injury.

Some employers of television and radio servicemen provide paid vacations and holidays after a specified number of years’ service. Many also provide or help pay for health and insurance benefits.

Where To Go for More Information

Additional information about jobs in television and radio servicing may be obtained from local servicemen, local dealers who sell and service television sets and other electronic equipment, and manufacturers of television sets who provide training for servicemen. Local vocational schools which offer courses in television or electronics may also provide helpful information.

Watch Repairmen

(D.O.T. 4-71.510)

Nature of Work

Watch repairmen or “watchmakers” repair and adjust watches, clocks, and other timepieces. This work is precise and delicate. First, the working parts of the watch are removed from the case and examined with the aid of a magnifying eyeglass. The repairmen may then replace the mainspring, hairspring, balance and other wheels, or broken jewels, and adjust improperly fitted wheels and other parts. The parts may also be cleaned and oiled before the dials, hands, crystal, and wristband are reassembled. The development of interchangeable mass-produced parts has decreased the need for
making parts by hand but factory-made parts sometimes must be adjusted to insure a "true" fit. In their work, watch repairmen use small lathes and handtools such as tiny pliers and screwdrivers.

Watchmakers who own or work in retail jewelry stores also repair jewelry and may sell watches, jewelry, silverware, and other items such as china and lamps. They may also hire and supervise salesclerks, other watch repairmen, jewelers, and engravers; arrange window displays; purchase goods to be sold; and handle other managerial duties.

Where Employed

Most watch repairmen work in retail jewelry stores or in separate watch repair shops, either as owners or as employees. Many are employed by department stores and mail order houses or operate watch repair concessions in such establishments. Others work for trade shops (not usually open to the public) which repair watches for retail stores. A number work for jeweled-watch factories and importing firms or teach in watch repair schools.

There are probably over 25,000 watch repairmen employed in all parts of the country, chiefly in the New York City area and in other large cities.

Training, Other Qualifications, and Advancement

A few States—Florida, Iowa, Indiana, Kentucky, Louisiana, Minnesota, Oregon, Tennessee, and Wisconsin—require that watch repairmen obtain a license to work at the trade. To obtain a license, they must pass an examination designed to test their skill with tools and their knowledge of watch construction and repair. Watchmakers in all States, however, can demonstrate their ability by passing an examination given by the American Watchmaking Institute. The certificate awarded watchmakers who pass this examination is widely recognized by employers as an indication of an acceptable standard of skill.

Many young people prepare for this trade through courses given in private watch repair schools. Some enter through vocational high school training. Others are trained in formal apprenticeship or other on-the-job training programs.

Watch repair schools generally have no specific educational requirements for entrance, although most students are high school graduates. The length of time required to complete the course—usually 18 months to 2 years—is determined by its content, the ability of the individual student, and whether attendance is full or part time. In most watch repair schools, a considerable amount of time is spent taking apart various types of watch movements and reassembling them, truing hairsprings, removing and replacing balance staffs and balance wheels, learning how to use a watchmaker's lathe, and cleaning watches. Some schools offer courses in the repair of unusual types of timepieces, for example, chronographs and new-type electric or electronic watches. Students are required to furnish their own tools.

Important qualifications for success in this field are mechanical aptitude, finger dexterity, a sensitive touch, good vision (with or without glasses), and patience. For those interested in owning or working in a retail store, salesmanship and a good business sense are desirable.

Beginners with sufficient funds—about $1,000 to $1,500 is needed to purchase a watch-timing machine and other tools and equipment—may open their own watch repair shops. Some watch repairmen gradually extend their serv-
ices to include the sale of various items of jewelry and eventually establish retail jewelry stores.

**Employment Outlook**

Employment opportunities will continue to be good through the mid-1960's for experienced watch repairmen who have established reputations for doing high quality work. Jobs for beginners, however, are likely to be somewhat limited. A few new jobs will become available, particularly in small cities where business activities are expanding and in newly established shopping centers in the suburbs of large cities. In addition, inexperienced watchmakers as well as other persons with the qualifications important in watch repairing will be in growing demand to work on miniature devices, especially in industries producing electronic equipment. Nevertheless, most openings will probably continue to rise from the need to replace repairmen who retire, transfer to other fields of work, or die.

Employment of watchmakers is likely to rise slowly over the long run. Factors that will tend to increase the demand for watchmakers will be partially offset by other factors that will operate to decrease it. For example, the number of watches in use will undoubtedly rise as the population increases. In addition, the trends toward owning more than one watch, wearing watches as costume jewelry, and buying more children's watches are expected to continue. The popularity of small watches, which need repair more frequently than large ones, and the introduction of more complicated timepieces—chronographs, calendar watches, and self-winding watches—will also help maintain a large volume of repair work. On the other hand, sales of inexpensive watches which can be replaced at a price as low as the cost of repairing them will probably continue to grow; competition from persons employed in other fields who repair watches in their spare time is expected to continue; and new types of watches are being developed which will require less repair.

**Earnings and Working Conditions**

Salaries of most beginning watchmakers ranged from about $60 to $80 a week in 1960 depending on individual ability and the type and place of employment. Experienced journeymen employed in retail stores generally received from $85 to $125 for a 40-hour week. Watch repairmen who are in business for themselves usually earn considerably more than those working for a salary. Earnings of the self-employed depend on the amount of repair work done and, in the case of watchmakers who own retail jewelry stores, the volume of sales.

Watchmakers frequently work longer than the standard 40-hour week. Those who are self-employed or located in small communities usually work a 48-hour week or longer. There may be some tendency toward eye strain, but the work involves little physical exertion. This light, sedentary work is frequently recommended to certain handicapped and disabled workers.

**Where To Go for More Information**

Information on schools giving training courses acceptable to the trade, as well as on watch repairing as a career, may be obtained from:

American Watchmakers Institute,
MACHINING OCCUPATIONS

Almost every product of American industry contains metal parts or is manufactured by machines made of metal parts. Many of these metal parts are made by machining workers, who make up the largest occupational group in the metalworking trades. In late 1960, more than a million workers were employed as all-round machinists, machine tool operators, tool and die makers, instrument makers, setup men, and layout men.

Machining workers, one of the most important groups of workers in the labor force, use machine tools to form metal to desired shapes and sizes with great accuracy. Metal parts which must fit together exactly are first shaped by casting, forging, rolling, or stamping, and then finished to more precise measurements by machining.

Nature of Work

The principal job of machining workers is to operate machine tools. A machine tool is a power-driven machine which holds firmly both the piece of metal to be shaped and a cutting instrument, or “tool,” and brings them together so that the metal is cut, shaved, ground, or drilled. In some cases, the cutting tool is moved and the metal is held stationary; in others, the metal is moved against a stationary tool.

The most common types of machine tools are: grinding machines, drilling machines, lathes, milling machines, cutoff machines, polishing and buffing machines, boring mills, shapers, and planers. Lathes turn and shape metal against a sharp cutting tool. Grinding machines smooth metal parts by means of power-driven abrasive wheels. Boring mills and drilling machines make holes in metal. Milling and broaching machines cut or remove excess metal with tools which have several cutting heads. Shapers and planers are machine tools which produce flat surfaces.

Accuracy is very important in metal machining work. Metal products usually are made of separate parts which must be interchangeable and thus easily assembled by mass-production processes. Metal parts sometimes are machined accurately to within one-tenth thousandth of an inch (which is only one-thirtieth the width of a human hair). Machining workers follow directions which generally are given in drawings or blueprints which may specify exact dimensions of finished parts. Machining workers frequently use micrometers and other precision-measuring instruments to check the accuracy of their work against these specifications.

Besides operating machine tools, skilled machining workers also lay out and assemble metal parts. They use chisels, scrapers, files, and other small handtools in chipping, filing, and polishing the parts so that they will fit together exactly.

The all-round machinist is a skilled worker who can operate most types of machine tools. The largest number of machining workers are skilled and semiskilled machine tool operators who run lathes, drilling machines, milling machines, grinders, and other machine tools. Unlike all-round machinists, machine tool operators commonly work with only one kind of machine tool.

A highly skilled machining job is that of tool and die maker, who specializes in making dies for use with presses and die casting machines, devices to guide drills into metal, and special gages to determine whether the work meets specified tolerances. Another highly skilled machining job is that of instrument maker who machines, with great accuracy, instrument parts made of metal or other materials, and often assembles and tests instruments. Setup men and layout men are skilled specialized workers employed in plants which produce large amounts of metal products. Setup men adjust machine tools so that semiskilled machine tool operators can run the machine and perform the proper
machining operations. Layout men mark machining directions on metal so that an operator can perform the proper machining operations. (A detailed discussion of the types of work performed by workers in each of these machining occupations is presented later in this chapter.)

Since continuous attention is required when machine tools are in operation, the work may be rather tedious, especially on simple and repetitive machining jobs. However, where the work is varied and complex, and standards of accuracy are high, a worker can experience the satisfaction which comes to a capable and conscientious craftsman in a highly skilled trade.

Location of Machining Work

An estimated 600,000 machine tool operators, 300,000 machinists, 150,000 tool and die makers, 35,000 instrument makers, and 45,000 setup men and layout men were employed in machining jobs in late 1960. About two-thirds of these workers were employed in the metalworking industries, mostly in plants which manufacture machinery, transportation equipment such as automobiles and aircraft, fabricated metal products, and electrical machinery and equipment. (See chart 23.)

Many thousands were employed in nonmetalworking establishments such as repair shops of railroads and maintenance shops of factories which make textiles, paper, glass, or chemicals (usually one or only a few machinists worked in each of these establishments). A smaller number worked in industrial and university research laboratories and shops which fabricate models of new products.

Machining workers are employed in every State and in almost every city in the country. More than half of all machining workers are employed in Ohio, New York, Illinois, California, Michigan, and Pennsylvania. Other States with large numbers of machining workers are: Massachusetts, Connecticut, New Jersey, Indiana, Wisconsin, and Texas. Maintenance machinists are employed in almost every city. Most instrument makers are employed in New York City, Chicago, and a few other large cities.

Training, Other Qualifications, and Advancement

The common method of entering skilled machining occupations is through apprenticeship, which is a period of formal on-the-job training during which the new worker learns all the aspects of his trade. He is taught how to operate machine tools, and how to use handtools and measuring instruments. In addition to shop training, the apprentice is given classroom instruction in blueprint reading, mathematics, and other related subjects. In choosing apprentices, employers usually prefer young men who have a high school or trade school education. Some companies use aptitude tests to determine whether apprentice applicants have the necessary mechanical ability and the temperament suited to perform this exacting work. Machining workers must also have good vision, and superior judgment of depth and distance.

Most machine tool operators and some machinists, tool and die makers, and instrument makers have “picked up” the skills of their trade informally through experience on several jobs. They generally start in the less skilled machining jobs and gain “know-how” while working with experienced craftsmen. They gradually advance to more skilled jobs as they
acquire experience and knowledge. Some of these workers improve their qualifications for the more skilled trades by taking courses in blueprint reading and shop mathematics in vocational schools.

Because machining work is not physically strenuous, women are sometimes employed as machine tool operators. Relatively few women are employed in skilled machining occupations.

Skilled machining workers have several advancement opportunities. For example, many can advance to supervisory positions such as foreman. Tool and die makers and instrument makers can advance to technical positions, such as tool designer. Skilled machining workers also can open their own tool and die shops or machine shops.

**Employment Outlook**

There will be thousands of opportunities for workers to get jobs as tool and die makers, all-round machinists, instrument makers, machine tool operators, layout men, and setup men in the 1960′s. A large proportion of these job openings will result from the need to replace workers who transfer to other fields of work, or who retire or die.

Despite changing business conditions and technological developments, the long-range trend of production-worker employment in the metalworking industries has been upward. During the 1960′s, the number of workers employed in machining jobs in these industries is expected to increase moderately because of increasing demands for consumer products such as automobiles and appliances, and for industrial goods such as machinery and instruments.

Employment opportunities for machining workers during the 1960′s also may be favorably affected by defense spending, since it appears likely that the Armed Forces will increase their purchases of metal products. Many military products will be new products, involving new metals or alloys and requiring special machining skills.

Employment in the individual machining occupations is expected to increase at varying rates. Technological changes are expected to cause employment of machine tool operators, setup men, and layout men to increase more slowly than employment of other machining workers. A new technological development is the use of automated machining lines in which machine tools are linked together for automatic production operations. Cutting speeds are also increasing. Increasing mechanization and growth in nonmetalworking industries have expanded needs for maintenance machinists who keep mechanical equipment in good condition. Machining workers employed in maintenance shops tend to have fairly steady employment over the years, because the amount of work they must do is not wholly dependent on changes in the volume of production. Maintenance work continues even when production declines.

The numerical control of machine tools is another technological advance—not yet widespread—which may affect machining workers. The use of numerically controlled machine tools broadly involves the following sequence of operations: Engineers or draftsmen translate part dimensions and tolerances, cutter shapes and sizes, cutting paths and sequences, and other data into numbers or codes representing numbers. These numbers are punched on tapes or cards which are inserted into electronic devices that translate numbers into motions or actions such as drilling or cutting. The machine tool operator simply installs the tool, inserts and removes the workpiece, and changes the tapes or cards.

Specific effects of numerically controlled machine tools on the employment of machining workers could not be measured accurately in early 1961. However, numerical controls may greatly simplify the jobs of many machining workers and increase their production efficiency. Also, employment growth may be slowed in some machining occupations. (These effects are discussed in the sections of this chapter which cover individual machining occupations.)

In addition to the expected rise in machining employment, replacement needs will create thousands of openings. Retirements and deaths of experienced men alone may provide about 20,000 openings annually during the 1960′s. This will be a particularly important factor
in the skilled machining occupations, which have a relatively high proportion of older workers. In the less skilled occupations, shifting into other occupations is fairly common, and many openings will arise in this way.

**Earnings and Working Conditions**

The earnings of skilled machining workers generally compare favorably with those of other skilled industrial workers. Tool and die makers and instrument makers are the highest paid workers in the machining group, and among the highest paid skilled workers in manufacturing. Detailed earnings information is presented in most of the discussions of the individual occupations.

Most machine shops are fairly clean, well lighted, and free from dust. Safety instructions are an important part of job training. Because they work with high speed machine tools and sharp cutting instruments, workers in these occupations need good safety habits. Persons working around machine tools are prohibited from wearing loose fitting clothing and frequently wear protective goggles.

Machining work is not physically strenuous. The machine tools do the actual cutting while the machining worker sets the machine, watches the controls, and checks the accuracy of the work. The workers, however, usually stand at their jobs most of the day and move about frequently.

Companies that employ machining workers generally provide paid holidays and paid vacations. Life insurance, hospitalization, medical and surgical insurance, sickness and accident insurance, and pensions also are often available to machining workers.

The great majority of machining workers are members of unions. Among the labor organizations in this field are the International Association of Machinists; the International Union, United Automobile, Aircraft and Agricultural Implement Workers of America; the International Union of Electrical, Radio and Machine Workers; the United Steelworkers of America; and the Mechanics Educational Society of America.

**Where To Go for More Information**

The National Machine Tool Builders Association, 2139 Wisconsin Avenue, Washington 7, D.C.—whose members build a large percentage of all machine tools used in this country—will supply information on career opportunities in the Machine Tool Industry.

The National Tool & Die Manufacturers Association, 907 Public Square Building, Cleveland 13, Ohio, offers information on apprenticeship training, including Recommended Apprenticeship Standards for Tool and Die Makers, certified by the U.S. Department of Labor's Bureau of Apprenticeship and Training.

Many local offices of the State employment service, affiliated with the U.S. Employment Service, offer free aptitude testing to persons interested in determining their capacity to acquire the skills necessary for the all-round machinist and tool and die making trades. The State employment service also refers applicants for apprentice programs to employers. In many communities, applications for apprenticeship are also received by labor-management apprenticeship committees.

Apprenticeship information also may be obtained from the following international unions (which have local offices in many cities):

- International Association of Machinists, 1300 Connecticut Ave. NW., Washington 6, D.C.
- International Union of Electrical, Radio and Machine Workers, 1126 16th St. NW., Washington 6, D.C.
All-Round Machinists
(D.O.T. 4-75.010 and .120)

Nature of Work

The all-round machinist is a skilled metal worker who makes metal parts with machine tools. A machinist can set up and operate most types of machine tools. His wide knowledge of shop practice and the working properties of steel, cast iron, aluminum, brass, and other metals, and his understanding of what the various machine tools do, enable him to turn a block of metal into an intricate part meeting precise specifications.

Variety is the main feature of the work of an all-round machinist. He plans and carries through all operations needed in turning out machined products. He may switch from one kind of product to another. An all-round machinist selects the tools and material required for each job and plans the cutting and finishing operations in order to complete the finished work according to blueprint or written specifications. He makes standard shop computations relating to dimensions of work, tooling, feeds, and speeds of machining. He often uses precision-measuring instruments such as micrometers and gages to measure the accuracy of his work to thousandths of an inch. After completing machining operations, he may finish the work by hand, using files and scrapers, and then assemble the finished parts with wrenches and screwdrivers. The all-round machinist also “heat treats” cutting tools and parts to improve machinability.

Machinists employed in maintenance departments to make or repair metal parts of machines and equipment also have a broad knowledge of mechanical principles. They sometimes adjust and test the parts they have made or repaired for a machine.

Where Employed

Almost every factory using a substantial amount of machinery employs machinists to keep its mechanical equipment operating. The majority of the approximately 300,000 machinists employed in late 1960 worked in maintenance shops of a wide variety of industries such as the railroad, textile, automobile, and printing industries. Many were employed in Navy yards and other installations of the Federal Government. Some machinists worked in metalworking factories where large quantities of identical parts are produced, as well as in machine shops where a limited number of varied products are made.

An important advantage of this occupation is that machinists can be employed in almost every locality and industry because their skills are required to maintain all types of machinery. The largest number of machinists jobs are found in heavily industrialized States.

Training, Other Qualifications, and Advancement

According to most training authorities, a 4-year apprenticeship is the best way to learn the machinist trade. Many machinists, however, have qualified without an apprenticeship by picking up the trade over years of varied
experience in machining jobs. Several companies have training programs which qualify some of their employees as machinists in less than 4 years.

A young person interested in becoming a machinist should be mechanically inclined and temperamentally suited to do highly accurate work that requires concentration as well as physical effort. A high school or vocational school education is desirable preparation for machinist training and is required by many employers. Courses in mathematics and physics and some knowledge of electronics and hydraulics may be helpful both during and after apprenticeship training.

A typical machinist apprentice program lasts 4 years and consists of approximately 8,000 hours of shop training and about 570 hours of related classroom instruction. Shop training includes the learning of proper machine speeds and the operation of the various types of machine tools. The apprentice also is taught chipping, filing, hand tapping, dowel fitting, riveting, and other hand operations. In the classroom, the apprentice studies blueprint reading, mechanical drawing, shop mathematics, and shop practices.

A machinist who has just finished his apprentice training often is assigned the job of operating a single type of machine tool. With additional experience, he may be assigned jobs requiring him to operate several types of machine tools as well as to perform hand operations. Some journeymen machinists, however, remain machine tool specialists and do highly skilled work with one type of machine tool.

Numerous promotional opportunities are available to all-round machinists. Many advance to foreman of a section or to other supervisory jobs. With additional training, others may become tool and die makers or instrument makers. A skilled machinist has excellent opportunities to advance into other technical jobs in process planning, machine programming, and tooling. Machinists can also open their own machine shops.

**Employment Outlook**

Many workers will obtain jobs as machinists in the 1960's. Some opportunities will develop because of the expected increase in employment in this occupation. Thousands of new workers also will be needed each year to replace machinists who transfer to other fields of work, or who retire or die. In this relatively large occupation, retirements and deaths alone may result in about 6,000 job openings annually during the 1960's.

The employment of machinists is expected to increase especially in maintenance shops as industries continue to use a greater volume of complex machinery and equipment. Skilled maintenance machinists are needed to prevent costly breakdowns in highly mechanized plants where machine tools often are linked together by transfer equipment. In such plants, a breakdown of one machine may stop many other machines.

**Earnings and Working Conditions**

The earnings of all-round machinists compare favorably with those of other skilled factory workers.

Maintenance machinists employed in various manufacturing industries in 37 selected areas in 1960, received average straight-time hourly earnings ranging from $1.87 in Greenville, S.C., to $3.17 in Detroit and Milwaukee. Average straight-time hourly earnings of maintenance machinists employed in these industries in the following 15 cities were:

- Atlanta ........................................ $2.54
- Birmingham ................................... 3.14
- Chicago ........................................ 3.08
- Cincinnati .................................... 2.81
- Detroit ......................................... 3.17
- Greenville .................................... 1.87
- Houston ........................................ 3.04
- Los Angeles–Long Beach .................... 3.01
- Milwaukee ...................................... 3.17
- Minneapolis–St. Paul ....................... 2.96
- New York ...................................... 2.90
- Portland, Oreg. ............................... 3.03
- Rockford, Ill. ................................. 2.65
- San Francisco–Oakland ..................... 3.10
- Worcester .................................... 2.68

Machinists must follow strict safety regulations when working around high speed machine tools. The greater use of safety goggles and other protective devices in recent years
has reduced the accident rate for these workers.

Most companies which employ machinists provide paid holidays and paid vacations. Many machinists also receive benefits such as life insurance, medical and surgical insurance, and retirement pensions.

Unions to which many machinists belong include the International Association of Machinists; the International Union, United Automobile, Aircraft and Agricultural Implement Workers of America; the International Union of Electrical, Radio and Machine Workers; and the United Steelworkers of America.

(See introductory section of this chapter for Where To Go for More Information.)

Machine Tool Operators

(D.O.T. 4-78.000 through .589 and 6-78.000 through .589)

Nature of Work

Machine tool operators shape metal to precise dimensions by the use of machine tools. Although some operators can operate several tools, most can operate only one or two machine tools. Many operators are essentially machine tenders who perform simple, repetitive operations which can be learned quickly. Other machine tool operators, however, are much more skilled and can perform complex and varied machining operations.

The work of skilled machine tool operators is similar to that of all-round machinists, except that often it is limited to a single type of machine and involves little or no hand fitting or assembly work. (By contrast, all-round machinists can operate almost every machine tool.) The skilled machine tool operator plans and sets up the correct sequence of machining operations in accordance with blueprints, layouts, or other instructions. He adjusts speed, feed, and other controls and selects the proper cutting tools for each operation. Adjustments may be necessary during machining operations, and changes in setup also may be required. Therefore, the skilled operator must be able to use all the special attachments of his machine. Upon completing his work, he checks measurements with micrometers, gages, and other precision measuring instruments to see whether they meet specifications. The skilled machine tool operator also may select cutting and lubricating oils used to cool metal and tools during machining operations.

The majority of machine tool operators are much less skilled than the operators described above. A typical job of a semiskilled operator is to place rough metal stock in a machine tool on which the speeds, feeds, and operation sequence have already been set by a skilled worker. The operator watches the machine and calls his supervisor when anything unusual happens. Special, easy-to-use gages help him to measure work quickly and accurately. The operator with limited training may make minor adjustments to keep his machine tool operating, but he depends on skilled machining workers for major adjustments.

Lathes, drill presses, boring machines, grinding machines, milling machines, and automatic...
screw machines are among the machine tools used by machine operators. Both skilled and semiskilled operators have job titles based upon the kind of machine they operate, such as engine lathe operator, milling machine operator, and drill press operator.

Where Employed

Machine tool operators are primarily employed in metalworking factories where metal parts for automobiles, aircraft engines, machinery, and other metal products are mass produced. Because of their limited training, few semiskilled operators can work either in the maintenance department of a plant or in a machine shop which produces small quantities of parts to special order. Skilled machine tool operators, on the other hand, can work in production, job, or maintenance shops, and in toolrooms, because their greater skills widen their job opportunities.

Machine tool operator jobs are found in greatest number where metalworking industries are located. States leading in the employment of operators are Ohio, Illinois, Michigan, New York, California, and Pennsylvania.

Training, Other Qualifications, and Advancement

Most machine tool operators learn their skills on the job. A new worker usually starts by observing a skilled operator at work. When the learner is operating a machine, he is supervised closely by a more experienced worker. The new worker learns how to use measuring instruments and to make elementary computations needed in shop work. He gradually acquires experience and learns to operate a machine tool, read blueprints, and plan the sequence of machining work.

Individual ability and effort largely determine how long it takes to become a machine tool operator. Semiskilled machine tool operators generally learn their jobs within a few months. A period of 1 1/2 to 2 years of on-the-job training and experience generally is required to become a skilled machine tool operator. Some skilled machine tool operators' jobs are filled by men who have completed machinists' apprentice-ships. Some companies have formal training programs for new employees which acquaint them with the details of machine tool operation and machining practice.

Although there are no special educational requirements for semiskilled operator jobs, young persons seeking these jobs can improve their job opportunities by completing courses in mathematics and blueprint reading. In hiring unskilled operators, employers often look for persons who also have mechanical aptitude and some experience working with machinery.

Skilled machine tool operators can advance to jobs as all-round machinists and tool and die makers. They may also advance into process planning, machine programming, and maintenance jobs.

Employment Outlook

Anticipated growth in the metalworking industries in the 1960's is expected to cause some increase in employment of machine tool operators. In addition, the need to replace those workers who transfer to other jobs, retire, or die, may also provide many job opportunities each year. Retirements and deaths alone may result in about 10,000 job openings each year during the 1960's.

Technological developments may affect both the number and skill requirements of machine tool operators. The continued development and use of faster and more versatile automatic machine tools will result in greater output per operator. Future widespread use of numerically controlled machine tools would also slow employment of machine tool operators (see discussion on page 448). Workers with thorough backgrounds in machining operations, mathematics, blueprint reading, and good working knowledge of the properties of metals will be better able to adjust to future technological changes and to find new jobs in the machining field.

Earnings and Working Conditions

Machine tool operators are paid on an hourly rate or incentive basis, or on the basis of a combination of both methods of wage payments. Operators employed in production shops are usu-
ally classified as class A, class B, and class C operators, according to their skill level. Class A operators are the most highly skilled and usually are paid the highest rates. (In the machinery manufacturing industry in 1959-60, class A operators received 20 to 40 cents an hour more than class B operators, and 40 to 80 cents an hour more than class C operators.) Average straight-time hourly earnings for class A drill press, engine lathe, and milling machine operators in the machinery manufacturing industry in 1959-60, were as follows:

<table>
<thead>
<tr>
<th>Location</th>
<th>Drill press operators, single or multiple, class A</th>
<th>Engine lathe operators, class A</th>
<th>Milling machine operators, class A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baltimore</td>
<td>$2.42</td>
<td>$2.88</td>
<td></td>
</tr>
<tr>
<td>Boston</td>
<td>$2.56</td>
<td>2.48</td>
<td>2.66</td>
</tr>
<tr>
<td>Buffalo</td>
<td>2.34</td>
<td>2.54</td>
<td>2.56</td>
</tr>
<tr>
<td>Chicago</td>
<td>2.65</td>
<td>2.77</td>
<td>2.89</td>
</tr>
<tr>
<td>Cleveland</td>
<td>3.02</td>
<td>2.73</td>
<td>2.85</td>
</tr>
<tr>
<td>Dallas</td>
<td>2.13</td>
<td>2.33</td>
<td>2.30</td>
</tr>
<tr>
<td>Denver</td>
<td></td>
<td>3.22</td>
<td>3.19</td>
</tr>
<tr>
<td>Detroit</td>
<td>2.80</td>
<td>3.12</td>
<td>3.15</td>
</tr>
<tr>
<td>Hartford</td>
<td>2.16</td>
<td>2.63</td>
<td>2.59</td>
</tr>
<tr>
<td>Houston</td>
<td>2.41</td>
<td>2.80</td>
<td>2.74</td>
</tr>
<tr>
<td>Los Angeles—Long Beach</td>
<td>2.41</td>
<td>2.75</td>
<td>2.70</td>
</tr>
<tr>
<td>Milwaukee</td>
<td>2.73</td>
<td>2.80</td>
<td>2.87</td>
</tr>
<tr>
<td>Minneapolis—St. Paul</td>
<td>2.48</td>
<td>2.52</td>
<td>2.56</td>
</tr>
<tr>
<td>Newark—Jersey City</td>
<td>2.38</td>
<td>2.58</td>
<td>2.61</td>
</tr>
</tbody>
</table>

Machine tool operators are required to wear protective goggles and to avoid wearing loose-fitting garments when working around high speed machine tools. Increasing emphasis upon these and other safety regulations in recent years has reduced the accident rate for these workers.

Most machine tool operators are members of the International Association of Machinists; the International Union of Electrical, Radio and Machine Workers; the International Union, United Automobile, Aircraft and Agricultural Implement Workers of America; the United Steelworkers of America; and other unions. Most labor-management contracts covering these workers provide health insurance, life insurance, pensions, and other benefits.

(See introductory section of this chapter for Where To Go for More Information.)

### Tool and Die Makers

(D.O.T. 4-76.010, .040, and .210)

#### Nature of Work

Tool and die makers are highly skilled, creative workers whose products—tools, dies, and special guiding and holding devices—are the basis of mass production in metalworking industries. Tool makers specialize in producing jigs and fixtures (which are devices required to hold metal while it is being shaved, stamped, or drilled). They also make gages and other measuring devices which are used in manufacturing precision metal parts. Die makers construct metal forms (dies) which are used in stamping and forging operations to shape metal. They also make metal molds used in die-casting and in molding plastics. Tool and die makers also repair dies, gages, jigs, and fixtures. Some tool and die makers help design tools and dies.

In comparison with most other machining workers, tool and die makers have a broader knowledge of machining operations, shop practices, mathematics, and blueprint reading, and can work to closer tolerances and do more precise handwork. Tool and die makers use almost every type of machine tool and precision measuring instrument. They work with all metals and alloys commonly used in manufacturing.

#### Where Employed

Approximately 150,000 tool and die makers were employed in 1960. The largest numbers were employed in plants making industrial, construction, and farm machinery and equipment. The automobile, aircraft, and other trans-
MACHINING OCCUPATIONS

Apprentice receiving pointers on die construction from experienced tool and die maker.

Portion equipment industries also employed large numbers of tool and die makers. Several thousand of these craftsmen worked in small tool and die jobbing shops, which make tools, dies, and other machine tool accessories for use in metalworking factories. Companies manufacturing electrical machinery and fabricated metal products were other important employers of tool and die makers. Many nonmetalworking industries also employed tool and die makers.

Nearly half of all tool and die makers are employed in California, Ohio, Michigan, New York, and Illinois. Other States with many of these skilled craftsmen are Pennsylvania, New Jersey, Indiana, and Massachusetts. Detroit, Cleveland, Chicago, and Los Angeles are important job centers for tool and die makers.

Training, Other Qualifications, and Advancement

Tool and die making requires several years of varied training and experience which is obtained through formal apprenticeship or equivalent on-the-job training. Since this work is highly skilled, persons planning to enter the trade should have a good working knowledge of mathematics and physics as well as considerable mechanical ability, finger dexterity, and a liking for painstaking work. In selecting apprentices, most employers prefer young men with high school or trade school education. Some employers test apprentice applicants to determine their mechanical aptitudes and their abilities in mathematics.

A tool and die apprenticeship ordinarily lasts 4 or 5 years. Most of the time is devoted to practical shop training, but some classroom work also is part of the training program. During shop training, the apprentice learns to operate major machine tools, such as lathes and milling machines. He learns to use handtools in fitting and assembling tools, gages, and other mechanical equipment. Tool and die maker apprentices study heat treating and other metalworking processes. Classroom training in shop mathematics, shop theory, mechanical drawing, tool designing, and blueprint reading also is given to apprentices. After apprenticeship, several years' experience often is necessary to qualify for more difficult tool and die work. Some companies have separate apprenticeship programs for toolmaking and diemaking.

Many metal machining workers have become tool and die makers without completing formal apprenticeships. These men, after years of experience as machine tool operators or as machinists and after vocational or correspondence school training, have developed into all-round workers who can skillfully perform almost any metal machining operation, including tool and die making.

The increasing complexity of modern machinery and metalworking equipment is raising the technical and mental skill requirements for tool and die making. A knowledge of mathematics, the basic sciences, electronics, and hydraulics will give young persons entering this occupation greater opportunities to further their careers.

An early investment in thorough training for this occupation may lead to better paying jobs in the future. Men who have had tool and die training often advance to supervisory and administrative positions in industry. Many tool and die makers become tool designers. Others may open their own tool and die shops.
Employment Outlook

An increasing number of tool and die makers will be needed in the 1960's as a result of the anticipated expansion of metalworking activity. In addition, many openings may become available as workers transfer to other fields of work, retire, or die. Retirements and deaths alone may result in about 3,000 job openings annually in the 1960's.

The anticipated long-range expansion in the aircraft and missile, machinery, and other metalworking industries will result in a continued increase in the employment of tool and die makers. Their skills are needed to make the dies and tools used to produce the large numbers of identical metal parts which are often required in these industries.

Unlike other machining workers, whose employment may be adversely affected by technological changes, tool and die makers will help to put many technological developments into effect. More tool and die makers will be needed to make and repair the dies and holding devices used in mass-production industries. However, numerically controlled machining operations may require fewer of the special tools and jigs and fixtures which are now made by tool and die makers. (See page 448 for a discussion of numerical control and other technological changes.)

Tool and die makers, as a group, have a longer working life than many other workers in the labor force. Their jobs require extensive skill and knowledge which can be acquired only after years of experience. For this reason, companies are reluctant to lay off tool and die makers, even when production is decreased. Furthermore, tool and die makers have greater occupational mobility than other workers. They can transfer to jobs as instrument makers or machinists, or find jobs in other industries.

Earnings and Working Conditions

Tool and die makers are among the highest paid metal machining workers. In 1959–60, average straight-time hourly earnings of tool and die makers in machinery manufacturing job shops in the following cities were:

<table>
<thead>
<tr>
<th>City</th>
<th>Earnings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boston</td>
<td>$2.77</td>
</tr>
<tr>
<td>Buffalo</td>
<td>2.73</td>
</tr>
<tr>
<td>Chicago</td>
<td>3.43</td>
</tr>
<tr>
<td>Cleveland</td>
<td>3.02</td>
</tr>
<tr>
<td>Detroit</td>
<td>3.56</td>
</tr>
<tr>
<td>Hartford</td>
<td>2.70</td>
</tr>
<tr>
<td>Los Angeles–Long Beach</td>
<td>3.12</td>
</tr>
<tr>
<td>Milwaukee</td>
<td>3.18</td>
</tr>
<tr>
<td>Minneapolis–St. Paul</td>
<td>3.11</td>
</tr>
<tr>
<td>Newark–Jersey City</td>
<td>2.89</td>
</tr>
<tr>
<td>New York City</td>
<td>2.78</td>
</tr>
<tr>
<td>Philadelphia</td>
<td>3.02</td>
</tr>
</tbody>
</table>

Tool and die makers in various manufacturing industries in 30 selected areas in 1960 were paid average straight-time hourly earnings ranging from $2.09 in Charlotte, N.C. to $3.47 in San Francisco–Oakland, Calif.

Because tool and die makers do precision work, the areas in plants or shops where they work are generally clean and well-lighted. Tool and die makers stand part of the time when they are operating machine tools. At other times they do handwork at benches. Sometimes they operate machines, to test tools and dies they have made.

Good safety habits are necessary for tool and die makers because they work with high speed machine tools and sharp cutting instruments. The use of safety devices has reduced the injury rate for machining workers in recent years.

Most tool and die makers are members of such unions as the International Association of Machinists; the International Union of Electrical, Radio and Machine Workers; the International Union, United Automobile, Aircraft and Agricultural Implement Workers of America; the United Steelworkers of America; and the Mechanics Educational Society of America. Labor-management contracts covering these workers often provide for life and health insurance, pension plans, and other benefits.

(See introductory section of this chapter for Where To Go for More Information.)
Nature of Work

The increasing use of instruments in production, research, development, and testing work in industry and government, is making the job of the instrument maker increasingly important. Instrument makers (also called experimental machinists and model-makers) work closely with engineers and scientists in translating designs and ideas into experimental models, special laboratory equipment, and nonstandard instruments. They also modify existing instruments for special purposes. Experimental devices constructed by these craftsmen are used, for example, to stabilize heat (thermostats), measure distance (geodimeters), record earthquakes (seismographs), and help control industrial processes (servo-mechanisms). The instrument parts and models made by these workers range from simple gears to intricate navigation systems used in guided missiles.

The skills of instrument makers are similar in many respects to those of all-round machinists, tool and die makers, and setup men. Like these other machining workers, instrument makers fabricate metal parts by operating machine tools such as lathes and milling machines, and by using handtools such as files and chisels. They also determine the sequence of machining operations and follow blueprint instructions. Because accuracy is important, they measure finished parts with micrometers and standard optical measuring instruments. Finally, instrument makers and other machining workers make devices that hold metal parts in place and guide tools which shape them.

Certain significant differences exist, however, between the work of instrument makers and that of other skilled machining workers. Generally, instrument workers are not given detailed instructions such as blueprints. Rather, they often work from rough sketches, verbal instructions, or only ideas. Thus, in making parts, they frequently use considerable imagination and ingenuity. Instrument makers often work on parts which must not vary from specifications by more than one ten-thousandths of an inch (which is 30 times narrower than a human hair), or even by a few millionths of an inch. To meet these standards, instrument makers commonly use special equipment or precision devices, such as the electronic height gage, which are used only infrequently by other machining workers. Another important difference is that instrument makers work with a greater variety of materials, including plastics and the rarer metals such as silver and platinum.

An instrument maker may construct instruments from start to finish—making and assembling all the parts and testing finished instruments for proper operation. However, in large model shops or where time is important, an instrument maker may cooperate with other workers, each making a part or component of a more complicated instrument.

Because they often work on their own and have highly developed manual skills and reason-
ing abilities, instrument makers have considerable prestige among their fellow employees.

Where Employed

Most instrument makers are employed by firms which manufacture instruments. The Federal Government employed about 1,200 instrument makers in 1960. University and commercial research laboratories also employ instrument makers to make the special devices required in scientific research.

The main centers of instrument making are located in and around a few large cities, particularly New York City, Chicago, Los Angeles, and Washington, D.C.

Training, Other Qualifications, and Advancement

Most instrument makers advance from the ranks of machinists or skilled machine-tool operators. These craftsmen, working at first under close supervision and doing the simpler jobs in the instrument shop, usually need at least 1 or 2 additional years of experience to qualify as instrument makers.

Other instrument makers learn their trade through instrument-maker apprenticeships which generally last 4 or 5 years. The apprentice's shop training emphasizes the use of machine tools, handtools, and measuring instruments, and the working properties of various materials. Classroom instruction covers related technical subjects such as mathematics, physics, and blueprint reading. The apprentice must learn enough shop mathematics to enable him to plan his work and use handbook formulas. A basic knowledge of mechanical principles is needed in solving gear and linkage problems.

Employers generally prefer applicants who have a high school education, including courses in algebra, geometry, trigonometry, science, and machine shop work. Further technical schooling in electricity and electronics is often desirable, and may make possible future promotions to technician positions.

A young man interested in becoming an instrument maker should have a strong interest in mechanical subjects and a better-than-average ability to work with his hands. He must have initiative and resourcefulness, because instrument makers often work alone and almost always under minimum or no supervision. Since the instrument maker often faces new problems, he must be able to develop original solutions. The instrument maker frequently must visualize the relationship between individual parts and the complete instrument. He must understand how the instrument is used and the principles of its operation. Because of the nature of his work, the instrument maker has to be very conscientious and take considerable pride in creative work.

As the instrument maker's skill improves and as he broadens his knowledge, he may advance to increasingly responsible positions. About 10 years' experience is required to rise to the top skill level in instrument making. With additional training beyond the high school level in subjects such as physics and machine design, some instrument makers may advance to technician jobs. In these jobs, technicians plan and estimate time and material requirements for the manufacture of instruments, or provide specialized support to professional personnel. Others may become supervisors of less skilled instrument makers and help in their training.

Employment Outlook

The employment of instrument makers is expected to continue to increase rapidly during the 1960's, but the number of new openings in any one year will be limited by the relatively small size of the occupation. Probably not more than 35,000 workers were employed as instrument makers in 1960.

Growing numbers of instrument makers will be needed to make models of new instruments that may be mass produced in the future, and also to make custom or special purpose instruments that are not needed in large numbers. Many devices made by these craftsmen will be needed in the expanding fields of atomic energy, guided missiles, and industrial "automation" (the use of instruments to direct and control manufacturing processes). Also, many new precision instruments, which
will be even more versatile and sensitive than those in current use, can be expected to emerge from growing research and development programs of universities, government agencies, private laboratories, and manufacturing firms. New instruments are needed to solve many serious technical and scientific problems. For example, scientists who work with atomic reactors need better control systems for handling radioactive materials, as well as improved "thermometers" which can measure temperatures in the millions of degrees.

Instrument maker employment will not rise as rapidly as total sales and production of instruments because semiskilled workers can produce and assemble instruments that have been standardized and are being produced in large quantities.

In addition to new job opportunities for instrument makers that will occur as a result of expanded industrial, scientific, and defense requirements, there will be several hundred new openings annually for these craftsmen as a result of promotions to technician positions, transfers to other fields of work, and retirements and deaths.

**Earnings and Working Conditions**

Earnings of instrument makers compare favorably with those of other highly skilled metalworkers. Wage data obtained from a small number of instrument manufacturers and research laboratories and from selected union contracts indicate that wages of these craftsmen in 1960 generally ranged from $2.50 to $3.25 an hour. A few skilled instrument makers employed by the Federal Government in Washington, D.C., were receiving from $2.93 to $3.53 an hour, and averaged around $3.15 an hour.

Instrument shops usually are not as noisy as some other places where machining workers are employed. Generally, the machines do not run continuously and many of the machine tools are quite small.

Serious work accidents are not common among instrument makers, but machine tools and flying particles sometimes cause finger, hand, and eye injuries. Safety rules generally require the wearing of special glasses, aprons, tightly fitted clothes, and shirts with elbow-length sleeves; the wearing of neckties is prohibited.

Many instrument makers belong to unions, two of which are the International Union of Electrical, Radio and Machine Workers and the International Association of Machinists. Union management contracts covering these workers often provide life and health insurance, pensions, and other benefits.

(See introductory section of this chapter for Where To Go for More Information.)

**Setup Men (Machine Tools)**

(D.O.T. 4-75.160)

**Nature of Work**

The setup man, often called a machine tool job setter, is a skilled specialist employed in plants and machine shops which do machining in large volume. His main job is to set up machine tools—that is, to get machine tools ready for use by semiskilled operators. He may also explain to these workers the operations to be performed, and show them how to check the accuracy of their work. Usually a setup man is assigned a number of machine tools, which often are one type, such as turret lathes. However, he may set up several different machine tools such as milling machines and automatic screw machines. Working from drawings, blueprints, written specifications, or job layouts, he determines the rate at which the material is to be fed into the machines, operating speeds, tooling, and operation sequence. He then selects and installs the proper cutting or other tools, and adjusts guides, stops, and other controls. He may make trial runs and adjust the machine and tools until the parts produced conform to specifications. The machine is then turned over to a semiskilled operator.
After the machine tool has been running a while, the setup man may make additional adjustments to maintain accurate production.

Where Employed

Most setup men work in factories that manufacture machinery, automobiles, and aircraft. Usually they are employed by large companies which employ many semiskilled machine tool operators. Setup men usually are not employed in maintenance shops or in small jobbing shops. Most of them work in Ohio, Illinois, Michigan, New York, and California.

Training and Other Qualifications

To become a setup man, a worker usually must qualify as an all-round machinist or skilled machine tool specialist. A setup man must be thoroughly trained in the operation of one or more machine tools. He must read blueprints and make computations in selecting speeds and feeds for machine tools. He also must be able to explain to a semiskilled machine tool operator how to perform machining operations and how to check machining accuracy. Above all, a setup man must be skilled in selecting the sequence of operations so that metal parts will be made exactly to specifications. Jobs for setup men usually are filled from within a shop by promotion or reassignment.

Employment Outlook

This is a small occupation which will provide a relatively small number of job opportunities for new workers in the next decade. Many of these openings will result from needs to replace setup men who transfer to other jobs, are promoted, or who retire or die. Employment of setup men should increase moderately in the 1960's with the expected greater use of new machine tools which must be set up by skilled workers.

The use of numerically controlled machine tools may limit employment growth in this occupation (see discussion on page 448). Work requirements of setup men also may change when numerically controlled machine tools are used. Setup men then may only preset tools, instruct operators, and check the first few parts that are produced. Since setup men are skilled workers, their chances for advancement or transfer into other jobs will remain good.

(See introductory section of this chapter for Where To Go for More Information.)

Layout Men

(D.O.T. 4-75.140)

Nature of Work

The layout man is a highly skilled specialist who marks metal castings, forgings, or metal stock to indicate where and how much machining is needed. His work enables other workers to use machine tools simply by following his lines, points, and other instructions. He uses many instruments, such as the scriber, with which he marks lines on the surface of the metal; the center punch, to indicate the centers on the ends of metal pieces to be machined or drilled; the keyseat or box rule, for drawing lines and laying off distances on curved surfaces; dividers, for transferring and comparing distances; L- or T-squares for determining right angles; and calipers and micrometers for accurate measurement. Not only must the layout man work with extreme accuracy, but he also must be familiar with the operation and capabilities of standard machine tools.

Where Employed

Layout men work primarily in the mass-production metalworking industries employing large numbers of machine tool operators. Most of the layout men work in plants producing electrical machinery and transportation equipment. Many are employed in Ohio, Illinois, Michigan, New York, and California.
Training and Other Qualifications

From 6 to 10 years’ training and experience are needed to develop the skill for this occupation. Required training includes a machinist apprenticeship, or an equivalent knowledge of machine tools, machining qualities of metals, and the proper sequence of machining operations. Layout men must learn to visualize the sequence of machining operations so they can correctly prepare detailed work plans for less skilled workers. A layout man must be well trained in mathematics and blueprint reading, and be able to use various precision-measuring tools. Mechanical ability and a liking for painstaking work are other important qualifications for layout men.

These skilled jobs usually are filled from within an establishment by promotion or reassignment.

Employment Outlook

Employment is expected to increase slowly in this small occupation in the 1960’s. Anticipated growth in metalworking industries—particularly in plants employing large numbers of machine tool operators—will cause employment of layout men to increase. Replacement needs also will provide a small number of job opportunities for skilled machinists to be promoted to jobs as layout men.

Use of numerically controlled machine tools may adversely affect employment of layout men (see discussion on page 448). However, correct positioning of metal stock and tools will continue to be important, and layout men will be needed to mark accurate reference points. In addition, layout men can easily transfer to other work such as process planning, which will become more important with further technological development.

(See introductory section of this chapter for Where To Go for More Information.)
FOUNDRY OCCUPATIONS

The metal castings produced by foundry workers are essential parts of thousands of products ranging from automobile engines to cooking utensils. In 1960, an estimated 386,000 workers were employed in the Nation’s more than 5,000 foundries. Many of these workers were employed in skilled occupations. Hourly earnings in many foundry occupations were above the average for factory work as a whole.

In casting metal objects, a mold is prepared with a cavity in the shape of the casting to be made; metal is then melted and poured into the cavity where it cools and solidifies. (Other metal shaping methods include machining, forging, stamping, and rolling.) The casting process is an economical and fast method of forming metal into a wide range of intricate shapes. Castings have considerable strength and rigidity and range in size from a fraction of an inch to many feet. They may weigh anywhere from less than an ounce to many tons. Among the thousands of articles made by the casting process are machinery bases, ship propellers, bearings, water faucets, water mains, bathtubs, automobile engine blocks, pipe, and aircraft and missile components.

Nature and Location of Foundry Work

About 290,000 of the foundry industry’s workers were employed in 1960 in ferrous foundries—those that make castings of iron and steel. About 60 percent of these workers were in ferrous foundries which produce gray-iron castings and the remainder were employed in steel and malleable iron foundries. About 96,000 were employed in nonferrous foundries. Most of this group worked in foundries which made copper-base alloy (brass and bronze), aluminum, magnesium, and lead castings. Most foundries specialize in casting a particular metal since somewhat different methods and equipment are needed for casting the different metals. However, many shops cast several metals. In many foundry occupations, workers can transfer from foundries casting one type of metal to foundries which produce castings of a different metal, with additional training.

In general, castings are produced in small- and medium-size shops. About 80 percent of all foundries employ fewer than 100 workers. More than two-thirds of the foundry workers are employed in independent foundries (shops which sell their castings to other firms). The remaining workers are employed in “captive shops”—foundries that are departments of plants using the castings in the manufacture of their own products.

There are five principal methods of casting based primarily on different types of molds. By far the most common of these is green sand-molding. In this method, sand composed chiefly of silica and clay is packed in a boxlike container, called a flask, around a pattern (a model of the object to be cast). The pattern is withdrawn and molten metal is poured into the mold cavity to form the desired metal shape. The sand mold can be used only once, but the sand can be reclaimed.

A second method, known as permanent molding, employs a metal instead of a sand mold. Metal molds, which can be used many times, are used chiefly for casting nonferrous products.

Precision investment casting, a third method (often known as the “lost wax” process), uses ceramic molds. In this method, a wax or plastic pattern is coated with refractory clay. After the coating hardens, the wax or plastic is melted and drained out, leaving a mold cavity into which the casting metal is poured. Castings obtained from these molds are very exact and need little machining.

Shell molding, a fourth process, was introduced after the end of World War II and is becoming increasingly important. In this proc-
ess, resinbonded sand shells made from master metal patterns replace green sand molds. Advantages of this method are greater precision, good surface finish of the casting, lower unit cost in quantity production, and ease in handling, because of the lighter weight of the shell mold compared with other types.

Die casting is a process in which molten metal is forced under high pressure into steel dies from which the resulting castings are automatically ejected. Because die casting is done entirely by machines operated by die-casting machine operators, it is a distinctly different process from other casting methods. The work performed by die-casting machine operators is not described in this chapter, but these workers are included in the total employment estimate.

Some foundries use very little mechanized equipment. These foundries are usually small, ordinarily use the sand molding method, and produce small amounts of different kinds of castings. They employ all-round molders (the key foundry occupation) and a substantial number of unskilled laborers.

Other foundries are highly mechanized and are typically large shops that produce great quantities of identical castings. For example, such a foundry may produce thousands of automobile engine cylinder blocks. In such shops, a large amount of mechanized equipment is used. For example, materials and castings being processed are moved with mechanical conveyors and cranes. These shops use relatively few unskilled laborers. They also employ proportionately fewer highly skilled workers than the small, relatively unmechanized shops, since the large shops usually divide the job duties of the all-round molder, coremaker, and other skilled workers into specialized functions that are performed by semiskilled workers.

There are foundry jobs in every State and almost every large- or medium-size city in the country. Very frequently, foundries are located near the plants where their castings are used. As a result, they tend to be concentrated in areas where there is considerable metalworking. The greatest numbers of foundry workers are found in the important metal-working centers of Ohio, Michigan, Pennsylvania, Illinois, and Indiana.

### Foundry Occupations

More than four-fifths of the approximately 386,000 workers in foundries or foundry departments in 1960 were employed in plant occupations. (See tabulation below.) More than half of the plant workers had jobs which are not found in other industries. It is these occupations that are chiefly discussed in this chapter of the Handbook.

<table>
<thead>
<tr>
<th>Occupational group</th>
<th>Percent of total employment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total employment</td>
<td>100.0</td>
</tr>
<tr>
<td>Nonplant occupations</td>
<td>16.5</td>
</tr>
<tr>
<td>Professional and technical</td>
<td>4.2</td>
</tr>
<tr>
<td>Managerial</td>
<td>3.5</td>
</tr>
<tr>
<td>Clerical and sales</td>
<td>8.8</td>
</tr>
<tr>
<td>Plant occupations</td>
<td>83.5</td>
</tr>
<tr>
<td>Specialized casting occupations</td>
<td>47.0</td>
</tr>
<tr>
<td>Materials movement, mechanical</td>
<td>4.0</td>
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<tr>
<td>Equipment maintenance and repair</td>
<td>7.5</td>
</tr>
<tr>
<td>Machining occupations</td>
<td>3.0</td>
</tr>
<tr>
<td>Laborers and service occupations</td>
<td>22.0</td>
</tr>
</tbody>
</table>

In order to explain more clearly the duties of foundry workers, a brief description of the jobs involved in the most common casting process —sand casting—is presented.

The first step in foundry work after the casting has been designed is for the patternmaker to make a wood or metal pattern in the shape of the final casting desired. Next, a hand molder makes a sand mold by packing and ramming sand, specially prepared by a sand mixer (D.O.T. 4-82.310; 6-82.310 and .320), around the pattern. A molder’s helper (D.O.T. 8-82.10) sometimes assists in these operations. When the job calls for large numbers of identical (usually small) castings, a variety of machines are used to perform many operations at a much faster rate than is possible by hand. An operator of any one of these machines is called a machine molder.

A coremaker shapes sand, specially prepared by sand mixers, into a core (a body of sand designed usually to create a hollow space in the casting). The core is baked in an oven by a core-oven tender (D.O.T. 6-82.120). Core parts or sections are put together by a core assembler.
The core is then placed in the mold and the mold is ready for the metal pouring.

A melter, or cupola tender (D.O.T. 4–91.351, .411, .441, and .572), operates a furnace that melts the metal. The metal is customarily poured into the mold by a pourer (D.O.T. 6–91. 610, .612, and .613), although in some small foundries it is part of the molder’s job. When the casting has cooled, it is taken out of the mold by a shakeout man (D.O.T. 8–82.10) and sent to the cleaning and finishing department.

Chippers (D.O.T. 6–82.910) and grinders (D.O.T. 6–82.330) use pneumatic chisels, powered abrasive wheels, saws, and handtools, such as hammers, chisels, and files, to remove excess metal and to finish the casting. The rough surface of the casting may be cleaned by sandblasting. Sandblasters (D.O.T. 6–82.720) operate machines which blast the casting with air mixed with abrasive particles. The casting surface may be smoothed by tumbling. In this process, castings, together with an abrasive material, and sometimes water, are placed in a barrel which is rotated. As the barrel turns the castings tumble against each other, thereby removing sand, burrs, and scale. The men who control these barrels are called tumbler operators (D.O.T. 6–82.730). Sandblasters and tumbler operators may also operate a machine that both tumbles and blasts the castings.

The casting may be placed in heat treating furnaces to improve the physical properties of the metal; heat treaters, such as annealers (D.O.T. 6–87.110), run these furnaces. Casting inspectors (D.O.T. 6–82.920) then check finished castings for structural soundness and properties, and determine whether their dimensions meet blueprint specifications.

The number of workers in the principal occupations unique to the foundry industry are shown in chart 24. Detailed discussions of the duties, training, and other qualifications; earnings; and employment outlook for three of these occupations—molders, coremakers, and patternmakers—are given at the end of this chapter.

There are many workers in those foundry occupations which are found in other industries as well as in foundries. These workers made up a substantial part of foundry employment in 1960. About 29,000 of these workers, such as maintenance mechanics, machinists, carpenters, and millwrights, maintain and repair foundry plant and equipment. Foundries employed an estimated 7,000 crane and derrick operators and 4,000 truckdrivers. In many foundries, some of the castings are machine finished. Nearly 8,000 machine tool operators do this work. Foundries also employed about 85,000 workers in relatively unskilled jobs, such as guards, janitors, laborers, and helpers.

About 64,000 foundry workers were employed in professional, office, managerial, or sales jobs. Included in this group were nearly 12,000 engineers, chemists, metallurgists, and other technical workers. Some were employed in research activities. Engineers and other technical personnel have been employed in greater numbers in recent years to improve castings and meet new production and quality requirements. Constant effort has been made, for example, to develop methods of reducing the weight of castings without losing strength and other important characteristics. Current research also deals with the problem of getting...
greater accuracy in the molding process. Other engineers and scientists are employed to design and lay out machinery and equipment and to supervise plant operation and maintenance.

About 2,000 of the industry’s professional and technical workers were technicians who worked in a variety of functions concerned with the control of quality in casting production. In this group are workers who test molding and coremaking sand, make chemical analyses of metal, and operate machines which test the strength and hardness of castings. Some use X-ray or magnetic apparatus to inspect the internal structure of castings.

The foundry labor force is predominantly male. Women, who make up only about 6 percent of the industry’s labor force, are employed primarily in office jobs, but some are employed in such plant jobs as semiskilled coremaker. Negroes account for about one-third of the plant workers in foundries. They are employed in skilled as well as unskilled jobs, with a considerable number working as skilled molders and coremakers.

Training, Other Qualifications, and Advancement

Most foundry plant workers start in unskilled jobs, such as laborers or helpers. Specialized jobs in the plant are frequently filled by promotion. A worker may begin as a laborer and, after receiving informal on-the-job training from a foreman or experienced worker, gradually learns how to perform the more skilled jobs. This is the usual practice in training workers for such direct casting process jobs as melter, chipper, and grinder.

The majority of skilled foundry workers—particularly hand molders, hand coremakers, and patternmakers—learn their jobs through formal apprenticeship. In this type of training, the young worker is given supervised on-the-job training for a period of 3 to 5 years, usually supplemented by classroom instruction. A worker who has completed an apprenticeship program is usually preferred by foundry management because he has a greater working knowledge of all foundry operations and is, therefore, better qualified to fill supervisory jobs.

Employment Outlook

The foundry industry will hire many thousands of new workers in the 1960-70 decade, mainly to replace experienced workers who retire, die, or transfer to other fields of work. Because the industry employs a large number of workers (about 386,000 employees in 1960), retirements and deaths alone should create from 7,000 to 10,000 job openings annually during the 1960’s.

Foundry employment is expected to rise slowly above the 1960 level. A sizable increase in foundry production is anticipated. Many of the industries that use large quantities of castings in their products, such as the aircraft, construction, and machinery industries, are expected to expand their output considerably in the 1960’s. However, foundry employment is expected to rise at a much slower rate than production. Continued improvements in casting methods, particularly in machine molding and coremaking, and the increasing use of machinery for materials handling will result in greater output per worker.

Employment of technical personnel—particularly sand technologists, metallurgical assistants, and some other technicians—will continue to grow faster than that of most other groups of foundry workers. Two factors which will tend to increase the demand for scientists and other technical workers in the industry are the expected introduction of new scientific techniques in casting and quality control, and the expansion of research activities. Many maintenance workers and operators of materials moving machines will be employed also, owing to the increasing use of more and more complex processing and materials handling equipment. In contrast, the numbers of hand molders, hand coremakers, and other hand processing workers will show little increase, because of the increasing substitution of machine molding and coremaking for hand processes. The number of laborers and other unskilled workers employed in the industry will decline.
Employment in foundries has been sensitive to changes in general business conditions. For example, employment rose sharply in 1951, during the Korean conflict, and in 1955-56, when business activity was again at a high level. Foundry employment dropped substantially during 1949, 1954, and 1958, when business activity generally declined. During the 1960's, it is expected that substantial year-to-year changes in the level of foundry employment will continue.

**Earnings and Working Conditions**

Wages in foundries are somewhat above the average for all manufacturing. In November 1960, production workers in iron and steel foundries earned an average of $94.13 a week or $2.51 an hour (including pay for overtime and night work). In nonferrous foundries, the average was $101.09 a week or $2.54 an hour. These averages compare with average weekly earnings of $90.16 or average hourly earnings of $2.30 for production workers in all manufacturing industries in the same month.

Working conditions in foundries have improved greatly in recent years. In many of the new foundries, improvements have been made by reducing the heat, fumes, smoke, and noise that are part of foundry operations. Progress has also been made in reducing the foundry industry's injury-frequency rate (the average number of disabling work injuries for each million employee-hours worked). However, this rate is higher than the rate for manufacturing industries as a whole. From 1947 to 1960 the injury-frequency rate in independent gray-iron and malleable-iron foundries was reduced from 44.5 to 24.5, and from 27 to 18.3 in independent nonferrous foundries. The rate for all manufacturing industries was 11.3 in 1960.

Patternmaking and coremaking generally have the lowest injury rate among the different foundry production operations; molding has a somewhat higher rate. Jobs in melting and chipping tend to have the highest injury rates.

Various labor unions have foundry workers in their membership. Among these unions are the International Molders and Foundry Workers Union of North America; the United Steelworkers of America; the International Union, United Automobile, Aircraft and Agricultural Implement Workers of America; and the International Union of Electrical, Radio and Machine Workers. Many patternmakers are members of the Pattern Makers' League of North America.

**Where To Go for More Information**

International Molders and Foundry Workers Union of North America, 1225 East McMillan St., Cincinnati 6, Ohio
International Union of Electrical, Radio and Machine Workers, 1126 16th St. NW., Washington 6, D.C.
National Foundry Association, 4321 St. Charles Rd., P.O. Box 172, Bellwood, Ill.
Non-Ferrous Founders' Society, Inc., University Bldg., 1604 Chicago Ave., Evanston, Ill.
American Foundrymen's Society, Golf and Wolf Rds., Des Plaines, Ill.
Malleable Founders' Society, Union Commerce Bldg., Cleveland 14, Ohio.
Steel Founders' Society of America, 606 Terminal Tower, Cleveland 13, Ohio.

(Detailed discussions of professional, technical, mechanical, and other occupations found in the iron and steel industry as well as in many other industries are given in the sections of this Handbook covering the individual occupations. See index for page numbers.)

**Molders**

**Nature of Work**

The molder prepares a mold, made of specially prepared sand, which contains a hollow space in the shape of the item to be made. The mold is made by packing and ramming prepared sand around a pattern—a model of the object to be duplicated—in a molding box.
Hand molder ramming sand around pattern in flask.

Called a flask. A flask is usually made in two parts which can be separated to allow removal of the pattern by the molder without damaging the mold cavity. Molten metal is poured into the cavity which, when solidified forms the casting. The sand is prepared by adding water and other substances so it will hold its shape and not crumble when molten metal is poured into the mold. A molder uses rammers, trowels, shovels, mallets, and other handtools in the handling, compacting, and smoothing of sand in molds made by hand.

The nearly 47,000 workers in this occupation in 1960 were classified either as hand or machine molders. Hand molders use mainly hand methods to make the sand molds. Molds for small castings are usually made on the workbench by bench molders (D.O.T. 4-81.010); those for large and bulky castings are made on the foundry floor by floor molders (D.O.T. 4-81.030). Skill requirements in this occupation vary considerably. An all-round hand molder (journeyman) makes many different kinds of molds. A less skilled molder does more repetitive work, specializing in a few simple types of molds.

Machine molders (D.O.T. 4-81.025 and .050; 6-81.010 and .020) operate one of several types of machines which simplify and speed the making of large quantities of identical sand molds for castings. The machine molders' duties consist mainly of assembling the flask (molding box) and pattern on the machine table, filling the flask with prepared sand, and operating the machine by the properly timed use of its control levers and pedals. They are commonly semiskilled workers, whose duties are limited to operating the machines which are set up for them. Sometimes they are journeymen molders who set up and adjust their own machines with little supervision. Machine molders are employed mainly in production foundries which make large quantities of identical castings.

Training, Other Qualifications, and Advancement

Completion of a 4-year apprenticeship training program, or the equivalent in experience, is needed to become a journeyman molder and thus qualify for all-round hand molding and for the skilled specialized or supervisory jobs. Men with this training are also preferred for some kinds of machine molding.

The molder apprentice works under the close supervision of journeymen who instruct him in the skills of the craft. About half of the apprenticeship training is devoted directly to molding. The apprentice may begin with a simple job, such as shoveling sand, and gradually take on more difficult and responsible work, such as ramming molds, withdrawing patterns, and setting cores. He also learns to operate the various types of molding machines. As his training progresses, he makes complete molds, beginning with simple shapes and progressing to those of increasing complexity. This training includes both floorwork and benchwork. In addition, the apprentice works in other foundry departments in order to develop the diversified knowledge of
foundry practice needed by fully qualified molders. He is taught sand preparation, melting of metal, and how to clean and finish castings. The apprentice usually receives, in addition, at least 144 hours of classroom instruction each year in such subjects as shop arithmetic, metallurgy, and shop drawing.

Molders’ helpers and less skilled hand molders frequently learn the various elements of skilled molding informally, while on the job, and then seek jobs as journeymen. However, this is often a lengthier and less reliable way of learning the trade than through apprenticeship.

The less skilled type of hand molding, in which highly repetitive work is done, requires only a brief training period. “Learners” (either men without previous foundry experience or upgraded foundry helpers) are assigned to work with a molder engaged in making a particular kind of mold. After 2 to 6 months of this training, the learner is usually competent to make the same mold or one that is roughly similar, without close supervision.

The more difficult and responsible types of machine molding jobs also require formal or equivalent training. However, the less skilled machine molding jobs are ordinarily learned in 60 to 90 days of on-the-job training.

An eighth grade education is usually the minimum requirement for apprenticeship. Many employers specify additional education up to and including high school graduation. Eighth grade schooling, however, is sufficient for learners of less skilled hand molding or machine molding jobs.

Physical standards for molding jobs are fairly high. The molder stands at his work, moves about a great deal, and must do frequent lifting. The hand molder needs a high degree of manual dexterity and good vision. Since the work is fairly strenuous, very few women are employed as molders.

Employment Outlook

The need to replace molders who retire, die, or transfer to other fields of work will provide most of the job openings for new workers to enter this trade during the 1960’s. Retirements and deaths alone will provide about 1,000 openings annually. Several hundred of these openings will be for molding apprentices. There will be even more openings each year for workers in entry jobs in machine molding and in the less skilled types of hand molding.

Little increase in the total number of molders is expected during the 1960’s, despite the expected sizable increase in foundry production. The continuation of the trend toward more machine molding and less hand molding, and increasing use of permanent molds and shell molds, will result in a greater foundry output per molder employed.

Earnings and Working Conditions

In mid-1959, experienced machine molders in gray-iron foundries in 12 metropolitan areas had straight-time average hourly earnings ranging from $2.42 to $2.97. The lowest straight-time average hourly earnings reported for floor molders were $2.46; the highest earnings were $2.83. In 11 of the 12 areas, hand bench molders had straight-time average earnings ranging from $2.37 to $2.80 an hour.

Most molders are members of labor unions. Many of them have been organized by the International Molders and Foundry Workers Union of North America. Others are members of the United Steelworkers of America; the International Union, United Automobile, Aircraft and Agricultural Implement Workers of America; and the International Union of Electrical, Radio and Machine Workers.

(See introductory section of this chapter for Where To Go for More Information.)

Coremakers

Nature of Work

Coremakers prepare the “cores” which are placed in molds to form the hollows or holes usually required in metal castings. The poured metal solidifies around the core so that when the core is removed, the desired cavity or con-
tour remains. A core may be made either by hand or machine. In both instances, prepared sand is packed into a core box, a block of wood or metal into which a hollow space of the size and shape of the desired core has been cut. After the core has been removed from the core box, it is hardened either by baking or by other drying methods. When hand methods are used to make a core, the coremaker uses mallets and other handtools to pack and ram sand into the core box.

In hand coremaking, small cores are made on the workbench by *bench coremakers* (D.O.T. 4-82.010) and bulky cores are made on the foundry floor by *floor coremakers* (D.O.T. 4-82.010). There is a wide range of skill requirements in this occupation. All-round hand coremakers (journeymen) prepare different kinds of large and more intricate cores. The less skilled coremakers make the smaller and simpler cores frequently produced in large numbers, so that the work is highly repetitive. Many skilled coremakers are employed as supervisors.

*Machine coremakers* (D.O.T. 6-82.010, .020, and .030) operate several different types of machines which force sand into specially shaped hollow forms to make the sand cores. Some machine coremakers are required to set up and adjust their own machines and do any necessary finishing operations on the cores. Other coremakers are primarily machine tenders. They are more closely supervised and the necessary adjusting of the machines is done for them. Machine coremakers are employed mainly in foundries where large quantities of identical castings are made.

**Training, Other Qualifications, and Advancement**

Completion of a 4-year apprenticeship training program or the equivalent in experience is needed to become a skilled hand coremaker. Coremaking apprenticeships are also sometimes required for the more difficult and responsible machine coremaking jobs. Only a brief period of on-the-job training is needed for less skilled hand coremaking and for most machine coremaking jobs. Training in coremaking and molding are often combined in a single apprenticeship.

The coremaking apprentice works with journeymen coremakers, first helping them in routine duties and then undertaking more advanced work, such as making simple cores, or operating core ovens. As his skill increases, the apprentice makes more complex cores. He acquires experience in benchwork and floorwork and in the operation of any coremaking machines used in the plant. On-the-job training is generally supplemented by classroom instruction covering such subjects as arithmetic, shop drawing, and the properties of metals. Hand coremakers with all-round training have opportunities for promotion to supervisory jobs.

An eighth grade education is usually a minimum for coremaking apprentices; some employers require that apprentices be high school graduates.

Persons without previous foundry experience may be hired directly for the less skilled coremaking jobs, or foundry laborers or helpers may be upgraded to do this work. Physical requirements for light coremaking are not exacting because the work is not very strenuous. Some types of hand coremaking require a high degree of manual dexterity. Women are frequently employed to do light coremaking.

**Employment Outlook**

During the 1960's, employment of hand and machine coremakers is expected to increase slowly above the 1960 level of about 25,000. The continued trend toward a greater proportion of cores being produced by machine rather than by hand and the resulting greater output per worker will limit the growth in the number of coremakers. The need to replace experienced workers who retire or die will create about 500 additional job openings annually for new workers. Other new workers will be required to replace coremakers who transfer to other fields of work.

**Earnings and Working Conditions**

Experienced machine coremakers in gray-iron foundries in six metropolitan areas, in
mid-1959, had straight-time average hourly earnings ranging from $2.40 to $3. Average earnings of hand coremakers in 12 areas ranged from $2.06 to $2.86 an hour.

Most coremakers are members of labor unions. Many of them have been organized by the International Molders and Foundry Workers Union of North America. Other unions which have coremakers in their membership include the United Steelworkers of America; the International Union, United Automobile, Aircraft and Agricultural Implement Workers of America; and the International Union of Electrical, Radio and Machine Workers.

(See introductory section of this chapter for Where To Go for More Information.)

Patternmakers

Nature of Work

Patternmakers are highly skilled craftsmen who manually build patterns used in making molds out of which foundry castings are formed. About half of the nearly 19,000 workers in the occupation in 1960 were metal patternmakers (D.O.T. 5-17.010). A large proportion were wood patternmakers (D.O.T. 5-17.020) and a small number worked with other materials such as plaster and plastics.

The patternmaker must be able to work from blueprints prepared by an engineering department. He makes a precise pattern for the product, after allowing for shrinkage of molten metal used in the casting process and for other factors.

The metal patternmaker prepares patterns from metal stock, or more commonly, from rough castings made from an original wood pattern. He uses a variety of metalworking machines, including the engine lathe, drill press, shaper, milling machine, power hacksaw, and grinder, to shape and finish the patterns.

The wood patternmaker selects the appropriate woodstock, lays out the pattern, marks the design for each section on the proper piece of wood, and saws each piece roughly to size. He then shapes the rough pieces into final form, using various woodworking machines, such as lathes, planers, bandsaws, and sanders, as well as many small handtools. Finally, he assembles the pattern segments by hand, using glue, screws, and nails.

Throughout his work, the patternmaker carefully checks each dimension of the pattern. A high degree of accuracy is required, since any imperfection in the pattern will be reproduced in the castings made from it. Other duties of patternmakers include making core boxes (in much the same manner as patterns are constructed) and repairing patterns and core boxes.

About half of the patternmakers work in specially equipped pattern shops in foundries. The other half work in establishments that make patterns for foundries on order, or in departments of plants that buy castings from a foundry.

Training and Other Qualifications

Apprenticeship, or a similar program of on-the-job training, is the principal means of
qualifying as a journeyman patternmaker. Because of the high degree of skill and the wide range of knowledge needed for patternmaking, it is very difficult to obtain the necessary training by informally picking up the trade. However, in some instances skilled machinists have been able to transfer to metal patternmaking with additional on-the-job training or experience. Good trade school courses in patternmaking provide useful preparation for the prospective apprentice. Such courses may, in some cases, be credited toward completion of the apprenticeship period. However, these courses do not substitute for apprenticeship or other on-the-job training.

The usual apprenticeship period for patternmaking is 5 years. At least 720 hours of classroom instruction in related technical subjects is normally provided. There are separate apprentice programs for wood and metal patternmaking.

The patternmaker apprentice begins by helping journeymen in routine duties. Then he makes simple patterns under close supervision, gradually learning to use the various types of machines and handtools. As his training progresses, the work becomes increasingly complex and the supervision more general.

Patternmaking, although not strenuous, requires considerable standing and moving about. A high degree of manual dexterity is especially important because of the precise nature of many hand operations. The ability to visualize objects in three dimensions is also important. Employers generally require patternmaker apprentices to have had at least a high school education.

Employment Outlook

Little change in the number of patternmakers is expected in the 1960's. Despite the increase in foundry production, the number of patternmakers has not grown significantly for several decades. Mass production, which required the preparation of large numbers of identical castings, resulted in greater use of metal and plastic rather than wood patterns. As the more durable metal patterns can be used many times in the making of identical molds, the number of individual patterns required for a given number of castings has declined.

Replacement needs will provide some job opportunities for new workers to be trained as patternmakers. It is estimated that about 500 new patternmakers will be needed annually in the 1960's to replace workers who retire, die, or transfer to other fields of work. Most of the job openings will be in metal patternmaking. Because patternmakers learn either basic metalworking or woodworking skills, they can find jobs in related fields when patternmaking employment is not available. Wood patternmakers can qualify for skilled woodworking jobs, such as cabinetmaker, and metal patternmakers can transfer their skills to machine shop jobs, such as machinist or layout man.

Earnings and Working Conditions

Experienced wood patternmakers in gray-iron foundries in six metropolitan areas, in mid-1959, had straight-time average hourly earnings ranging from $2.80 to $3.88.

Many patternmakers are members of the Pattern Makers’ League of North America.

(See introductory section of this chapter for Where To Go for More Information.)
FORGE SHOP OCCUPATIONS

Forging is the process in which workers use hammers and presses to shape glowing hot metal. This method of shaping metal is similar to that used by the oldtime blacksmith, except that large mechanical equipment is substituted for the blacksmith's small handtools.

Because forged metal is strong, such items as automobile crankshafts, gears, screwdriver blades, pliers, and aircraft and missile parts are produced by forging. Most forged products are made of steel, but brass, aluminum, and other metals are also forged. Some forged parts weigh less than a pound, but others weigh many tons.

Some of the jobs required to produce forgings are found only in forge shops; this chapter deals primarily with such jobs. (For a detailed description of the duties, training, working conditions, and job prospects of blacksmiths, who do work similar to that of many forge shop workers, see the statement on blacksmiths, page 507.)

Nature of Work

Before metal may be forged, workers must first heat it in intensely hot furnaces. Then other workers manipulate the glowing hot metal between die halves that shape the metal. These die halves are attached to hammers or presses which pound or squeeze the metal. Other workers smooth off the rough edges of the forged metal parts and perform other finishing operations.

The dies used in forging may be either flat (called open dies), or they may have a hollow space in the form of the metal part to be forged (called closed dies). Open dies are generally used where a small number of identically shaped forgings are to be produced. Closed dies are usually used to make large quantities of identical forgings (for example, automobile crankshafts).

The basic equipment used by forge shop workers consists of various types of hammers, presses, and furnaces. Forge shop workers may also use handtools such as tongs, wrenches, and measuring devices such as rulers and calipers.

The principal forge shop jobs are concerned with the operation of forging hammers, presses, and furnaces. Crews, generally consisting of from 2 to 10 men, operate this equipment. A crew usually specializes on a particular kind of hammer or press. Duties of the more important forge shop jobs are described below:

Hammersmiths (D.O.T. 4-86.120) control

Hammerman forging metal between "closed" dies attached to drop hammer.
steam hammers, equipped with open dies, that pound hot metal blocks and bars into particular shapes. The precision of these forged parts depends on the skill of the hammersmith. He interprets blueprints, drawings, or sketches to determine how to work the metal under the hammer. He directs a crew of assistants in the manipulation of the metal and controls the force of the hammer so that the piece being forged will be shaped to the customer's specifications. The hammersmith may also determine whether the metal being worked needs additional heating. During the forging process, he may also place various forming tools between the dies and the part being forged in order to make forgings of various simple shapes. The hammersmith's crew consists of one or more helpers; a hammer driver ("hammer runner") who manipulates the controls of the hammer to regulate the force of the forging blow; a craneman who transfers large blocks of heated metal from the furnace to the hammer and manipulates the metal under the hammer; and a heater who heats the metal to the correct forging temperature.

*Drop hammer operators* (D.O.T. 4–86.110), often called hammermen or forgers, operate different types of drop hammers that shape heated metal by pounding it between closed dies. These workers use tongs to pick up and turn the heavy, hot metal bar or block on the bottom half of the die, and operate the controls of the hammer to strike the number of blows required to shape the metal. A drop hammer operator supervises the helpers and heaters assigned to him. He may set the dies in the hammer or supervise his crew in doing this work.

The level of skill required of these operators depends on the size and the type of drop hammer being used and the size and complexity of the object being forged. Generally, operators of large, steam- or compressed-air-powered hammers who regulate the force of the forging blow, are more skilled than operators of other kinds of hammers. Drop hammer operators who forge very large, unusually shaped objects must also be highly skilled.

*Press smiths* (D.O.T. 4–86.125) work on huge forging presses which shape hot metal by squeezing it between open or closed dies. These skilled workers must know how to control the heating of the metals, regulate the pressure of their forging presses, and position the work between the dies. Their duties may also include setting up the dies in the presses.

Many of the skills and duties of press smiths who work on forging presses equipped with open dies are similar to the skills of hammersmiths. Both groups of workers must be able to understand blueprints, drawings, or sketches in order to transform heated metal into finished forgings; both groups of workers must be able to manipulate heated metal between open dies; and both groups of workers may have to supervise crews composed of an assistant operator, a craneman, a heater, and several helpers.

Press smiths who work on forging presses equipped with closed dies must work to more precise specifications than open die press smiths but do not need as much skill because the closed dies determine the shape of the forging. The closed die press smith may supervise a small crew or he may work alone.

*Upsettermen* (D.O.T. 4–86.125) operate upset machines which forge hot metal by applying pressure to the metal as it is held between dies. Unlike forging presses and hammers in which metal is shaped as the top die is dropped or pressed on the lower die, in an upset machine the metal is shaped as one die moves against the other die parallel to the ground.

Upsettermen control the heating of metal, adjust the machine's pressure on the metal, aline the dies, and position the metal between the dies. A small crew consisting of a heater and helpers is often supervised by an upsetterman. Deep-socket wrenches, aircraft engine cylinders, bolts, and valves are some of the products made in large quantities on upset machines.

*Heaters* (D.O.T. 4–88.081) control the supply of fuel and air in furnaces so that different metals can be heated to the most suitable temperatures for forging. When the heater sees that the metal is at the right temperature, by observing the color of the metal or by using a temperature gage, he may move the metal to the hammers or presses, using tongs or me-
Inspectors (D.O.T. 4–86.162) check forgings for size, shape, quality, and other specifications. Some inspectors examine forged pieces for flaws and faulty workmanship while the forgings are still hot. Others inspect forgings after they have been trimmed and cleaned. Inspectors visually inspect forged parts or they may use micrometers, calipers, or other measuring devices to determine whether forged parts meet exact specifications. Testing for flaws may also be done with strength and hardness testing machines, electronic testing devices, and other testing equipment.

Die sinkers (D.O.T. 4–76.010) are the highly skilled workers who make the closed dies that are used on some forging hammers and presses. Working from a blueprint or drawing, a die sinker traces the outline of the object to be forged on two matched blocks of steel. He carves the shape of the piece to be forged in the steel blocks by using drill presses and other machine tools. The die sinker smooths and finishes the die cavity using handheld tools such as small files. Finally, the die sinker makes a sample casting from the completed dies, and checks all the measurements using a micrometer and other precision measuring instruments.

A considerable number of forge shop workers are employed to clean and finish forgings. For example, trimmers (D.O.T. 6–88.717) remove excess metal from forged pieces with presses or hammers equipped with trimming dies. Chippers (D.O.T. 8–78.10) use power hammers to remove imperfections. Grinders (D.O.T. 8–77.10) remove rough edges from completed forgings with mechanically powered abrasive wheels. Sandblasters (D.O.T. 6–82.720) operate sandblasting or shotblasting equipment to clean and smooth forgings. Picklers (D.O.T. 8–74.13) dip forgings in an acid solution to remove surface impurities. Heat treaters (D.O.T. 4–87.220) heat and cool forgings under controlled conditions, to make them last longer. They produce forgings of specified degrees of hardness and strength by cooling them in the air or in baths of water, oil, or brine.

Where Employed

Independent shops (forge shops that produce forgings for sale) employed almost two-thirds of the nearly 70,000 workers who were directly engaged in the production of forged products during 1960. The remainder were employed in the forging departments of steel mills; by manufacturers of automobiles, farm machinery, handtools, structural and ornamental metal products used in bridges, buildings, and boats; and in types of plants which use forgings in their final products.

Employment of forge shop workers is concentrated mainly in Wisconsin, Ohio, Illinois, Michigan, and Pennsylvania. Forge shops are usually located near steel producing centers, which provide steel for forgings, as well as near metalworking plants.

Training, Other Qualifications, and Advancement

Most forge shop workers learn their skills through on-the-job training and work experience. As they acquire experience and skills, they progress from the simple to the more difficult jobs. Advancement to the skilled job of hammersmith, for example, requires 4 or 5 years of on-the-job training and experience.

The basic entry job of hammer and press crews is that of helper, although in some plants workers begin as heaters. After a worker has served as a helper, he may be upgraded to one of the more skilled jobs, such as heater, hammersmith, drop hammer operator, or forging press operator.

Employers usually require no more than an eighth grade education for helpers and heaters, but high school graduates are preferred. Therefore, young men interested in preparing themselves for the more skilled forge shop jobs and for supervisory positions should complete high school and include mathematics, drafting, and shopwork in their studies.

Because much forge shop work involves lifting and moving of heavy forgings and dies, workers must be strong. However, cranes may be used for moving very large objects. Forge shop workers must have the stamina to work under very hot and noisy conditions for an entire working day.
A few companies offer apprentice training programs for the more skilled forge shop jobs, such as die sinker, heat treater, hammersmith, hammerman, and press smith. The programs, which generally last 4 years and provide 8,000 hours of varied training, give the trainee a combination of classroom training and practical experience in using the tools of the trade. For example, hammersmith apprentices learn how to operate hammers and furnaces and how to use hand tools. They also learn about the properties of metals, how to read blueprints, and how to weld. The die sinker apprenticeship lasts from 4 to 8 years, depending on the particular area or shop in which he works.

Inspectors who visually inspect rough forgings, using simple gages, can usually perform their jobs after on-the-job training lasting only a few weeks. However, inspectors who examine forgings that must meet a customer's exact specifications are required to have some technical background in blueprint reading and mathematics. They may also be given several months of on-the-job training before they can operate the more complicated testing equipment.

**Employment Outlook**

A few thousand young people each year will have opportunities to get jobs in forge shops during the 1960's. Many of these openings will result from the expected moderate growth in the employment of forge shop workers. Other opportunities will arise because workers who retire, die, or transfer to other fields of work will have to be replaced.

Additional workers will be needed in forge shops because metalworking industries which use forgings in their final products—particularly the aircraft and missile, industrial machinery, and automobile industries—are expected to expand. However, the growth in forge shop employment may be limited by the use of metal castings to replace some forged parts, by the competition from new material and metals which are not forged, and by the continued use of more modern equipment. The wider use of more modern equipment will probably have a greater effect on the employment of helpers than on the employment of the more skilled forge shop workers.

**Earnings and Working Conditions**

In January 1961, production workers (including unskilled and semiskilled workers as well as skilled craftsmen) in independent iron and steel forging plants had average earnings of $115.35 a week or $2.95 an hour. Production workers in all manufacturing industries averaged $90.25 a week or $2.32 an hour in the same month.

In many forge shops, the earnings of hammer and press smiths are determined by the number of forgings they produce. Other members of hammer or press crews are paid a percentage of the operators' pay.

An examination of several union-management contracts indicates that skilled hammersmiths, press smiths, and die sinkers received the highest hourly rates among forge shop workers; die sinker rates were between $3 and $4 an hour. According to a private survey of a large number of union-management contracts covering forge shop workers, the rates for many hammersmiths and press smiths in mid-1960 were between $2.25 and $3.25 an hour, although these workers frequently earned considerably more depending on the number of forgings produced.

Most forge shop workers are union members. Many are members of the International Brotherhood of Boilermakers, Iron Shipbuilders, Blacksmiths, Forgers and Helpers. Others are members of the United Steelworkers of America; the International Union, United Automobile, Aircraft and Agricultural Implement Workers of America; the International Association of Machinists, and the International Die Sinkers' Conference (Ind.). Many of the plants which employ forge shop workers have union-management contracts which provide insurance and pension plans, and other nonwage benefits.

Although forge shops typically are hot and noisy, working conditions have been improved in recent years. Many firms have installed...
large ventilating fans and have attempted to reduce machine concussion and vibration.

The injury-frequency rate in forge shops is higher than in many other types of factory work, but it has been declining in recent years because of the greater emphasis upon safety precautions. Forge shop firms and the unions have contributed to the reduction of accidents in forge shops by promoting greater use of protective goggles, metal-toe shoes, metal helmets, and safety guards at the machines.

Where To Go for More Information

Drop Forging Association, 1121 Illuminating Bldg., 55 Public Square, Cleveland, Ohio.

International Brotherhood of Boilermakers, Iron Shipbuilders, Blacksmiths,Forgers and Helpers, 570 New Brotherhood Bldg., Kansas City 1, Kans.
DRIVING OCCUPATIONS

One out of every 19 male American workers in the civilian labor force in 1960 earned his living as a driver or deliveryman. Over 21/4 million men played a vital role in moving passengers and goods over miles of highways and city streets. (See chart 25 for percent of employment by individual occupation.) They transported food and thousands of other products used in our homes, schools, and factories. They also transported millions of Americans to and from work every day.

Some of them, like the over-the-road truck-driver, the intercity bus driver, the local bus driver, and the taxicab driver, spend practically all of their working time in driving. Others, like the local truckdriver and delivery man, spend considerable time in loading and unloading goods, making pickups and deliveries, and collecting money. Still others, like the routeman, spend a good deal of their time selling. This chapter deals only with employment opportunities for drivers of intercity and local trucks and buses; routemen; and taxicab drivers.

Many driving jobs require a high degree of responsibility. Drivers, for the most part, operate large and expensive equipment which they must drive carefully, obeying safety regulations and traffic laws, to deliver their passengers and freight safely. These men are on their own, away from direct supervision.

Although employment in some driving jobs is not expected to increase substantially during the next decade, expansion in the employment of local and over-the-road truckdrivers is anticipated as a result of increased freight tonnage.

Normal turnover in this large occupational field will also provide many job opportunities each year.

Driving jobs offer excellent opportunities for young men who are not planning to attend college and who have no interest in or aptitude for the skilled technical occupations. The pay of most drivers is relatively high and working conditions are fairly good. Many young men will also enjoy the freedom from close supervision, as well as the frequent contacts with people, which is characteristic of most of these jobs.

CHART 25
TRUCKDRIVERS MAKE UP FOUR-FIFTHS OF WORKERS IN DRIVING JOBS.....

Over-the-Road Truckdrivers
(D.O.T. 7–36.240)

Nature of Work

The men at the wheels of the big trucks seen on our highways and turnpikes are generally the top professional drivers in the country. These men drive the largest and most expensive equipment and receive the highest wages of all
Over-the-road truckdriver checking light and air line connections before starting trip.

drivers. They are on their own practically all the time and have a great deal of responsibility.

Most over-the-road drivers operate gasoline or diesel powered tractor-trailers. (The tractor is the vehicle with the very short chassis which draws the trailer in which the freight is carried.) They deliver goods usually over long distances—frequently driving at night.

Unlike the local truckdriver who spends considerable time in loading and unloading, the over-the-road driver (sometimes called intercity driver, line-haul driver, or long-haul driver) spends practically all of his working time in driving. He may, however, sometimes handle the freight he carries. Some drivers, for example, may have to unload their goods because they make deliveries to stores at night when there are no receiving crews on hand. Drivers of long-distance moving vans generally have to load or unload their vehicles, with the assistance of helpers hired locally.

The truckdriver must back up big trailers to loading platforms. To do this requires the ability to maneuver the trailers while driving in reverse. The driver must also be able to judge distances accurately while driving around corners or through narrow passageways.

Because the over-the-road truckdriver spends most of his time driving, safe driving practices and courtesy are of the utmost importance. Every one has seen the emergency warning signals set out by a driver near his disabled truck on the edge of the highway. Many motorists have noted the courtesy of truckdrivers who pull off to the shoulder of the road at the top of a hill to allow the accumulated traffic to pass.

The long-haul truckdriver has a responsible job which also requires initiative. He is entirely on his own for long periods of time, transporting goods and materials of great value which must be delivered safely and on time.

Interstate Commerce Commission regulations require drivers to inspect their trucks before and after trips and make out reports on the condition of the vehicles at the end of the run. Drivers are also required to keep a daily log of their activities. If a driver has an accident, he must make out a detailed report.

Where Employed

The more than one-half million over-the-road drivers are employed throughout the United States. Many work out of some of the large cities, such as Chicago and Los Angeles; however, some large companies have their operating headquarters in fairly small towns.

Over-the-road drivers are employed by private and for-hire carriers. Private carriers are companies, such as chain food stores or manufacturing plants, which use trucks to transport their own goods. For-hire carriers are either common carriers (trucking companies serving the general public) or contract carriers (trucking firms hauling goods under contract only for certain companies). Most of the drivers of the big tractor-trailer combinations on long intercity runs are employed by common carriers. On shorter hauls, many drivers are employed by contract and common carriers to make deliveries of machinery, food, petroleum products, household appliances, and other items, from
plants to warehouses and from warehouses to large volume purchasers.

Qualifications, Training, and Advancement

Regulations of the Interstate Commerce Commission establish minimum qualifications for over-the-road drivers. The driver must be at least 21 years of age, able-bodied, with good hearing and vision of at least 20/40 with or without glasses. He must be able to read and speak English, have at least 1 year’s driving experience (which may include driving private automobiles), and a good driving record. Most States require truckdrivers to have a chauffeur’s license, which is a commercial driving permit obtained from State Motor Vehicle Departments.

These are minimum standards which apply to all over-the-road drivers. Most fleet operators, however, have higher standards. Many firms will not hire drivers under age 25. Some employers specify height and weight limitations. Many require applicants to have at least a grade school education; others require 2 years of high school. Some companies will employ only an applicant who has had several years of experience in handling vehicles of the type he would be required to drive.

The standards for over-the-road drivers are higher than those which generally prevail for local truckdrivers. Furthermore, these standards are more strictly adhered to than those for local drivers, whose standards frequently may be lowered when there is an insufficient number of applicants for local driver jobs.

The truck-trailer combination often seen on our highways probably costs as much as $20,000 and the load inside may be worth more than $100,000. The owners of this transportation equipment, therefore, employ drivers with a know-how based on years of driving experience and who also can accept great responsibility.

Many training authorities and employers recommend that young men interested in becoming professional drivers would do well to take the driver-training courses offered by many of the Nation’s high schools. If such a high school course is not available, the professional driving schools which operate in most large cities are recommended. A high school course in automotive mechanics is also very helpful.

Most long-haul drivers have had experience in local trucking. Usually they have entered this occupation by first driving a small, light truck. After gaining experience they have moved on to the larger and more complicated trucks. A young man may also begin as a helper to a local truckdriver and assist him in loading and unloading the truck. He may occasionally do some driving to relieve the driver.

Another type of experience considered very desirable by employers is a combination of intercity bus and local truck driving. This experience may be gained by working for an intercity bus company for the spring and summer months and by working for a local trucking company during the fall and winter months delivering such products as fuel oil. Thus, the driver gets the road experience with the bus company and learns how to handle a truck and trailer with the local trucking company.

All employers are interested in obtaining good, safe, reliable drivers, but the methods of selection and training vary. Some companies have formal tests and training programs. Other companies do their hiring on the basis of personal interviews and their training program consists of a “break-in” period during which the new employee observes and works with an experienced driver.

Applicants for jobs as over-the-road drivers are required to pass a physical examination which is usually paid for by the employer. Many firms also give written traffic and driving knowledge tests. Some employers give tests to measure such factors as sharpness and field of vision, reaction time, the ability to judge speed, and emotional stability. The last step in the selection of drivers is the road test. The applicant is expected to demonstrate his ability to handle, under a variety of driving conditions, a vehicle of the type and size he will operate in regular service.

A new driver may be given a brief indoctrination course. Company policy is explained and the new employee is taught how to prepare the various forms he will use on the job. The new driver will then make one or more training
trips with an instructor or an experienced driver.

Drivers employed by common carriers frequently start on the “extra board,” bidding for regular runs on the basis of seniority as vacancies occur. (The extra board is a list of men, assigned in rotation, who substitute for regular drivers or who make extra trips when necessary.) Drivers for private carriers are more likely to begin with assigned regular routes.

Promotional opportunities in this occupation are limited. A few drivers may advance to jobs as safety supervisors, driver supervisors, and dispatchers. Most drivers, however, can only expect runs which will give them higher earnings.

Employment Outlook

A very substantial increase in the employment of over-the-road truckdrivers is anticipated during the 1960’s as a result of increased industrial activity, continued decentralization of industry, and the movement of population to the suburbs. A large number of job openings will also be created by transfers from this field of work. Many long-haul truckdrivers often return to local truckdriving jobs. Several thousand additional openings will also result each year from retirements and deaths.

The freight carried by over-the-road trucks has been increasing as a result of the general economic growth of the Nation and because trucks have been hauling an increasing proportion of the total freight. Many factories, warehouses, and stores are being located at great distances from each other in suburban or semi-rural areas where rail facilities are nonexistent or extremely limited. Furthermore, the growth of chain stores and the trend to decentralization of factories are developments requiring daily coordination of shipping which can best be handled by trucks.

Improvements in trailer design have also contributed to more over-the-road trucking. These advancements have made it possible to ship certain kinds of freight for longer distances by truck than was previously possible. For example, some refrigerated trailers now provide temperatures down to 20 degrees below zero, and new livestock trailers feature controlled ventilation, nonskid floors, and interior walls designed to avoid bruising and other injury to the animals. As a result of these, and other factors mentioned previously, a large part of the future increase in long-haul freight traffic will probably be by truck and thus expand the demand for over-the-road truckdrivers.

Some recent freight transportation innovations will limit somewhat the anticipated increase in trucking business and driver employment. For example, “piggyback,” the movement of highway trailers on railroad flat cars, which saves the cost of driver, fuel, and tractor, appears to have promising prospects, although it accounts for only a small share of total freight shipped at present. The increasing use of trailer-carrying ships, recently introduced for the transportation of loaded trailers for long distances, could also adversely affect the employment of over-the-road truckdrivers. In any event, the effect of this latter innovation would be largely limited to the movement of those commodities where the time element is not too important.

In addition, the trucking business may undergo a considerable expansion without a corresponding increase in driver employment. State limitations on truck weight, size, and speed are being liberalized as a result of the construction of better highways. The movement of bigger loads at higher average speeds could result in a need for fewer drivers than would otherwise be required to move the greatly increased over-the-road tonnage anticipated during the 1960’s.

The over-the-road driver has a better chance of remaining employed during business recessions than workers in many other occupations. Although the total tonnage moved declines, over-the-road trucking is less affected than other means of transportation. It gets a larger share of the shrinking transportation business because manufacturers and merchants, unable to buy merchandise in railroad carload lots can reduce inventories and still maintain their diversified stock by small daily shipments by truck.
Most over-the-road drivers earned well above $100 a week in 1959. Drivers employed by class I common carriers of general freight (carriers with gross operating revenues of $1 million or more a year) had average annual earnings of $7,839 in 1959, the most recent year for which such data are available. The rates paid to over-the-road drivers are fairly uniform because this is a highly unionized field and union-employer contracts are generally master agreements covering all employers within a region—an area including a number of States. Furthermore, regional contracts tend to be quite uniform because drivers working under different contracts often travel the same routes. The earnings of an individual driver are affected by such factors as the mileage driven, the number of hours worked, the type of equipment driven or the weight of the loads carried, and the type of "run"—whether or not pickup or delivery enroute is required.

Drivers on the longer runs are generally paid on a mileage basis for actual driving time. For all other time during which the driver is required to be on duty, he is paid at an hourly rate. This includes waiting time, delay time due to breakdown of equipment or impassable highways, layover time (time spent at a terminal away from home beginning at some designated hour after his run ends), and time spent in making pickups or deliveries enroute. Regular drivers are usually assured minimum pay for a certain number of hours—generally 8 hours a day.

Some private carriers pay their drivers on the same basis as their other employees—a monthly, weekly, or daily wage. Generally, such a wage is for a specified number of hours and if the driver works beyond that he receives extra pay.

Interstate Commerce Commission regulations limit the hours of work of over-the-road drivers. No driver may be on duty for more than 70 hours in any 8-day period. A driver must be off duty for at least 8 hours after driving for 10 hours before he can drive again. Many drivers, particularly on the very long runs, work fairly close to the maximum permitted. A workweek of at least 50 hours is very common.

Most drivers receive pay for 6 national holidays plus 1 or more State and local holidays. They also have paid vacations, usually from 1 to 4 weeks, depending upon their length of service. Health, insurance, and pension plans, usually paid for by the employers, are very common.

Over-the-road truckdrivers are often required to spend time away from home—particularly when they drive long runs. The driver often starts out in the evening and arrives at the terminal in the other city the following morning. There, the company provides lodging for him either in a company dormitory or a hotel. In the evening, he starts on his return trip and arrives at the home terminal the following morning. The driver may make two or three such round trips a week. If the trips are part of a relay operation, another driver is working a similar schedule starting from the other end of the run.

Some companies use two-man sleeper teams on their very long runs. One drives while the other sleeps in a little bunk behind the cab. The vehicle goes straight on through to the end of the run where there may or may not be a layover before the return trip. Two periods of 4 hours of resting or sleeping in a berth in the truck meet the ICC requirement of 8 hours off duty following 10 hours of driving. This means that the drivers on a run may remain with the truck in some cases for over 100 hours.

Although earnings on sleeper runs are the highest in this field of work, few drivers stay with this type of run very long. The work is very tiring and requires being away from family and friends for days and even weeks. However, many drivers come back to sleeper runs after they have had a rest or have done some relay driving for a while. The earnings of drivers of long-distance moving vans are also quite high, but their hours are long and the work is strenuous. They drive more miles than the average over-the-road driver and also work more hours in loading and unloading goods.

Largely because of intensive safety programs and drivers' skill, the accident rate in over-the-road trucking is surprisingly low. Injuries occur less frequently than in other forms of motor transportation.
Driving the big over-the-road trucks does not involve the physical effort most people associate with truck driving. Sitting in one place for hours at a time, however, is tiring and the nervous strain of sustained driving at night is also fatiguing.

Most over-the-road drivers are members of the International Brotherhood of Teamsters, Chauffeurs, Warehousemen and Helpers of America (Ind.). Some drivers of private carriers belong to unions representing the plant employees of the companies for which they work.

Local Truckdrivers
(D.O.T. 7-36.200 through .299)

Nature of Work

Much of the food, clothing, and other products required by consumers are transported by trucks. The men who move these goods from terminals, warehouses, and factories to wholesalers, retailers, and consumers in the local area must be skilled drivers to avoid accidents on congested city streets. They must also be able to maneuver big trucks into tight parking spaces, through narrow alleys, and up to loading platforms. (Telephone linemen, repairmen, and many thousands of other workers for whom driving trucks is only incidental to their primary job duties are not included in this discussion.)

When the local truckdriver reports to work at the terminal or warehouse, he receives his assignment to make deliveries, pickups, or both. He also receives the delivery forms he will need and checks the condition of his truck. His truck is generally loaded for him by platform men. If he does the loading himself, however, and must make many deliveries, he arranges the items in proper sequence so that there will be a minimum of handling. At the customer's place of business, the driver generally loads and unloads the merchandise himself. If he has heavy loads such as machinery or if he has many deliveries to make during the day, he may have a helper to assist him. The driver of a moving van usually has a crew of helpers to assist him in loading and unloading household or office furniture.

At the delivery points, the driver gets customers to sign receipts and freight bills, and he sometimes collects money for freight, C.O.D. deliveries, and other charges. At the end of his day he turns in all receipts and cash collected and records his time and the deliveries made. He also reports whatever maintenance or repair is needed before his truck is used again.

Some of these workers drive special types of trucks, such as dump or oil trucks, which may require the operation of mechanical levers, pedals, or other equipment. For example, if they drive dump trucks, they operate levers inside the cab or at the side of the truck in order to set the dumping mechanism in motion. If they haul heavy machinery, they operate mechanical hoists to load and unload the machines.

Where Employed

About 1¼ million workers were employed as local truckdrivers in early 1960, mostly in and around large metropolitan areas. They work in all localities, however, including the smallest villages.

A large majority of local drivers work for businesses which deliver their own products and goods—such as department stores, meatpackers and other food processors, wholesale distributors, petroleum companies, grocery chains, and construction companies. Many other truckdrivers are employed by local for-hire operators—trucking companies which serve the general public or specific companies under contract. Some other truckdrivers are employed by the Federal Government and by States and municipalities. A large number of local drivers are in business for themselves.

Qualifications, Training, and Advancement

Qualifications for local truckdrivers vary considerably, depending upon such factors as the type of equipment to be operated and the nature
of the employer's business. Generally, applicants must be 21 years of age or older. Some employers prefer applicants who have completed grade school or have had 2 to 4 years of high school. The applicant must be physically able to lift heavy objects and otherwise be in good health. He should have good hearing and good vision (with or without glasses). Since a driver often deals directly with the public, employers look for men who are tactful and courteous.

An applicant must have or get a chauffeur's license, which is a commercial driving permit. Familiarity with traffic laws and safety measures is necessary, and some previous experience in driving a truck is helpful. A young man may obtain such experience by working as a truckdriver's helper. Employers also give consideration to driving experience gained in the Armed Forces.

Since he will be responsible for costly vehicles and cargo, a truckdriver must be cautious, alert, and able to judge distances and to coordinate his reactions so as to avoid accidents in congested traffic. To demonstrate these qualifications, an applicant's driving ability will be tested, and he may have to pass a written examination, as well as a general physical examination.

Training given to a new driver is often informal and may consist only of riding with and observing an experienced driver on the job. If he is to drive a special type of truck, the new driver may be given additional training. In some companies, a new driver is given a brief indoctrination course which lasts 1 or 2 days. This instruction covers his general duties, the efficient operation and loading of his truck, company policies, and the preparation of delivery forms and company records.

Although most new employees are immediately assigned to regular driving jobs, some start as extra drivers. These drivers take over the routes of regular drivers who are ill or on vacation, or make extra trips when necessary. They receive regular assignments when openings occur.

Local truckdrivers may get jobs as dispatchers or advance to jobs as terminal managers, or supervisors. However, these jobs are relatively few. For the most part, advancement for a local truckdriver consists of earning higher hourly wages by driving heavy or special type trucks instead of light trucks, or by transferring to over-the-road truck driving.

An experienced truckdriver who has some business ability and ambition can start his own trucking company when he has sufficient capital to purchase expensive trucking equipment and meet other business expenses. Truckers who own only one or two vehicles continue to account for a sizable proportion of local for-hire trucking business.

**Employment Outlook**

A moderate rise in the employment of local truckdrivers is anticipated during the 1960's because of the expected increased volume of freight. Many new workers will also be needed to replace drivers who retire, die, or transfer to other fields of work. Retirements and deaths alone will result in about 10,000 to 15,000 job openings each year for local truckdrivers during the next few years.

The rise in total business activity anticipated between 1960 and 1970 will increase the volume of freight. Since trucks carry virtually all freight for local distribution and do not compete for hauling with other types of carriers, this anticipated increase in total intercity and local freight volume will expand local trucking business and, thereby, truckdriver employment. Another factor that will contribute to the employment of more drivers is the continued growth of suburban areas.

Some recent developments may offset somewhat the growth in the number of local truckdrivers that would otherwise occur with an increase in freight volume. For example, the trend toward larger deliveries to relatively fewer customers is the result of the growth of chain stores and shopping centers. The introduction of new equipment may also affect the number of drivers who will be needed to deliver large and heavy loads. For example, the greater use of trucks equipped with power tailgates that can be raised or lowered to platform or ground level will reduce the time needed for deliveries. Innovation in local trucking will continue to be limited, however, by the narrow city streets and heavy traffic.
Earnings and Working Conditions

On the average, hourly union wage scales were $2.56 for local truckdrivers and $2.27 for driver-helpers on July 1, 1959, according to a survey in 52 large cities. Average hourly pay scales for drivers ranged from $2.02 in New Orleans to $2.82 in the San Francisco-Oakland area. Wage scales vary even in the same city depending on the type of trucking service (such as general freight drayage or local moving and storage), the type of product hauled, and the size and type of truck operated.

As a rule, local truckdrivers are paid by the hour and receive extra pay for working overtime, usually after 40 hours. Some drivers are guaranteed minimum daily or weekly earnings. Local truckdrivers frequently work 48 hours or more a week and thus often drive 6 days a week. Daytime work is customary, but night or early morning work is sometimes necessary. Some drivers are assigned different routes when they report to work each day. Others, however, deliver over regular routes or runs.

Local truckdrivers generally have paid vacations of 1 or 2 weeks after a year of service and up to 4 weeks after 20 years. In addition, they usually receive pay for 6 national holidays plus 1 or more State and local holidays.

A majority of local truckdrivers belong to unions. Most of them belong to the International Brotherhood of Teamsters, Chauffeurs, Warehousemen and Helpers of America (Ind.). Some local truckdrivers employed by private carriers are members of unions representing the plant workers of their employers.

Practically all unionized local truckdrivers and their helpers are covered by health, and life insurance, and pension plans which are generally paid for by the employer. When uniforms are required, the cost is usually paid for entirely or partly by the employer, who may also provide for their upkeep.

Local truckdrivers, because they drive in heavy traffic through narrow city streets, are subject to nervous strain. The actual operation of a truck is not physically demanding, but when local drivers make many deliveries during a day, their work can be exhausting. Some drivers may develop physical disorders, such as back strains and hernias. Local truckdrivers do, however, have certain advantages. For the most part, they have steady employment. Furthermore, unlike over-the-road drivers, they usually work a regular daytime schedule and return home in the evenings.

Routemen

(D.O.T. 7-35.100)

Nature of Work

Routemen are as much salesmen as they are drivers. In fact, they are sometimes known as driver-salesmen or route-salesmen. Once they are assigned to their routes, they must, through their selling ability, increase sales to existing customers and obtain new business by canvassing potential customers within their territories. Routemen drive panel or light trucks over an assigned route selling and delivering goods, or providing services such as collecting and delivering laundry and dry cleaning, to retail establishments (wholesale routemen) or directly to the public (retail routemen).

Before starting on his daily route, the routeman loads or supervises the loading of his truck. The amount of merchandise in his truck is generally checked by another employee. Some routemen deliver merchandise previously ordered and obtain orders for future delivery. Others make immediate sales from the stock in the truck. In either case, they must collect payments and keep records of their transactions. When they check in at the plant after completing their routes, they empty their truck and turn in their collections to the cashier. The retail routemen serving homes make from 5 to 10 times as many stops as the wholesale routemen who serve stores and other business establishments.

The work performed by routemen varies according to the industry in which they are employed, the type of routes they have (retail or...
Some specific examples, however, may indicate in a general way what most routemen do.

A typical day for a dry-cleaning routeman begins when he picks up cleaned garments at the processing plant and loads his truck, which is equipped with carrying racks. He delivers the garments to homes or business establishments and picks up soiled clothing. He marks the articles picked up so they may be identified at the plant. Sometimes, he makes notes of the types of stains or of special processes to be used, such as waterproofing. Each cleaned garment has an itemized bill attached, so that the routeman can collect the amount of money due.

Although all routemen must be able to get along well with people, it is particularly important for the dry-cleaning and laundry routeman. His reaction to complaints and requests for special services may be the difference between increasing business or losing customers. Periodically, he calls at homes and business establishments along his route which are not using his company’s services to try to get their trade.

A good example of a wholesale routeman is the man who delivers bakery products to grocery stores. His truck is loaded the night before or early in the morning, and he checks to see whether he has the proper variety and quantity of products before starting on his route. He stops at from 10 to 50 grocery stores. At each stop, he brings the orders of bread and other bakery products into the store, and arranges them on the display racks, in the best possible display space he can secure. Together with the store owner or manager he checks the merchandise he has delivered. He also credits the store for the value of the stale bread and cakes left over from the previous delivery.

The routeman prepares a list of products he plans to deliver the next day. This represents his estimate of the amount of bakery products that will be sold by the grocery stores on his route. From time to time, he calls on grocers along his route, who are not his customers, and tries to get orders from them.

Where Employed

About 100,000 routemen worked for a wide variety of businesses in 1960. Since most routemen were employed by companies which distributed food products or provided personal services, they worked in small towns as well as in large cities throughout the country. The greatest concentration of employment, however, was in the dairies, bakeries, and laundry and dry-cleaning plants located in the large cities.

Some routemen were engaged in wholesale distribution of goods and services to stores and other business establishments, while others distributed goods and services to homeowners and apartment dwellers. Many companies employed both wholesale and retail routemen.

Qualifications, Training, and Advancement

In addition to being a good driver, a routeman must have sales ability. To induce people to buy he must have a thorough knowledge of the product or service he is selling and a persuasive personality. Other important sales qualifications are a pleasant voice, ability to speak
well, and a neat appearance. He also needs to have self-confidence, initiative and tact.

Besides having selling ability, a routeman must be able to work without direct supervision, do simple arithmetic, and write legibly. In most States, a routeman is required to have a chauffeur’s license, which is a commercial driver permit. Information regarding this license can be obtained from State Motor Vehicle Departments.

Most employers require their routemen to be high school graduates, preferably 25 years of age or older. Many of the large companies give applicants aptitude and other psychological tests to determine whether they will make good salesmen and safe drivers.

High school courses in salesmanship, public speaking, driver-training, bookkeeping and business arithmetic, and school-work programs in retail and wholesale merchandising are helpful to a person interested in entering this occupation. In the years immediately following high school, a young man interested in preparing himself for this occupation may obtain valuable experience as a sales clerk in a store or in some other type of selling job.

Another method of entering this occupation is to get a job as a routeman helper (D.O.T. 9–35.10). Employers usually hire boys 18 years of age or over who have a driver's license for this job. The helper assists the routeman by loading the truck at the beginning of the day, and runs deliveries from the truck to the customer’s home or store. He may collect payments or obtain receipts, and may sometimes drive to relieve the routeman. Still another way of becoming a routeman is to get a job (plant or office) in a bakery, dairy, laundry, or dry-cleaning establishment. After learning something about the business, a young man may get a job as a routeman when an opening occurs.

Most companies give their routemen on-the-job training which varies in length and thoroughness. Many of the large companies have classes in salesmanship. Some companies assign newly hired routemen for brief periods to jobs in the different departments of the plant to familiarize them with all the processing operations, so they can answer customers’ questions intelligently and be better salesmen. New employees are then trained for a short time on routes with supervisors. The first week, the routemen usually observe and assist the supervisors; later, they take over the operation under the direction of the supervisors.

Routemen may be promoted to route foremen or sales supervisors, but these jobs are relatively scarce. For most routemen, advancement is limited to moving from a retail to a wholesale route where earnings are usually higher. However, some routemen obtain better paying sales jobs as a result of the experience gained in route selling.

Employment Outlook

The employment of routemen in the 1960’s is expected to remain at approximately the current level. However, a few thousand opportunities for new workers to enter this occupation will occur each year as a result of retirements, deaths, and transfers to other fields of work.

Since 1940, the number of routemen has been declining despite increases in population, income, and consumer expenditures. During World War II, there were sharp reductions in the number of routemen, particularly in home delivery, because of a shortage of men and gasoline. Deliveries were made less frequently—a practice which was continued after the war. During the postwar period, the introduction of larger home refrigerators caused a further decline in the home delivery of milk and dairy products.

The employment of routemen in wholesale routes has also been declining because individual manufacturers now produce a greater variety of products than routemen can handle, and because large supermarkets have been replacing small neighborhood stores. In recent years, some manufacturers and wholesale food companies have replaced their routemen with salesmen who cover their assigned territory by automobile. Truckdrivers, rather than routemen, then make the deliveries.

The decline in the employment of routemen appears to have run its course. Any further effect of the factors previously mentioned will
probably be counterbalanced by the continuing population shift to the suburbs, with its demand for retail routemen, and by the continuing development of new products, increasing the demand for wholesale routemen. New lines of frozen food for example are often introduced and marketed by wholesale routemen in thousands of food stores throughout the country.

Earnings and Working Conditions

Most routemen are paid a salary plus a percentage of the sales or collections they make. Earnings vary considerably according to the product sold and also between routemen selling the same product. To a considerable extent, the earnings of routemen may be determined by their selling ability and the amount of time they spend in canvassing. Wholesale routemen generally earn more than retail routemen because, although they receive a lower percentage of sales, they handle much larger quantities.

Some recent studies indicate that in 1960 retail milkmen, making home deliveries, averaged about $100 a week. Weekly earnings of these routemen, usually based on sales commissions, ranged from $93 in Dallas, to $135.50 in Minneapolis–St. Paul. The weekly earnings of milkmen on regular wholesale routes averaged more than $100 a week, and ranged from $101 in Boston, to $195.50 in Minneapolis–St. Paul. The average weekly earnings of dry-cleaning and laundry routemen ranged from $72.50 in the area around Providence, R.I., to $131 in Chicago. According to a 1961 survey of baking firms in 13 Eastern States, driver-salesmen for both wholesale and home-service bakeries had minimum weekly salaries of from $50 to $98. By selling more baked products to their customers and by increasing the number of customers on their routes, driver-salesmen can increase their earnings considerably.

The number of hours worked by routemen varies. Some routemen work only about 30 hours a week; others may work as much as 60 or more hours a week. It depends, to some extent, on whether the individual routeman has a well-established route or whether he is trying to build up a new one; whether he has a retail or a wholesale route; and how ambitious he is. For some routemen, the hours of work are limited by union contract. The hours of routemen may also vary according to seasonal peaks and lows. During the spring cleaning season, for example, dry-cleaning routemen may work about 60 hours a week; whereas, in the dead of winter, they may not work more than 30 hours a week.

Many companies require routemen to wear uniforms. Some employers pay for the uniforms and for keeping them clean; others require the routemen to do so.

Most routemen receive paid vacations, generally ranging from 1 to 4 weeks, depending upon length of service, and 6 or more paid holidays a year. Many employers provide hospitalization and medical benefits. Some routemen are covered by pension plans.

The routeman is on his own to a great extent. He does not work under strict supervision and, within certain broad limits, may decide how fast he will work and where and when he will have his lunch or rest period. This freedom of action, plus the daily meeting and dealing with different people on his route, appeals to many young men. On the other hand, a retail routeman has to make deliveries in bad weather, do a great deal of lifting and carrying, and climb up and down stairs. He may also have to work unusual hours.

Many routemen, particularly those delivering bakery and dairy products, are members of the International Brotherhood of Teamsters, Chauffeurs, Warehousemen and Helpers of America (Ind.). Some routemen belong to the unions which represent the plant workers of their employers.
Intercity Bus Drivers  
(D.O.T. 5-36.010)

Nature of Work

The drivers of the big buses which travel between the cities of our country are selected on the basis of their driving skill, emotional stability, and courtesy. A driver’s duties generally begin when he takes charge of the bus at the terminal, garage, or on the highway. Before beginning his scheduled trip, the driver inspects the bus carefully at the terminal or garage. He checks the fuel, oil, water, and tires; and makes certain that the bus is carrying safety equipment, such as fire extinguishers, first-aid kits, flags, and flares. The driver also picks up the tickets, change, report blanks, and other items needed for his trip. He receives a listing of the express and mail to be carried.

Unless the driver is to take over an already loaded bus on the highway from another driver, he moves his empty bus from the terminal or garage to the proper loading platform, where he takes on his passengers. He collects fares—tickets or cash—from the passengers as they board the bus, and announces the destination, route, time of arrival, and other information concerning the trip. The driver also loads or supervises the loading of baggage into the baggage compartment. He checks the loading plan so that the baggage can be unloaded at the proper destination with minimum effort.

The driver operates the bus carefully at speeds which will enable him to arrive at and leave regular bus stops according to established time schedules. On most runs, he also stops momentarily at other designated points to discharge or pick up passengers, and load or unload baggage wherever necessary. He announces regular stops, and rest or lunch stops. Before continuing the trip he counts the passengers to make certain all have reentered the bus. The driver also regulates lighting, heating, and air-conditioning equipment for the passengers’ comfort. In an emergency, he is sometimes required to make minor road repairs such as changing tires, for which he generally receives extra pay.

Upon arriving at his final destination, the driver unloads or supervises the unloading of the remaining baggage and turns in the lists of packages or mail carried. He prepares reports on mileage, time, and fares as required by company rules. He also keeps a log of hours as required by the Interstate Commerce Commission. The driver must make out a complete report if an accident or unusual delay occurs.

Where Employed

Approximately 26,000 intercity bus drivers were employed by more than 1,600 bus companies in 1959. About 16,000 of these drivers worked for the 143 large class I intercity companies—those with annual revenues of over $200,000. Although most bus drivers work out of the larger cities, some are employed in smaller cities and towns.

Qualifications, Training, and Advancement

All intercity bus drivers are required to meet minimum age, health, and experience qualifications established by the Interstate Commerce Commission. The ICC minimum age requirement is 21 years. In addition, the applicant must be able-bodied, have good hearing, and his eyesight must be at least 20/40 with or without glasses. He must have at least 1 year's driving experi-
ence (through all four seasons), he must be able to read and speak English, and he must have a good driving record.

Although many intercity bus companies use these standards for bus driver positions, the large companies have higher requirements. Most of these companies prefer applicants to be at least 23 years of age with a high school education or its equivalent. Applicants are often given comprehensive examinations to determine their driving skill, intelligence, temperament, and personality. Some of the large companies do not accept applicants who wear glasses.

Young persons interested in becoming bus drivers should have good foot, hand, and eye coordination; be able to judge distances accurately, and react quickly. An even temperament and emotional stability are other important qualifications because bus drivers work under considerable tension when they operate large vehicles in heavy and swiftly moving traffic. Since they represent their companies in dealing with passengers, bus drivers must also be courteous and tactful.

Although previous experience in the operation of a truck or bus is not required, it is preferred by some employers. In most States, the law requires that a trainee for a bus driver's job must either have or obtain a chauffeur's license, which is a commercial driving permit.

Most intercity bus companies conduct training courses for beginning drivers. These training programs, which usually last from 2 to 6 weeks, include both classroom and driving instruction. In the classroom, the trainee is instructed in company and Interstate Commerce Commission rules; State and municipal regulations; safe driving practices; rates, schedules, and timetables; and how to deal with the public. He is also taught how to keep clerical records, check supplies, inspect the bus, and make minor emergency repairs.

The trainee then rides with a regular driver to observe correct driving practices and other aspects of the job. He also makes trial runs, without passengers, to demonstrate his driving skill. After satisfactorily completing the training, which generally includes final driving and written examinations, the new driver begins a "break-in" period. During this period under strict supervision, he makes regularly scheduled trips with passengers.

New workers start out on the "extra board," which is a list of drivers on call who are given temporary assignments. While on the extra board, the new driver may substitute for a regular driver who is ill or on vacation. He may also drive a second or overload section, make an extra trip if necessary, or drive chartered buses. Extra drivers may have to wait several years before they have the necessary seniority to bid for and receive a regular assignment.

Opportunities for promotion are generally somewhat limited, particularly in the small companies. An experienced driver may be promoted to a job as dispatcher, supervisor, sales representative, terminal manager, or regional manager. For most drivers, advancement consists of receiving better assignments, with consequent higher earnings, as their seniority increases.

**Employment Outlook**

During the 1960's, employment of intercity bus drivers will probably rise moderately, reversing the downward trend in the 1946-58 period when the number of drivers dropped from 32,000 to 26,000 because intercity bus traffic decreased. Additional workers in this relatively small occupation will be needed mainly as a result of the expected increase in intercity bus travel.

Among the factors which contributed to the decrease in the intercity bus traffic and affected the employment of bus drivers, was the rapid growth in the number of automobiles and their use in intercity travel. The expansion of the air transportation industry also offered some competition to bus travel on long trips. The drop in employment was also caused by the increased efficiency which resulted from larger buses, better highways, improved scheduling, and generally more effective use of buses and drivers.

The growth in population and higher consumer incomes expected during the 1960's should result in more travel generally, a portion of which is expected to be by bus, since the share of intercity traffic carried by automobile
is not likely to increase as rapidly as in the past. Some of the other factors which are expected to make bus travel more attractive during the 1960's are: New and improved highways, which are expected to cut the scheduled running time of many buses; larger and more comfortable buses; and deluxe express buses offering hostess service, refreshments, and other conveniences. Touring and charter services, package express and first-class mail delivered by buses, which have become important sources of revenue in the past few years, are also expected to affect the bus industry favorably in the future. The further curtailment or elimination of railroad passenger service in many areas may also bring about an increase in intercity bus traffic.

Earnings and Working Conditions

Drivers (including extra men) employed by class I intercity bus companies, averaged $6,148 in 1959. Many regular drivers employed by these companies earned more than $7,000 a year.

The wages of intercity bus drivers are typically computed on a mileage basis. Rates ranged from about 7 to 11½ cents a mile in 1960. Most regular drivers were guaranteed pay for either 160 miles or for 8 hours a day. For all work other than their regular assignment or “tour of duty,” they receive additional pay, customarily at premium rates.

Extra drivers are usually paid by the hour when they are on call, but not driving. They are paid the regular mileage rate when actually driving. Drivers usually start at a minimum rate and receive increases at intervals of 6 months or a year. The maximum rate is generally reached at the end of 2 years. Extra men generally earn slightly less than regular drivers but, if enough work is available, they may earn as much or more than regular drivers. Extra drivers receive a weekly or biweekly guarantee either in minimum hours, mileage, or earnings. Trainees are usually paid a flat daily rate.

Most drivers who work for the large companies average between 32 and 36 hours a week. Work schedules may range from 6 to 10 hours a day and from 3½ to 6 days a week. For example, a driver on the run between Washington, D.C., and New York City may make one 10-hour round trip a day for 3 days a week, drive part way and return each day for 6 days, or have the run split in some other way.

Interstate Commerce Commission regulations limit the hours of work of intercity bus drivers. According to ICC regulations, intercity drivers may drive no more than 10 consecutive hours, after which they must have at least 8 hours off. Drivers are also limited to 60 hours of “on duty” time in a 7-day period. The on-duty time is the period from the time the driver is required to report for work until the time he is relieved.

Most intercity bus drivers belong to the Amalgamated Association of Street, Electric Railway and Motor Coach Employees of America. The Brotherhood of Railroad Trainmen, and the International Brotherhood of Teamsters, Chauffeurs, Warehousemen and Helpers of America (Ind.) have also organized intercity bus drivers in a few areas.

The labor-management contracts covering most intercity bus drivers provide for health and life insurance, and pension plans which are usually financed jointly by the workers and their employers. Drivers are also given vacations with pay ranging from 1 to 4 weeks, depending on the company for which they work and their length of service. They also usually receive 6 paid holidays. When away from home terminals overnight, drivers generally receive pay for food and lodging. Drivers must usually pay for their own uniforms.

Driving an intercity bus is not usually physically burdensome, but the work is demanding and requires steady nerves. The bus driver is given a great deal of independence in the actual performance of his job and he is solely responsible for the safety of both the passengers and bus. Many drivers enjoy working without direct supervision and take pride in assuming these responsibilities. Some drivers like the idea of meeting the public and enjoy the opportunity to travel.

Among the less desirable aspects of this job are the weekend and holiday work and the necessity of occasionally spending a night away from home. Another unfavorable part of the
job is that extra drivers are on call at all hours and may be required to work at any time on very short notice. In addition, drivers with little seniority may, in some cases, be laid off when business declines.

Where To Go for More Information

For information regarding job opportunities, a young man should apply to intercity bus companies or the local office of the State employment service.

Local Transit Bus Drivers

(D.O.T. 5-36.010)

Nature of Work

Local bus drivers transport millions of Americans to and from work every day. These drivers follow definite time schedules and routes over city and suburban streets in order to get passengers to their destinations on time.

The local bus driver’s workday begins when he reports to the terminal or garage where he is assigned his bus. He receives his change, tokens, transfers, passes, and any other items needed. Before starting the run, the driver is usually required to check the tires, brakes, and lights. Some companies also require him to check the water, oil, and fuel.

On most runs, the driver makes regular stops every block or two, where he operates the controls of the bus doors to enable passengers to enter and leave the vehicle. As the passengers board the bus, the driver collects cash fares, tokens, tickets, or transfers, issues transfers and tokens, and makes change. The local bus driver often answers questions concerning schedules, routes, transfer points, and street numbers; he is sometimes required to call out the name of the street at each regular bus stop. The driver also regulates heating, air-conditioning, and lighting equipment to keep the passengers comfortable.

At the end of his day’s run, the bus driver turns in a trip sheet which usually includes a record of fares received, trips made, and any delays in schedule. In case of accident or an unusual delay, the driver must make out a comprehensive report on its nature and cause.

Where Employed

In 1959, about 70,000 bus drivers were employed by the local transit bus industry. Approximately one-fourth of the drivers worked in cities where the transit system was municipally owned, such as Boston, Chicago, Cleveland, Detroit, Los Angeles, New York, and San Francisco.

In addition to the bus drivers employed by the local transit bus industry, some local drivers work for charter and sightseeing lines and for companies which specialize in operating school buses. A few drivers are employed by the Federal, State, and local governments. Although many drivers work in major metropolitan areas such as New York, Chicago, and Detroit, some bus drivers are employed in most communities throughout the Nation.
Qualifications, Training, and Advancement

Applicants for bus driver positions should be between the ages of 21 and 40, of average height and weight, and have good eyesight—with or without glasses. The applicant must be in good health, with no physical disabilities, and must be able to pass both the written and physical examinations given by most employers. He must be able to judge distances accurately; have good foot, hand, and eye coordination; and have quick reflexes. Because the driver often works under pressure and deals with many different personalities, an even temperament and emotional stability are important. Although educational requirements are not high, many employers prefer applicants with a high school education or its equivalent.

A motor vehicle operator's permit and, generally, 1 or 2 years of driving experience on some type of motor vehicle are basic requirements. Most States require bus drivers to have a chauffeur’s license which permits the holder to operate commercial motor vehicles. This license may be obtained either during or immediately after the driver's training period. Some employers prefer drivers who have had some experience operating a truck or bus. Because the applicants will eventually be transporting passengers and since an accident could involve serious injury to a large number of people, good driving records are essential. An applicant who has had a serious traffic violation or accident which occurred while a vehicle was moving may be disqualified.

Most local transit companies conduct training courses which may last several weeks and include both classroom and driving instructions. In the classroom, the trainee is taught company rules, safety regulations, and safe driving practices. He is taught how to keep records, and how to deal tactfully and courteously with passengers.

The trainee makes several trips without passengers, under the direct supervision of an experienced driver. After he becomes familiar with the operation of the bus, the company’s routes, and other details of his work, he makes, under supervision, several trips over a regular run with passengers. At the conclusion of his training, the new driver is often required to pass a written and final driving examination before he goes out on a run.

After the driver passes the examinations, he is placed on the “extra” list. While on this list, he takes over the runs of regular drivers who are ill or on vacation and also makes extra trips in the morning or evening rush hours. He remains on the extra list until he has the necessary seniority to “bid” for and obtain a regular run. It may take anywhere from several months to several years before he is assigned a regular run. He also may drive charter and sightseeing runs, and also other extra runs such as special service buses for public meetings and sporting events.

Promotional opportunities in regular driving jobs are generally limited and slow. Experienced drivers may advance to jobs as instructors, dispatchers, road supervisors, and, sometimes, to executive positions. Promotion in municipally owned bus systems is usually by examination. The opportunities for advancement of most drivers are limited to assignments to more desirable runs. Only after acquiring sufficient seniority do the drivers receive these assignments.

Employment Outlook

There will be a small number of opportunities for new workers to enter this occupation each year during the 1960's, even though employment of local bus drivers is expected to continue to decline, as in recent years. These openings will result from the need to replace drivers who retire, die, or transfer to other fields of work. Retirements and deaths alone may account for more than 1,000 openings each year during the 1960-70 decade.

In recent years, there has been a considerable decline in the volume of passenger traffic handled by the local-transit bus industry. The main cause of this decline has been the rapid rise in the number of private automobiles and their increasing use for transportation in both city and suburban areas. Another factor has been the rapid growth of suburbs, most of which have a wide variety of stores, theaters, restaurants, and other services. Because most suburban shopping centers have good parking
facilities and are easily reached by automobile, many suburban residents have found it unnecessary to use public transportation for shopping or other activities. In addition, increasing traffic congestion and parking problems in most downtown sections have led to the decline of many central business districts. This in turn has resulted in the curtailment of downtown bus service between rush hours.

As local transit bus traffic declined steadily in recent years and bus schedules and routes were curtailed or entirely eliminated, the employment of bus drivers also declined. The decline in bus driver employment was limited, however, partly because transit companies are not completely free to curtail or eliminate unprofitable routes, since the companies are usually regulated by municipal authorities.

Employment of local transit bus drivers is expected to continue to decline during the 1960’s—but at a somewhat slower rate than during 1950–60. The continuing population shift to the suburbs will again be responsible for a moderate drop in employment. No sharp decline is expected because downtown traffic congestion and parking problems will continue to limit the use of automobiles in downtown areas. Factors which will slow the downward trend in bus driver employment are the replacement of streetcars by buses, and the increased need for school buses in the suburbs. An increase in the number of municipally owned companies might also favorably affect bus driver employment, since municipally owned companies, even more than privately owned companies, may provide service in the public interest on unprofitable routes.

Earnings and Working Conditions

Local transit bus drivers are usually paid by the hour, and earnings vary according to locality, length of service, size of company or city, and length and type of run. According to a survey of minimum hourly wage scales set by union contracts for bus drivers in 52 large cities, the average hourly rate was $2.36 on July 1, 1960. For more than half of the bus drivers covered by the contracts, scales ranged from $2.25 to $2.55 an hour. Hourly scales were highest in the Great Lakes, Pacific, New England, and Middle Atlantic regions. Among the cities surveyed, the hourly pay scales for experienced bus drivers ranged from $1.69 in Charlotte, N. C., to $2.61 in Chicago, Ill. Wage scales for beginning drivers were generally 5 to 15 cents an hour less.

Most bus drivers have a standard work schedule of 8 hours a day, 40 hours a week. For additional work, drivers usually receive 1½ times their hourly rates. In many companies drivers often work in excess of their standard work schedule, thereby increasing their weekly earnings. Drivers on the extra list generally are guaranteed a minimum number of hours of work or a minimum weekly salary, but frequently earn more than the guaranteed minimum.

The workweek for regular drivers usually consists of any 5 consecutive days, with Saturdays and Sundays being counted as regular workdays. All transit companies run some buses in the evening and some companies operate 24 hours a day. Therefore, many drivers have to work at night. Many drivers have regular “straight” runs which are unbroken except for meal periods. Others may work the “swing” run, in which the operator drives for several hours, is off for several hours and then drives again for several hours. If the total elapsed time between the beginning and end of a split shift exceeds a stated number of hours, the driver generally receives extra pay.

Nearly all local transit bus drivers are covered by labor-management contracts which provide for health, insurance, and pension plans; the major plans are financed jointly by the workers and their employers. However, there are many plans which are paid for solely by the employer. Drivers also are given vacations with pay ranging from 1 to 5 weeks, depending on the length of service, and usually 6 or 7 or more paid holidays a year.

Although driving a bus is not physically exhausting, bus drivers are exposed to the nervous tension which arises from driving a large vehicle on heavily congested streets and dealing with many types of passengers. In addition to driving a bus, they must collect fares,
answer questions, see that passengers are clear of the doors, and request riders to move to the rear.

Among the more favorable aspects of this job is the steady year-round employment once a driver receives a regular assignment. Bus drivers are usually free of direct supervision—which many drivers also find desirable. Drivers take pride in being solely responsible for the safety of the passengers and bus and in acting as the bus company's representative to the general public.

Most bus drivers are members of the Amalgamated Association of Street, Electric Railroad and Motor Coach Employes of America. Drivers in New York City and several other large cities belong to the Transport Workers Union of America. The International Brotherhood of Teamsters, Chauffeurs, Warehousemen and Helpers of America (Ind.) has also organized some local transit bus drivers.

Where To Go for More Information

For information on employment opportunities for a local bus driver, a young man should apply to the local transit company in his area or to the local office of the State employment service.

Taxi Drivers

(D.O.T. 7-36.040)

Nature of Work

In many communities, taxicabs are a necessary part of the regular transportation system. Taxicab drivers, in addition to providing transportation, also perform other services. For example, they assist passengers with their luggage and may also pick up and deliver packages. Cab drivers occasionally provide sightseeing tours for out-of-town visitors.

Drivers get their "fares" or passengers in one or more ways. Some companies have two-way radio systems over which requests for taxicabs are transmitted to the driver. Other companies have cab stands at which drivers may wait for phone calls from their central office which will direct them to pick up passengers. Many drivers wait in front of theaters, hotels, railroad stations, and other buildings which may have large numbers of prospective passengers. In small cities and in suburban areas, drivers may work from a central location, such as a terminal, to which they return after each trip. Passengers may also be picked up while the driver is returning to his stand or station.

Drivers are usually required to keep records, such as the date, time, and place passengers were picked up, and the destination, time of arrival, and amount of fare collected. If the cab driver owns his own cab or if he rents a cab over an extended period of time, he may periodically clean the cab. In large cab companies, this job is generally performed by cleaners employed by the company.

Where Employed

Approximately 135,000 to 150,000 taxi drivers were employed full time in 1960 in the taxicab industry, which is made up of both privately owned cabs and fleets of company-owned vehicles. There were also many part-time driv-
ers. Although taxicab drivers are employed in every metropolitan area in the country, the greatest concentration of these workers is found in large cities. New York City, Washington, D.C., Chicago, Philadelphia, Boston, New Orleans, Detroit, St. Louis, and Baltimore lead in the employment of cab drivers.

Qualifications, Training, and Advancement

To become a taxi driver in most large cities, it is necessary to have, in addition to a State-issued chauffeur's license, a special taxicab operator's license issued by the local police or safety department or Public Utilities Commission. Although licensing requirements vary considerably among cities, in general, applicants must be over 21, in good health, have a good driving record, and have no criminal record.

Most large communities require an applicant for a taxi driver's license to pass a written examination on taxicab and traffic regulations. The examination may include questions on street locations, insurance regulations, accident reports, lost articles, zoning or meter rules, and passenger pickup and deliveries. In some cities, the cab company will teach the driver-applicant taxicab regulations and the location of streets and important buildings. In other cities, the driver may prepare himself for the license examination. After the driver has passed the examination, he pays an annual license fee generally ranging from $1 to $5.

Although formal education is seldom required, many companies prefer applicants for a taxi driving job to have at least an eighth-grade education. A neat, well-groomed appearance is desirable, as is the ability to deal tactfully and courteously with all types of people. Good foot, hand, and eye coordination are particularly desirable because taxi drivers must often operate their cabs in fast moving and heavy traffic.

Opportunities for advancement for taxi drivers are extremely limited, with promotion to the job of dispatcher often the only possible advancement. Some drivers, however, have become road supervisors, garage superintendents, or claims agents. Many drivers who work for companies try to purchase their own cabs so that they can become their own employers. In some large cities, however, the number of cabs is restricted by ordinance, which may limit the opportunity to own cabs in such areas.

Employment Outlook

There will be a large number of opportunities for new workers to become taxi drivers during the 1960-70 decade primarily because of the high turnover rate in this occupation. The total number of full-time taxi drivers is not expected to increase to any great extent during the 1960's.

In the past, the employment of taxi drivers has been adversely affected by the increased use of privately owned automobiles, rented cars, and the continuing population shift to the suburbs. In more recent years, however, the level of employment appears to have stabilized. During the 1960's, the use of taxicabs for local transportation is expected to increase somewhat. Increased population, higher consumer incomes, parking difficulties, and higher local transit bus and streetcar fares are some of the factors which may lead to a greater use of taxicabs and a slight increase in the employment of taxicab drivers.

This occupation has a relatively high turnover rate which results from the lack of assurance of a steady income, long hours, and the use by some workers of this job as stopgap employment when better jobs are not available. Transfers from this occupation are expected to be the major reason that employment opportunities will be available for many new workers who wish to enter this field of driving.

Earnings and Working Conditions

Wage information collected from a small number of employers in large cities on the East Coast and in the Midwest indicates that, in 1960, full-time taxi drivers earned, with their tips, from $60 to about $100 a week for a 6-day week. Most full-time drivers in these areas averaged about $75 or $85 a week. Driver-owners earned about the same amount, after deduction of their overhead and driving costs.
Most taxi drivers employed by taxicab companies are paid a percentage—usually between 40 and 50 percent—of the total fare. Drivers also frequently receive tips, ranging from 10 to 20 percent of the fare. Some companies pay their drivers a salary and give them an additional commission based upon the amount of business the drivers do. A few companies guarantee their drivers minimum daily or weekly earnings. Many drivers rent their cabs from the company by the day for a set price. Any receipts above the cab rental and other operating expenses are retained by the drivers.

A large percentage of full-time taxi drivers work 9 or 10 hours a day for 6 days a week. They usually begin work between 6 a.m. and 8 a.m. Many drivers work nights, starting between 3 p.m. and 5 p.m. Some drivers work on Sundays and holidays.

Taxi drivers usually put in long hours of work and do not receive overtime pay. Many of them do not receive fringe benefits, such as pensions and severance pay, that workers in many other occupations receive. When economic conditions decline, their earnings are generally reduced because of increased competition for less business.

Many college students have been able to work their way through school by driving cabs on a part-time basis and during summer and spring holidays. Some workers also become part-time drivers in order to supplement their regular income.

Driving a taxicab is not physically strenuous. Most drivers do not change tires or do other heavy repair work. Drivers are, however, subject to nervous tension from driving in heavy traffic in all kinds of weather, and dealing with passengers who differ markedly in their personalities.

Many drivers find the lack of direct supervision by an employer one of the more desirable aspects of their job. They may, however, be subject to municipal regulations which govern their personal appearance, the fares they charge, and their driving practices.

Although unionization in this occupation is not widespread in small cities, taxi drivers in many of the large cities belong to labor unions, particularly those drivers who work for the large taxicab companies. The main union in this field is the International Brotherhood of Teamsters, Chauffeurs, Warehousemen and Helpers of America (Ind.).
SOME FACTORY OCCUPATIONS NOT REQUIRING SPECIALIZED TRAINING

Assemblers

Nature of Work

Many of the products and parts made in factories must be assembled during various steps in the manufacturing process as well as in the final assembly of the product. For example, television sets, automobiles, and refrigerators are typical products which must undergo many assembly operations. The workers who put together parts or finished products are known as assemblers.

Some assemblers, known as floor assemblers, put together large, heavy machinery or equipment on shop floors, often fastening parts with bolts, screws, or rivets. Others, known as bench assemblers, put together small parts to make subassemblies or small complete units, while working at a bench. Many assemblers work on products or parts which move automatically past their work stations on conveyors. These workers must do their assembly job within the time period it takes the part or product to pass their work station.

The job duties of assemblers depend upon the product being manufactured or the manufacturing process being used. In aircraft and missile production, these workers may assemble and install units or parts into subassemblies. In the automobile industry, one assembler may start nuts on bolts and the next worker on the assembly line tightens the nuts with power-driven tools. Assemblers in electronic plants may connect parts with electrical wire.

Semiskilled assemblers do relatively simple, repetitive operations under close supervision, often guided by simple instructions. In contrast, skilled assemblers work on the more complex parts of subassemblies with little or no supervision and are responsible for the final assembly of complex jobs. These skilled workers must know how to read blueprints and other engineering specifications and use a variety of tools and precision measuring instruments.

The kinds of tools semiskilled assemblers use depend upon the job they are doing and the product on which they are working. Pliers, screwdrivers, soldering irons, power drills, and wrenches are among the common tools used by assemblers.

Where Employed

More than 500,000 semiskilled assemblers were employed in manufacturing plants...
in 1959, with the great majority in metalworking plants. Assemblers work in plants which manufacture, on a mass production basis, such diverse products as automobiles, aircraft, electrical and electronic equipment (such as radios and television sets), and instruments.

The number and types of assembly jobs within a plant depend to a great extent upon the product being manufactured and the way in which production is organized. Large numbers of semiskilled assemblers are usually employed in plants where the work can be divided into many routine and repetitive tasks.

Semiskilled assembly jobs are concentrated in greatest number where metalworking industries are located. California, Michigan, New York, Ohio, Illinois, and Pennsylvania are among the leading States in which assembly jobs are found.

Training, Other Qualifications, and Advancement

Inexperienced workers may be hired as trainees or helpers in manufacturing industries and trained on the job to do semiskilled assembling work in a few hours or days. The new worker may have his job duties explained to him by his supervisor and then be placed under the supervision of a more experienced employee. The trainee observes the experienced employee at work or directly assists him in his work. When the learner develops sufficient speed, he is placed “on his own” and is responsible for the work he produces.

Employers generally want applicants for semiskilled assembly jobs to be physically able, dependable, and to have some aptitude for mechanical work.

Some employers prefer persons with no previous experience in factory assembly work so that they can be more easily trained in the employers’ assembly methods. High school graduates or workers who have taken vocational school courses, such as blueprint reading, are preferred by many employers and usually have more job opportunities and greater advancement possibilities. Generally, for production-line assembly jobs, employers look for applicants who can do routine work at a steady and fast pace. For other types of assembly jobs, applicants may have to meet special requirements. For example, in plants producing electrical and electronic products which may contain many different colored wires, applicants often are tested for color blindness.

Many women are employed in semiskilled assembly jobs because much assembly work is relatively light and often requires the ability to work with small and delicate objects. This is particularly true in the electrical and electronic equipment industry. On the other hand, male workers are employed in final automobile assembly where the work generally is physically hard.

Possibilities for advancement are limited in this type of work. However, some workers who learn to perform a variety of assembly work and who have a knowledge of blueprint reading and shop mathematics are able to become skilled assemblers. A few workers also may become skilled inspectors or foremen.

Employment Outlook

Many thousands of semiskilled assembly jobs in manufacturing industries are expected to become available during the 1960’s. The metalworking industries (particularly those which produce electrical and electronic equipment), which employ the great majority of these workers, are expected to experience employment increases. In addition to the new openings which may be created by the expected increase in the employment of semiskilled assemblers, replacement needs will provide a considerable number of job opportunities for new workers in this relatively large occupational group. The need to replace workers who leave their jobs, transfer to other types of work, retire, or die should result in a considerable number of job openings.

Not all assembly jobs are expected to increase at the same rate. Technological changes may slow up the growth of some jobs. For example, the introduction of printed electrical circuits reduces the wiring work required in assembling radio and television sets, affecting the employment of assembly workers in plants producing these products. An increase in the
Earnings and Working Conditions

Earnings of semiskilled assemblers in manufacturing industries vary widely, depending on their skill, the type of product assembled, the size and location of the plant in which they are employed, and the method of wage payment. For example, assemblers who are paid on the basis of the number of items assembled may earn more than those paid on an hourly basis. Assembly jobs are commonly classified to reflect the level of skill and responsibility involved. In its surveys of earnings in machinery plants, the U.S. Department of Labor's Bureau of Labor Statistics classifies assembly jobs as class A, B, and C. A 1959–60 BLS survey of earnings of assemblers in such plants in 21 large cities and metropolitan areas shows that the average straight-time hourly earnings of class B male assemblers ranged from $1.73 in Dallas to $2.68 in Pittsburgh; and earnings of class C male assemblers ranged from $1.43 in Dallas to $2.45 in Milwaukee. (For the purpose of this publication, class B and C assemblers are considered to be semiskilled workers.)

The working conditions of semiskilled assemblers differ depending on the particular job performed. Assemblers of electronic equipment may put together small components at a bench in a room which is clean, well lighted, and free from dust. Floor assemblers of industrial machinery, on the other hand, may install and assemble heavy parts and are often exposed to contact with oil and grease. Assemblers on assembly lines may be under pressure to perform their assignments in the time the conveyor moves the parts or subassemblies past their work stations.

Many semiskilled assemblers in manufacturing industries are members of labor unions. These unions include the International Association of Machinists; the International Union of Electrical, Radio and Machine Workers; and the International Union, United Automobile, Aircraft and Agricultural Implement Workers of America. Most labor-management contracts in the manufacturing plants in which assemblers are employed provide for fringe benefits such as holiday and vacation pay, health insurance, life insurance, and retirement pensions.

Inspectors

Nature of Work

Almost everything manufactured, including those products we eat, drink, wear, or ride in, must be carefully inspected during the manufacturing process. The millions of automobiles, sewing machines, television sets, production machinery, and other mass-produced items must be inspected to make sure they operate properly. The workers who see that size and quality of raw materials, parts, assemblies, and the operation of the finished products meet specifications are known as inspectors.

Inspectors may look for scratches and other defects in products or parts. They often use simple gages to find out whether parts are made to specified sizes; they may also use measuring devices such as micrometers (a precision-measuring instrument) to check the accuracy of the parts. Inspectors may be required to read simple work orders and do arithmetic involving decimals and fractions when reading measuring instruments. Some inspectors use hand-tools such as screwdrivers or pliers in their work.

The work done by semiskilled inspectors in factories is different from that performed by skilled inspectors. Semiskilled inspectors usually work under close supervision; skilled inspectors work under general supervision. In addition, skilled inspectors are often required to read blueprints, interpret specifications, and
Inspectors use complex precision-measuring instruments. Inspectors do a variety of jobs in many industries. For example, they may be employed in radio and television manufacturing plants to test tubes and circuits to see that they meet specifications. They are also employed in the automobile industry to examine raw materials and parts during the various stages of manufacturing.

Inspectors often keep records of the number of parts they have inspected, accepted, and rejected. When they find that a large number of pieces are faulty, they notify their supervisors so that corrections can be made on the production line.

Where Employed

More than 200,000 semiskilled inspectors were employed in a wide variety of manufacturing plants in 1959. Plants which produced automobiles and parts; aircraft, missiles, and parts; electrical machinery and equipment, such as electrical motors, radios, and refrigerators; machinery; iron and steel; fabricated metal products, such as structural steel for buildings; and food products were among the important employers of inspectors. A large number of inspectors also were employed in the clothing, chemical, and ordnance industries.

Many of the inspection jobs are found in States which are manufacturing centers such as California, Michigan, New York, Ohio, Illinois, and Pennsylvania.

Training, Other Qualifications, and Advancement

Inspectors generally learn the requirements of their jobs during a brief period of on-the-job training. The training period may vary from a few hours or days to several months, depending upon the skill required.

Many employers prefer workers with no previous inspection experience. They look for applicants who are physically able, dependable, have good eyesight, and can follow instructions. Some employers prefer experienced production workers for inspection jobs. A few large companies give aptitude tests in selecting new employees for inspection work. For example, in the electronics industry, new workers may be given tests to determine their ability to work with numbers. Employers also look for employees who can do work requiring constant attention.

Many women are employed as inspectors because many inspection jobs are not physically hard. They generally work in plants which produce relatively small and light products and parts such as electrical and electronic equipment.

Some semiskilled inspectors who supplement their work experience with formal educational courses such as blueprint reading, shop mathematics, and electrical theory may advance to jobs as skilled inspectors. A few semiskilled inspectors, after acquiring sufficient experience and knowledge, may advance to foremen jobs.

Employment Outlook

Many thousands of young workers will be able to find employment as inspectors in manufacturing industries during the 1960–70 decade. Most of the industries which employ these workers are expected to increase their employment during this period.
In addition to the new jobs that will be created by increases in employment, replacement needs will provide job opportunities for new workers. A considerable number of job opportunities should result from workers who leave their jobs, transfer from this field of work, retire, or die.

The growing complexity of the products manufactured in our factories and rising quality standards should result in a need for more inspectors. However, the demand for inspectors may be offset somewhat by the trend toward the use of mechanized and automatic inspection equipment.

**Earnings and Working Conditions**

Earnings of inspectors vary considerably depending on their skill, the type of product inspected, the method of wage payment, and the size and location of the plant in which they are employed. Inspector jobs are commonly classified to reflect the level and skill involved. In its survey of earnings in machinery plants, the U.S. Department of Labor’s Bureau of Labor Statistics classifies inspector jobs as class A, B, and C. A 1959–60 BLS survey of earnings of inspectors in such plants in 19 large cities and metropolitan areas shows that the average straight-time hourly earnings of class B male inspectors ranged from $1.92 in Dallas to $2.76 in Houston; and earnings of class C male inspectors ranged from $1.64 in New York City to $2.51 in Philadelphia. (For the purpose of this publication, class B and C inspectors are considered to be semiskilled workers.)

The working conditions of inspectors vary considerably. For example, they may work in well-lighted, air-conditioned workplaces in an aircraft or missile plant; others may work on the production floor of a machinery or metal fabricating plant, often exposed to high temperatures, oil, grease, and noise.

Many inspectors employed in manufacturing industries are members of labor unions. The International Union, United Automobile, Aircraft and Agricultural Implement Workers of America; the International Association of Machinists; and the International Union of Electrical, Radio and Machine Workers are among the larger unions to which these workers belong. Most of the labor-management contracts in manufacturing plants employing inspectors provide for fringe benefits such as paid holidays and vacations, health insurance, life insurance, and retirement pensions.

**Power Truck Operators**

**Nature of Work**

In the past, manual workers in factories usually did the hard physical labor of moving raw materials and products. Today, many heavy materials are moved, with little physical effort, by workers who operate various types of self-powered trucks which can easily carry tons of material and lift it to heights of 18 or more feet.

A typical truck operated by these workers is the forklift truck which has a hydraulic lifting mechanism; other power trucks may have attachments such as scoops to lift coal or other loose material and tow bars to pull one or more small trailers.

Power truck operators start the truck, make it go forward or backward, stop the truck, and control the lifting mechanism and attachments by moving pedals and/or levers. Power truck operators may be required to keep records of material moved, do some manual loading, and unloading of materials, and maintain their trucks in good working condition by cleaning, oiling, checking water in batteries, and making simple adjustments.

The driver must use care and skill in driving his truck. For example, in driving through aisles where material is stored or when loading or removing materials from stock, he must be able to judge distance so that no damage occurs. The operator also must know how much of a load the truck can carry and the kinds of jobs it can do.
Forklift truck operator moving load of material.

Where Employed

Semiskilled power truckers are employed in all types of manufacturing industries. Many of these workers are employed in metal and metalworking plants which manufacture products such as automobiles and automobile parts, machinery, fabricated metal products, and iron and steel.

In addition to working in factories, large numbers of these workers are employed in commercial establishments, warehouses, depots, dock terminals, mines, and other places where great quantities of materials must be moved. In 1958, about 8,000 forklift truck operators were employed by the Federal Government; most of them were employed by the Army, Navy, and Air Force.

Many of these jobs are found where the metalworking industries are concentrated. Large numbers of industrial power truck operators work in California, Michigan, New York, Ohio, Illinois, and Pennsylvania.

Training, Other Qualifications, and Advancement

Most persons learn to operate a power truck in a few days. However, it takes several weeks to learn the physical layout and operation of a plant, as well as the most efficient way of handling the materials to be moved.

Large companies generally require applicants for a power truck operator job to pass a physical examination. Many large employers also have formal training programs for new employees. In these training programs, the employee learns how to operate the power truck, how to do simple maintenance work, principles of loading and handling materials, plant layout and plant operation, and safe driving practices and rules.

Advancement is limited. A few operators may become materials movement foremen or supervisors.

Employment Outlook

Power truck operator jobs in manufacturing industries are expected to increase considerably in the 1960’s. Most of the industries which employ large numbers of these workers are expected to have a long-range upward trend in employment. Replacement needs resulting from transfers to other jobs, retirements, and deaths also will provide many job openings.

The continued development and use of more efficient power trucks and other mechanized materials handling equipment could reduce somewhat the expected increase in the employment of these workers. For example, new mechanized materials handling equipment, such as continuous conveyor systems, moves materials in fixed paths at constant rates of speed, eliminating bottlenecks and allowing for accurate production control. This method of materials handling may result in less use of power trucks in some plants. On the other hand, many companies which use few or no power trucks today will require many semiskilled power truck operators as they mechanize their materials handling operations. Despite more efficient power trucks and mechanized equipment, the more widespread use of power trucks will result in a significant growth in this occupation.

Earnings and Working Conditions

Power truck operators employed in manufacturing industries generally are paid an hourly
SOME FACTORY OCCUPATIONS NOT REQUIRING SPECIALIZED TRAINING

rate. According to wage surveys made by the U.S. Department of Labor's Bureau of Labor Statistics in 1959–60, the average straight-time hourly earnings of forklift power truck operators in manufacturing plants in 59 cities and areas ranged from $1.31 in Jackson, Miss., to $2.71 in Akron, Ohio.

Safety instruction is an important part of the job training in power trucking work. For example, many of these workers are subject to hazards—such as falling objects and collisions between vehicles. The driver may operate his truck inside buildings and outdoors where he is exposed to various weather conditions.

Some operators may handle loose material which can be dirty or dusty.

Power truck operators have somewhat varied work in moving materials throughout a plant. Their work is likely to be less repetitive and routine than that of workers who do machine operator work.

Many power truck operators are members of labor unions. Most labor-management contracts in manufacturing plants employing power truck operators provide for fringe benefits such as paid holidays and vacations, health insurance, life insurance, and retirement pensions.

Production Painters

Nature of Work

Almost every metal or wood product manufactured by American industry is given a coating of paint or other protective material. Although some of this paint is applied by automatic methods, much of the painting in mass-production industries is done by workers known as production painters. These workers use spray guns to apply paint, lacquer, varnish, or other finishes to parts or finished manufactured products. Other production painters use brushes to apply paint. The work done by production painters in factories is different from that performed by skilled painters who are employed in construction and maintenance work. (See index for page number references to Painters.)

Painters who operate spray guns pour mixed paints into a spray gun container which is attached to an air-compressor unit. They make adjustments to the nozzle of the spray gun and the air-compressor so that the paint will be applied uniformly to the surface. The objects being sprayed may be stationary or attached to a moving conveyor. When working on objects requiring more than one color, production painters may apply masking tape to prevent overlapping of colors.

Although the duties of most production painters are quite simple and repetitive, the jobs of some may be rather varied. These production painters may make decisions involving the application of finishes, thinning of paint, and the adjustment of paint spray equipment. Production painters also may clean the surface to be painted before painting. For some assignments, which require production painters to mix paints and figure the size of the area to be painted, they use simple arithmetic involving decimals and fractions. Production painters may replace nozzles and clean guns and other paint equip-
ment when necessary. In addition to spray tanks and spray guns, production painters use tools such as mixing paddles, pliers, rules, and liquid mixing devices.

Where Employed

More than 90,000 production painters were employed in manufacturing industries in 1959; about 15 percent were women. About 40,000 of these workers were employed in plants manufacturing furniture and transportation equipment (primarily automobiles and aircraft). Others worked in plants which produce electrical and electronic machinery, machinery other than electrical, and fabricated metal products. Production painter jobs are found mainly in New York, Michigan, Ohio, Illinois, California, and Pennsylvania.

Training, Other Qualifications, and Advancement

Most production painters learn their jobs through on-the-job training. The length of training may vary from 2 weeks to several months.

The new worker may have his job duties explained to him by his supervisor and then be placed under the supervision of an experienced employee. The trainee may observe the experienced employee at work or assist him in his work.

Persons going into this work should be in good health, be able to stand for long periods of time, have a steady hand, and have good eyesight so that they can distinguish between colors and see whether the paint is applied evenly.

There are limited advancement possibilities in this field of work. A small number of workers have been able to advance to jobs as skilled inspectors or foremen.

Stationary Firemen (Boiler)

Nature of Work

Stationary firemen operate and maintain one or more steam boilers used to provide power for industrial machinery or for heating. In most plants, these workers operate mechanical devices which control the flow of air, gas, oil, or
powdered coal into the firebox to keep proper steam pressure in the boilers. They keep water in the boilers at required levels and move valves and other devices such as levers and switches to control and regulate boiler operation. They also may add chemicals to boiler water to prevent boiler corrosion. Stationary firemen regularly inspect boiler equipment, reading meters and other instruments, to make sure that the boilers are operating efficiently and in accordance with safety regulations.

Although some firemen in manufacturing plants operate low-pressure boilers, most firemen operate the more powerful high-pressure equipment. In many plants using high-pressure boilers, semiskilled stationary firemen are supervised by skilled workers called stationary engineers. (These skilled workers are responsible for the operation and maintenance of a variety of equipment including boilers, diesel and steam engines, and refrigeration and air-conditioning equipment. See index for page number references to Stationary Engineers.)

Stationary firemen keep equipment in good working order by cleaning, oiling, and greasing moving machinery parts. They may make minor repairs, using small handtools such as wrenches and hammers, and may keep simple records such as those which show the amount of fuel used and boiler temperatures.

Training, Other Qualifications, and Advancement

Most large and medium-size cities, and a few States, require that the applicant for a stationary fireman job have a license which permits him to do this work. Applicants can obtain the knowledge and experience to pass the license examination by first working as a helper in a boiler room, or working as a stationary fireman under a conditional license.

License requirements differ from city to city and from State to State. However, the applicant usually must prove that he meets the experience and other requirements for the license and pass an examination testing his knowledge of the job.

There are two types of stationary firemen licenses—for low and high pressure boilers. Low pressure firemen operate low pressure boilers generally used for heating. High pressure firemen operate the more powerful high pressure boilers and auxiliary boiler equipment used to power machinery and equipment in addition to heating buildings. However, both high and low pressure operators may operate equipment of any pressure class, provided a stationary engineer is on duty.

Stationary firemen must understand the operation of machinery and have normal vision and good hearing. (Because of the mechanization

Where Employed

About 70,000 stationary firemen were employed in a wide variety of manufacturing industries in 1959. Generally, these workers are employed in industries which are large users of power generating equipment. Leading industries in the employment of stationary firemen are lumber; iron and steel; textiles; stone, clay, and glass; foods; and chemicals.

Because stationary firemen work in so many different industries, they are employed in all parts of the country. Although some are employed in small towns and even rural areas, most work in the more heavily populated areas where large manufacturing plants are located. New York, Pennsylvania, Ohio, Illinois, Michigan, and New Jersey are States which have large numbers of firemen jobs.
of equipment, physical strength is no longer a major requirement for this type of work.)

Stationary firemen may advance to jobs as stationary engineers. In order to become stationary engineers, firemen sometimes supplement their on-the-job training by taking courses in subjects such as practical chemistry, elementary physics, blueprint reading, applied electricity, and theory of refrigeration, air-conditioning, ventilation, and heating. Stationary firemen may also advance to jobs as maintenance mechanics.

Employment Outlook

During the 1960’s, a slight increase in the number of semiskilled stationary firemen in manufacturing industries is expected. Most opportunities for new workers will result from replacement needs.

The expected increase in the use of stationary boilers and auxiliary equipment—used to generate power or heat plant structures—in the Nation’s manufacturing industries is the main reason why some increase in employment is expected in this occupation. However, improved operating efficiency resulting from use of automatic, more powerful, and more centralized equipment, and better use of manpower will limit the growth in the employment of stationary firemen.

Retirements and deaths of experienced stationary firemen will also result in job openings for new workers. In addition, a large number of job openings will be created by experienced workers who leave their jobs or transfer to other fields of work.

Earnings and Working Conditions

The type of equipment operated and the industry in which they are employed are among the factors affecting the earnings of stationary firemen. According to wage surveys made by the U.S. Department of Labor’s Bureau of Labor Statistics in 1959–60, the average straight-time hourly earnings of stationary firemen in manufacturing plants in 51 cities and areas ranged from $1.26 in Greenville, Ohio, to $2.83 in the Beaumont–Port Arthur, Tex., area.

Although many boiler rooms where stationary firemen work are clean and well lighted, these conditions do not always exist. Most stationary firemen, even under the most favorable conditions, are at times exposed to noise, high temperatures, dirt, dust, contact with oil and grease, odors, and fumes from oil, gas, coal, or smoke. In repair or maintenance work, these workers may have to crawl inside a boiler and work in a crouching or kneeling position.

Stationary firemen are subject to burns and falls, and injury from moving machinery. Boilers and auxiliary equipment which are not operated correctly, or are defective, may be dangerous to these workers and to other persons in the work vicinity. However, modern equipment and safety procedures have reduced accidents considerably in recent years.

Many stationary firemen are employed in plants which have labor-management contracts, most of which provide benefits which may include paid holidays and vacations, hospitalization, medical and surgical insurance, sickness and accident insurance, and retirement pensions. Among the unions to which these workers belong are the International Brotherhood of Firemen and Oilers and the International Union of Operating Engineers.
OTHER TRADES AND INDUSTRIAL OCCUPATIONS

Blacksmiths
(D.O.T. 4-86.010)

Nature of Work

The blacksmith makes and repairs many different kinds of metal articles, such as tools, gears, machine frames, and other industrial and agricultural equipment. He does this work by heating the metal in a forge (a special type of furnace) and hammering it into shape on an anvil. He also joins metal by heating separate pieces and hammering them together. He sharpens chisels, drills, picks, and other tools by reshaping their cutting edges.

The blacksmith determines when the metal being heated in the forge is ready for hammering by observing its color. He then removes the metal and hammers it into shape by hand or machine. After the article is formed, the blacksmith may heat-treat the metal to bring it to the proper hardness and temper. To harden tools, the blacksmith heats them to a high temperature in a heat-treating furnace and quickly cools them in an oil or water bath. In tempering (the process of making metal tougher and less brittle), the metal is heated in a tempering furnace to a temperature less than that used for hardening. The metal is kept at this temperature for a specified time, and then allowed to cool gradually in the air.

Blacksmiths use hand hammers, tongs, and chisels. In addition to these handtools, they often use welding equipment, grinders, presses, and automatic hammers.

Where Employed

In 1960, about 40 percent of the Nation's blacksmiths worked in small shops repairing farm and garden equipment, tools, automobile parts, and household articles. Often, blacksmiths in these shops perform other services such as welding and tool sharpening and reshaping; some shoe horses. Many blacksmiths are self-employed.

The other workers in this occupation are the industrial blacksmiths, employed chiefly in maintenance and repair departments in many industries. The petroleum industry leads in the employment of blacksmiths. A large number of these men work in oil-well drilling, sharpening and tempering drill bits, repairing tools, and assisting the driller in operating and maintaining drilling equipment. Many others work in the maintenance departments of petroleum refineries. Other industries which employ many blacksmiths are the railroad, construction, coal- and metal-mining, steel, and machinery manufacturing industries. Some blacksmiths have production jobs in metalworking establishments, where they operate machines that make large numbers of identical articles. (A detailed discussion of the duties, training, and employment opportunities in jobs related to the blacksmith trade is provided in the section on Forge Shop Occupations, which appears elsewhere in this Handbook. See index for page numbers.)

Blacksmiths work in all parts of the country, in small rural communities as well as in large industrial centers. There is some concentration of employment in Pennsylvania, Texas, and Illinois.

Training and Other Qualifications

Most workers enter the occupation by getting jobs as helpers in blacksmith shops where they gradually learn the trade. Others enter through apprentice training. The apprenticeship period is generally 3 or 4 years and customarily includes training in blueprint reading, the use of tools and equipment, heat-treatment...
of metal, forging methods, and welding. Blacksmiths in the railroad industry usually begin as apprentices. High school and vocational school courses in metalworking, blueprint reading, and mathematics will be helpful to young persons interested in becoming blacksmiths.

A blacksmith must possess considerable strength and stamina to pound metal into shape and to handle heavy parts for an entire working day. He must also have a precise touch when shaping metal parts even though he uses heavy tools and equipment.

**Employment Outlook**

There will be a small number of opportunities for new workers to enter the blacksmith occupation in the 1960's. Most of these openings will occur because of replacement needs, as many experienced blacksmiths are older men. Retirements and deaths will provide about 1,000 job openings for new workers each year during the 1960's.

Fewer than 40,000 blacksmiths were employed in late 1960, substantially less than 20 years ago. The need for blacksmiths has lessened because many of their skills are being performed by other workers such as welders and hammersmiths. In addition, some repair work, formerly done by blacksmiths, has been made unnecessary by the use of parts which are cheaper to replace than to repair. However, the decline in the employment of blacksmiths has slowed down in recent years, and this trend is expected to continue through the 1960's. The skills of all-round blacksmiths will still be needed in the maintenance departments of large industrial plants and in the many small metalworking and repair shops throughout the country.

**Earnings and Working Conditions**

The earnings of skilled blacksmiths depend upon the part of the country, the kind of shop, or the industry in which they work. In 1960, straight-time hourly earnings for blacksmiths employed in railroad shops averaged $2.62. In the steel industry, the union base rate for experienced blacksmiths was $2.83 an hour. With the cost-of-living adjustment but excluding incentive pay, they earned about $3 an hour in the steel industry. Although no overall wage data are available for blacksmiths employed in the petroleum industry, an examination of some 1960 union contracts indicates that blacksmiths in this industry earned $3.06 or more an hour. Other wage data collected from a limited number of employers indicated that blacksmiths in industry generally were receiving between $2.38 and $3.15 an hour in early 1960.

Although all blacksmith shops are rather hot and noisy because of the furnaces and hammers, the conditions under which blacksmiths work are better in some shops than in others. In small repair shops, the noise is not constant and the temperature is more easily controlled. In large production shops, the large forges and the sound of many automatic hammers create considerable heat and noise. In recent years, however, the introduction of large ventilating fans and the reduction of machine vibration have improved working conditions in production shops.

Blacksmiths are subject to a number of hazards. These include burns from forges and heated metals, and injuries from large pieces of metal which may drop while being handled. Safety devices such as goggles, metal-tip shoes, and leather aprons have reduced hazards in this trade.

Many blacksmiths belong to unions. The principal union in the trade is the International Brotherhood of Boilermakers, Iron Shipbuilders, Blacksmiths, Forgers and Helpers. Some blacksmiths are members of the Oil, Chemical and Atomic Workers International Union, the United Steelworkers of America, and other unions. Many union-employer agreements provide health insurance and pension plans for blacksmiths.

**Where To Go for More Information**

International Brotherhood of Boilermakers, Iron Shipbuilders, Blacksmiths, Forgers and Helpers, 570 New Brotherhood Bldg., Kansas City 1, Kans.
Boilermaking Occupations

Nature of Work

Boilermakers, layout men, and fitup men specialize in the repairing, fabricating, and assembling of boilers, tanks, vats, and similar vessels made of metal plate. These boilers and other vessels are widely used throughout industry to hold liquids and gases under pressure. Boilermakers are primarily engaged in the repairing and erecting of boilers and vessels, while layout men and fitup men are usually employed in the manufacturing of new boilers and heavy tanks. The repair work performed by boilermakers requires these workers to be all-round skilled craftsmen; fitup men and layout men have more specialized duties.

Boilermakers (D.O.T. 4–83.100). These craftsmen assemble and erect prefabricated parts and fittings at construction sites where the boilers or vessels are to be used. After the installation is completed they make all the necessary tests to check for defects. Boilermakers doing repair work in the field first determine the cause of trouble. They may then dismantle the boilers, vessels, or other units, and make repairs such as patching weak spots with metal stock, replacing defective sections with new parts, or strengthening joints. The repair and installation work performed by boilermakers must often meet standards set by State and local boiler and pressure vessel laws.

Boilermakers use a variety of tools and equipment in repair and assembly work. They cut and shape plate to size with power shears, power rolls, power presses, or oxyacetylene torches. They use welding or riveting equipment when repairing or assembling boilers. When assembling and erecting steel plate units in the field on a construction site, the boilermakers may use all types of rigging equipment including hoists, jacks, and rollers.

Layout Men (D.O.T. 4–83.200). In the manufacture of units made of heavy steel plate or other metals, the metal is initially prepared for fabricating operations by layout men. They mark on the plates and tubes all curves, lines, points, and dimensions which serve as directions to other workers for the cutting or shaping of the parts of boilers, tanks, and pressure vessels. They lay out the parts to scale as outlined on blueprints, sketches, or patterns. Layout men use compasses, dividers, scales, surface gages, hammers, and scribers in laying out the parts to be fabricated.

Fitup Men (D.O.T. 4–83.300). Before the various parts of boilers, tanks, vats, or other vessels are finally assembled, the fitup men assemble and temporarily fit them together in the shop. They bolt or tack welded parts together and correct irregularities in parts so that they fit together neatly and securely. Fitup men also assemble and fit together nozzles, pipes, fittings, and other parts.

Fitup men read and interpret blueprints and drawings used in the manufacturing process in order to check parts for accuracy and fit according to specifications. They use handtools such as hammers, sledges, wrenches, and
punches, and equipment such as welding machines, portable drills, and grinding tools.

Where Employed

Boilermakers are employed principally in repair shops which specialize in servicing and repairing boilers and pressure vessels used in commercial and industrial companies; they also are employed in the railroad transportation and construction industries. The boilermakers employed by the railroads work, for the most part, in locomotive shops where they maintain and repair steam heat generators, locomotive and stationary boilers, fireboxes, tanks, and other parts made of sheet iron or plate steel. Many boilermakers also work in the maintenance departments of industrial establishments to maintain and repair boilers, tanks, and other vessels. More than 2,400 boilermakers were employed in early 1960 in Federal Government installations, principally in Navy shipyards and Federal powerplants.

Boilermakers are employed in every State because of the widespread need for their skills in maintenance and repair work. Most of the boilermaking jobs, however, are located where the metalworking industries and railroad shops are concentrated. Pennsylvania, Ohio, Illinois, New York, and New Jersey have the largest numbers of boilermaking jobs. In the West, California and Texas lead in the employment of boilermakers.

Layout men and fitup men are primarily employed in the boilershop products industry which produces fire-tube boilers, heat exchangers, heavy tanks, heating boilers, water-tube boilers, and similar boiler-type items. Most layout men and fitup men are employed in the Middle Atlantic and East North Central industrial areas where the boilershop products industry is concentrated.

Training and Other Qualifications

Many men have become boilermakers by working as helpers for several years, but most training authorities agree that a 4-year apprenticeship is the best way to learn this trade. In the apprenticeship program, the apprentice works under the close supervision of a journeyman who instructs him in the skills of the trade. The apprentice learns how to use the tools and machines of the trade during his training period. Apprenticeship programs usually provide for about 8,000 hours of relatively continuous employment and training supplemented by about 600 hours of related technical instruction. Some of the related technical subjects studied by apprentice boilermakers during their training period are blueprint reading, shop mathematics, welding techniques, and shop metallurgical science covering stress and strain of metals.

Many layout men and fitup men acquire their skills on the job. They are usually first hired as helpers and learn the trade by working with experienced workers. It generally takes at least 2 years to qualify as a journeyman layout or fitup man in a fabricating shop where boilers and vessels are produced on a mass-production basis. However, in the railroad industry and in shops where products are custom made, layout and fitup jobs are generally filled by men who have first qualified as skilled boilermakers.

Prior training in mathematics, blueprint reading, and shopwork will prove helpful to young men interested in entering these trades. Mechanical aptitude and manual dexterity are important qualifications for persons who want to become boilermakers, layout men, or fitup men. Such persons are also required to be in good physical health and able to do heavy work.

Employment Outlook

During the 1960's, a moderate rise in the employment of boilermakers, layout men, and fitup men can be expected. Most opportunities for new workers, however, will result from replacement needs.

The expected large expansion in electric power generation facilities and the development of atomic energy for industrial use will result in an increased need for these workers in boiler manufacturing plants. In the construction industry, the fabrication and assembly of industrial power boilers, smokestacks, heavy tanks, and other large vessels also will favorably affect the employment of these workers. Some addi-
national maintenance boilermaker jobs will be created by the expansion of facilities in petroleum refineries, chemical plants, electric light and power plants, and steel plants.

In contrast to this growth, the employment of boilermakers in railroad repair shops will decline further. The number of these workers has been declining steadily since World War II because diesel engines have been replacing steam locomotives. In 1950, the railroads employed 9,800 boilermakers, but by March 1960, the employment of boilermakers in this industry had dropped to about 2,600.

Replacement needs will be the primary factor in creating job opportunities for new workers in these trades. Because a high proportion of experienced boilermakers, fitup men, and layout men are older men, many will be leaving the labor force during the next 10 to 20 years. Retirements and deaths may create about 8,000 new jobs during the 1960's. Additional job openings will be created by the transfer of experienced workers in these occupations to other fields of work.

**Earnings and Working Conditions**

The earnings of skilled boilermakers compare favorably with those of other skilled craftsmen. For example, the union wage rate of maintenance boilermakers in the basic steel industry was $3 an hour in 1960. The average straight-time hourly earnings of boilermakers employed by Class I railroads were $2.64 an hour in 1960. Recent earnings data of fitup men and layout men are not available.

According to a Bureau of Labor Statistics study of union wage scales in the building trades in cities of 100,000 or more population, the average minimum hourly scale for union journeymen boilermakers was $4.11 in July 1960. The minimum union wage scale for these workers in most of the areas surveyed ranged from $3.75 to $4.81 an hour. However, in a few areas the wage scale was higher; the highest hourly rate reported was $4.81 in Newark, N.J. Boilermakers employed in the building trades are not as steadily employed throughout the year as those who work in maintenance departments of large industrial establishments.

Many boilermakers, layout men, and fitup men are employed in metalworking plants which have employer-labor union contracts. Most of these agreements have provisions for fringe benefits such as hospitalization, medical and surgical insurance, life insurance, sickness and accident insurance, and retirement pensions.

When engaged in boiler repair and assembly work, boilermakers are often required to work in cramped quarters or at great heights. Some work must also be done under conditions of dampness, heat, and poor ventilation.

Boilermaking tends to be more hazardous than many other metalworking occupations. Although the injury-frequency rate in the boiler-shop products industry is considerably higher than the average for manufacturing industries as a whole, it has been declining in recent years because of the safety programs of employers and unions.

Most boilermakers, layout men, and fitup men belong to labor unions. The principal union of these trades is the International Brotherhood of Boilermakers, Iron Shipbuilders, Blacksmiths, Forgers and Helpers. Some of these craftsmen also are members of industrial unions, such as the Industrial Union of Marine and Shipbuilding Workers of America; the Oil, Chemical and Atomic Workers International Union; and the United Steelworkers of America.

**Where To Go for More Information**

International Brotherhood of Boilermakers, Iron Shipbuilders, Blacksmiths, Forgers and Helpers, 570 New Brotherhood Bldg., Kansas City 1, Kans.

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**Dispensing Opticians and Optical Laboratory Mechanics**

**Nature of Work**

The more than 80 million persons who wear prescription eyeglasses benefit from the important work done by dispensing opticians and optical laboratory (shop) mechanics. These workers make and fit eyeglasses prescribed by
an eye physician (oculist or ophthalmologist) or optometrist to correct a patient’s visual defect. The shop mechanic fabricates the finished eyeglasses by surfacing (grinding and polishing) lenses to meet the specifications of the prescription and the dispensing optician, and mounts the lenses in a frame. Then the dispensing optician fits and adjusts the eyeglasses to the customer’s requirements. In general, the fabrication and fitting of eyeglasses involves two separate functions. The dispensing optician serves the customer directly and the optical mechanic works in the shop. Occasionally, both functions are performed by the same person.

Dispensing opticians may also fit various types of prescription contact lenses. These lenses are worn in contact with the eyes and may be used as a substitute for, or change from, conventional eyeglasses. The most recently developed and currently the most popular type of contact lens is the corneal lens, a tissue-thin plastic disc, about a third of an inch in diameter. Although contact lenses are becoming increasingly popular, the number of persons wearing them is small compared with the number wearing conventional eyeglasses.

The dispensing optician (D.O.T. 5-08.010) works in a retail optical establishment. In fitting prescription eyeglasses, he makes certain that the eyeglasses follow the lens prescription and fit the customer properly. The optician determines exactly where the lenses should be in relation to the pupils of the eyes, by measuring the distance between the centers of the pupils (the pupillary distance). He also assists the customer in the proper selection of an eyeglass frame, by measuring the customer's facial features and giving consideration to the various styles and colors of the eyeglass frames.

Before prescription eyeglasses are fitted, the dispensing optician prepares a work order which gives the optical laboratory mechanic the information he needs to interpret the prescription properly, grind the lenses, and insert them in a frame. The work order consists of the lens prescription; information on the size and optical centering of the lens and other optical requirements; and the size, color, style, and shape of the frame. After the finished eyeglasses are returned from the laboratory, the optician adjusts them to the customer to make sure they fit properly. He uses small handtools, such as optical pliers, files, and screwdrivers, and a millimeter ruler to measure the pupillary distance. He also uses a precision instrument to check the power of the lenses and their surface quality.

In fitting contact lenses, the dispensing optician, following the directions of the eye physician, takes certain measurements of the cornea of the customer’s eye and then prepares specifications to be followed by a firm specializing in finishing such lenses. The dispenser fits the customer with the completed lenses, using precision instruments to measure the power and curvature of the lenses and the curvature of the cornea of the eye. Contact lens fitting requires more skill, care, and patience than conventional eyeglass fitting. The dispensing optician instructs the customer in the insertion, removal, and care of the contact lenses over a period of time, generally a few weeks. The physician rechecks their fit as needed. If minor adjustments are necessary, the dispensing optician makes them; if major changes are needed, he returns them to the contact lens manufacturer.

The optical mechanic (D.O.T. 5-08.010) performs the shop or laboratory work required to make prescription eyeglasses. There are two principal types of optical mechanics—the sur-
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\textit{facer} (D.O.T. 5-08.077) and the \textit{benchman} (or finisher) (D.O.T. 5-08.033). The surfercer, starting with standard or stock size lens blanks, lays out the work, grinds and polishes the surfaces of the lenses, and makes sure that the ground lenses conform to the prescription requirements. In small laboratories, one qualified man may perform all these operations. In large laboratories, the work is divided into separate operations which are performed by semiskilled workers who operate large power grinding and polishing machines in producing the lens surfaces. The surfercer uses precision instruments to measure the power and curvature of lenses.

The other principal type of optical laboratory mechanic—the benchman or finisher—marks and cuts the ground and polished lenses to fit the frame. He then bevels or smooths the edges of the lenses and assembles the lenses and frame parts into the finished eyeglasses. In large laboratories, these duties are divided into several operations which are performed by semiskilled workers. The benchman uses small handtools, such as lens cutters, chippers, pliers, files, protractors, and diamond point glass drills. He also uses precision instruments to determine, for example, if there are any imperfections in the lenses.

Both the surfercer and the benchman also do repair work. They may also duplicate eyeglass lenses that have been broken and replace damaged parts of frames.

\textbf{Where Employed}

About 21,000 dispensing opticians and optical mechanics were employed throughout the country in 1960. Of these, about 9,000 (4,000 dispensing opticians and 5,000 optical laboratory mechanics) were employed in the Nation's estimated 3,100 retail optical shops, which deal directly with individuals requiring correction of visual defects. Approximately 12,000 workers were employed in the prescription departments of the more than 1,250 wholesale optical laboratories which did work for retail optical firms. In addition to the 21,000 opticians and mechanics mentioned above, many of the approximately 2,500 proprietors of retail optical establishments were optical mechanics or dispensing opticians. Opticians and mechanics are mainly employed in cities and industrial areas. New York, Pennsylvania, Ohio, California, and Illinois are the leading States in the employment of these workers.

\textbf{Training, Other Qualifications, and Advancement}

Most dispensing opticians and optical mechanics learn their skills through informal, on-the-job training. Mechanics start in jobs requiring simple skill and dexterity and gradually work into the more difficult jobs. Some then move into dispensing offices and, with additional training, become dispensing opticians. A small number of opticians start immediately in dispensing work and learn their jobs under the guidance of trained opticians.

In addition to this informal method, young persons who are high school graduates can prepare for these occupations through formal apprenticeship programs. Most training authorities agree that workers who have learned their trade as apprentices have more job opportunities, improved job security, and are able to advance further in their careers. A number of optical firms have 4- and 5-year apprenticeship programs. Apprentices with exceptional

\textbf{Benchman checking lens to insure proper fit into eyeglass frame.}
ability may complete their training program in a shorter period.

The typical program for an apprentice optical mechanic in eyeglass lens production includes on-the-job training and related instruction in ophthalmic optics (vision improvement). This training qualifies a person for both surfacing and finishing work. However, apprentices may specialize in one phase of this work in the larger laboratories. The apprenticeship program for the surfacer emphasizes training in grinding operations, polishing, blocking, inspection, and layout. The benchman apprenticeship program concentrates on lens edging, layout for cutting, lens cutting and drilling, rimless spectacle assembly, inserting lenses into frames, and inspection of eyeglasses. In addition to this work experience, the apprentice optical mechanic receives related instruction in subjects such as types and measurement of lenses, the measurement and curvature of lens surfaces, and the effect of glass surfaces on light rays.

The dispensing optician apprentice is given training similar to that of the benchman apprentice. He receives additional instruction in optical mathematics, the relationship of the lens to the eye, the mechanics of dispensing, and the inspection of eyeglasses.

Formal school training plays a relatively small part in preparing for these occupations. However, academic training for entry into the dispensing optician occupation is being encouraged. In 1960, three schools were offering 2-year courses at the college level in optical fabricating and dispensing work. One college offers a 2-year home study course in optics and optical dispensing, designed to supplement the training of apprentices employed in retail optical dispensing shops. A few vocational schools have courses for training of optical mechanics. The larger manufacturers of contact lenses offer dispensers courses of instruction in contact lens fitting, usually lasting a few weeks.

Employers prefer applicants for entry jobs as dispensing opticians and optical mechanics to be high school graduates who have had courses in the basic sciences. A knowledge of physics, algebra, geometry, and mechanical drawing is particularly valuable in acquiring skills in these occupations. Interest in, and ability to do, precision work are essential. Because dispensing opticians deal directly with the public they must be tactful and have a pleasing personality. A discriminating color sense is also very helpful in their work because of the increasing importance of styling in eyeglass frames.


Advancement opportunities are available to both optical mechanics and dispensing opticians. Optical laboratory mechanics can become supervisors, foremen, and, frequently, managers. Many optical mechanics have become dispensing opticians, although there has been a trend in recent years to train especially for this latter job. There are opportunities for mechanics and dispensing opticians to go into business for themselves. In the past decade or so, the number of proprietors of retail optical establishments has increased substantially, reaching a total of about 2,500 in 1960. These owners came, for the most part, from the ranks of optical mechanics and dispensing opticians. Opticians may also get jobs as salesmen for wholesale optical goods companies. With additional educational training, opticians may become optometrists.

**Employment Outlook**

Employment of optical mechanics and dispensing opticians is expected to increase in the 1960's, as in prior years. New jobs in these relatively small occupations will provide employment opportunities for a few thousand workers. In addition, replacement needs will provide a few hundred job openings each year.

More optical mechanics and dispensing opticians will be needed to perform the growing amount of prescription lens fabrication and
dispensing work. Because of the increasing size, literacy, and educational level of the population, and with the particularly large growth in the number of older persons (who are those most likely to need eyeglasses), the production of prescription lenses should considerably exceed the 1960 level of about 29 million pairs. The market for eyeglasses will expand also because the importance of good vision is being emphasized increasingly in homes, schools, factories, and offices. (A widespread national promotion program which seeks to educate the public about the need for professional eye care is being sponsored by the optical industry.) Another factor is the more attractive design of eyeglass frames, in many different styles and colors, which has increased the numbers of pairs of eyeglasses purchased by individuals and lessened the opposition of many persons to the wearing of eyeglasses. The rapid growth in purchases of contact lenses in recent years also is expected to continue, providing more dispensing work for opticians.

As in the past, many technological developments affecting employment needs will continue to be made in the manufacture of eyeglasses and in the equipment used by optical laboratories to fabricate lenses to prescription specifications. Nevertheless, the expanding market for eyeglasses should result in a continued growth in the number of optical mechanics.

**Earnings and Working Conditions**

Weekly earnings for qualified optical laboratory mechanics generally ranged from about $90 to $135 a week in 1960. Dispensing opticians usually earn about 10 to 20 percent more than optical mechanics. Opticians who have their own business may earn much more. Foremen earn up to 20 percent more than skilled workers depending on their experience, skill, and responsibilities. Apprentices start at about 60 percent of the skilled worker's rate and their wages are increased periodically, so that after they complete the apprenticeship program they receive the pay of skilled workers. Wholesale establishments usually have a 5-day, 40-hour workweek. Retail shop employees generally work a 5½ or 6-day week. Workers in these occupations usually have year-round employment.

The work of the dispensing optician requires little exertion and is generally performed in pleasant, well-lighted, and well-ventilated surroundings. Optical mechanics may work under fairly noisy conditions because power grinding and polishing machines are used in preparing prescription lenses.

Physically handicapped persons who have full use of their eyes and hands and can do sedentary work, can perform some of the more specialized jobs found in the larger laboratories.

Some optical mechanics and dispensing opticians are members of unions. One of the unions organizing these workers is the International Union of Electrical, Radio, and Machine Workers.

**Where To Go for More Information**

American Optical Company,  
Box 1, Southbridge 1, Mass.

Association of Independent Optical Wholesalers,  
222 West Adams St., Chicago 6, Ill.

Guild of Prescription Opticians of America,  
110 East 23d St., New York 10, N.Y.

International Union of Electrical, Radio and Machine Workers,  
1126 16th St. NW., Washington 6, D.C.

Optical Wholesalers National Association,  
Chamber of Commerce Bldg., Columbus 15, Ohio.

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**Electroplaters**

(D.O.T. 4–74.010)

**Nature of Work**

Electroplaters use plating solutions and electric current to coat metal articles with a layer of chromium, nickel, silver, gold, or other metal. The electroplating process gives the metals a protective surface or a more attractive appearance. Metal products which are often electroplated include such widely different items as...
automobile bumpers, cigarette lighters, silverware, costume jewelry, plumbing fixtures, electrical appliances, bearings, component parts of electronic equipment, jet engine parts, and ammunition.

The skilled plater first studies specifications which indicate the parts of the objects to be plated, the type of plating metal to be applied, and the desired thickness of the plating. He prepares the plating solution by mixing a compound of the plating metal with other chemicals. The plater also calculates the amount of electric current required to carry the metal particles through the plating solution and the length of time the objects must remain in the solution so that the plating metal will be of the specified thickness. A plater must often use originality in designing special racks for holding the objects while they are in the plating tank.

In preparing an article for electroplating, the plater cleans it by dipping it in cleansing solutions, by scouring, or by buffing. He covers with lacquer, or with rubber or plastic tape, any part of the article which is not to be plated. He then places the article in the plating tank, where an electric current carries metal in the solution to the surface being plated. When the desired thickness of metal plate has been obtained, he removes, rinses, and dries the article.

The plater must analyze the plating solution periodically and sometimes add chemicals to keep the solution constant. It is also necessary for him to control the temperature of the solution. He examines finished articles for defective plating and may use micrometers and calipers to check the thickness of the plating. In addition to plating, platers do other kinds of finishing, such as spray painting, dipping, and flow painting.

Electroplaters employed in job shops, which do small lot plating of great variety, are often required to use considerable ingenuity in their work. Platers working in production shops, where large lots of metal parts of the same type are electroplated, usually carry out routine assignments. In some of the larger shops, chemists and chemical engineers often make the technical plating decisions while platers act as foremen and do some of the routine plating work.

As a foreman, a plater often supervises the work of helpers, who place objects on racks before plating and remove them afterwards, and clean tanks and racks. In some shops, a plater is expected to order chemicals and other supplies for his work.

Where Employed

Although electroplating shops are found in almost every part of the country, most are concentrated in the Northeast and Midwest near the centers of the metalworking industry. Large numbers of the approximately 20,000 electroplaters employed in 1960 were working in Chicago, Detroit, New York, Cleveland, Newark and Jersey City, Providence, and Los Angeles.

About 8,000 of these electroplaters were employed in independent job shops specializing in metal plating and polishing for other manufacturing firms and for individuals. The remaining platers were employed in the plating departments of plants primarily engaged in the manufacture of plumbing fixtures, heating and cooking utensils, lighting fixtures, wire products, electric control apparatus, electric appliances, radio and television products, motor vehicles and parts, mechanical measuring instruments, miscellaneous hardware items, and other metal products.
Training, Other Qualifications, and Advancement

Most platers are hired as helpers and learn the trade by working with skilled platers. It usually takes 4 years or longer to become a skilled worker in this way. Since less time is required to learn to work with only one or two metals, many employers tend to develop specialized platers rather than those who can work with all kinds of metals. This often makes it difficult for a plater to transfer to shops doing other kinds of electroplating.

Another way to enter the electroplating trade is through an apprenticeship program. Although apprentice training provides better all-round preparation, only a small percentage of electroplaters have been trained this way.

The planned program for apprentices includes a combination of on-the-job training and related classroom instruction in the properties of metals, chemistry, and electricity as applied to plating. The apprentice does progressively more difficult work as his skill and knowledge increase. By the third or fourth year, he determines cleaning methods, does plating without supervision, makes solutions, examines plating results, and supervises helpers. After 3 or 4 years of an apprenticeship program or general work experience, the worker usually becomes a fully qualified plater. From this position, he may qualify as a foreman.

High school and vocational school courses in chemistry, electricity, physics, mathematics, and blueprint reading will prove helpful to young persons interested in becoming master electroplaters. Some colleges, technical institutes, and vocational high schools offer 1- to 2-year courses in the principles and practices of electroplating. In addition to the training offered by these schools, many branches of the American Electroplaters' Society conduct basic courses in the fundamentals of electroplating. The increasing complexity of the plating process and the greater use of precision plating will require platers with a higher degree of technical training in the future.

Employment Outlook

The expected expansion in the machinery and metalworking industries and the broader application of the electroplating process brought about by recent developments in the use of aluminum, other metals, and metal alloys will increase the demand for skilled electroplaters in the 1960's. In addition to the new job openings which are expected to develop because of the increased use of the electroplating process, a small number of vacancies will develop from the need to replace those workers who shift to other lines of work, retire, or die.

A factor which is limiting the growth of this occupation somewhat is the tendency of some of the large, highly mechanized plants to employ chemists and chemical engineers to plan the plating operations and to use skilled platers only as foremen.

The growing use of anodizing—another method of finishing metals, used almost exclusively on aluminum products—may have some adverse effect on the use of the electroplating process in the future. However, with only little additional training, electroplaters can do this work since the equipment and skills required are similar. Vacuum plating, a relatively new metal finishing method, may limit the growth of employment of electroplaters if use of this process becomes widespread. This method requires equipment and skills different from those used in electroplating.

Earnings and Working Conditions

Wage rates of skilled electroplaters ranged from about $1.50 to $2.90 an hour in late 1960, as indicated by examination of a number of union contracts and information from a limited number of employers. During a worker's period of apprenticeship or on-the-job training, his wage rate usually starts at 60 to 70 percent of a skilled worker's rate and progresses to the full rate by the end of his training period. In almost all plants, workers are paid shift premiums for working at night.

Plating work involves some hazards because acid, alkaline, or poisonous solutions are used. Problems of humidity and odor also prevail in electroplating plants. However, most plants have installed systems of ventilation and other safety devices which have considerably reduced the occupational hazards. Protective clothing and boots provide additional protec-
tion. Mechanical devices are generally used to handle most of the lifting required, but at times the worker must lift and carry objects weighing up to 100 pounds.

Some platers are union members. Union platers belong to the Metal Polishers, Buffers, Platers and Helpers International Union. Other platers have been organized by the International Union, United Automobile, Aircraft and Agricultural Implement Workers of America, and the International Association of Machinists. Some of the labor-management contracts covering electroplaters provide health, insurance, and other benefits.

Where To Go for More Information
For educational information concerning electroplating and other metal finishing methods, write to:

American Electroplaters Society, Inc.,
445 Broad St., Newark 2, N.J.

For information on job opportunities, training, and other questions, write to:

National Association of Metal Finishers,
11 Park St., Montclair, N.J.

Stationary Engineers
(D.O.T. 5-72.010)

Nature of Work
The man in charge of the heating and air-conditioning equipment in a large office building is likely to be a stationary engineer. Stationary engineers are members of one of the larger skilled occupations in the United States.

Stationary engineers operate and maintain equipment used to generate power and to heat and air condition large industrial plants and commercial buildings. These workers are needed wherever large boilers, diesel and steam engines, refrigeration and air-conditioning machinery, generators, motors, and turbines are used. They work in many different types of establishments, such as power stations, factories, mines, sewage and water treatment plants, office and apartment buildings, hotels, hospitals, and schools.

The stationary engineer inspects the equipment for which he is responsible, regularly each day, to make sure that it is working properly. He reads meters, gages, and other instruments, and records such information as amount of fuel used, temperature of boilers, number of pieces of equipment in use, hours of operation, and repairs made. He must be able to detect and identify any trouble that develops by analyzing the various readings and watching and listening to the machinery. He uses levers, throttles, switches, valves, and other devices to regulate and control the machinery so that it operates efficiently. The engineer has a responsible job. The equipment he is in charge of is essential to the operation of the establishment. He also must operate and maintain the equipment properly in accordance with State and local safety laws.

The duties of stationary engineers depend on...
the size of the establishment in which they work and the type and capacity of the machinery for which they are responsible. In a large plant, the chief stationary engineer may be responsible for the entire operation of the boiler room and direct the work of assistant stationary engineers and other employees including turbine operators, boiler operators, and air-conditioning mechanics. Assistant stationary engineers may be responsible for the operation of all the equipment during a shift, or in charge of a specific type of machinery, such as refrigeration equipment. In relatively small plants, only an engineer and a helper may be needed, and the engineer, himself, may oil and clean the equipment, grease moving parts, and clean boiler tubes and walls.

Stationary engineers also may repair the equipment they operate, using hand tools such as wrenches and hammers. The repacking of valves and replacing of gaskets are common repair jobs performed by these workers. The amount of repair work done by these men depends largely on the type of equipment and the size of the plant in which they are employed. Occasionally, stationary engineers make mechanical changes such as installing a bypass line to change the flow of steam so that the equipment will operate more efficiently.

Where Employed

About 200,000 stationary engineers were employed in a wide variety of establishments in late 1960. More than 30,000 were employed by Federal, State, and local governments. The types of establishments in which the engineers worked ranged in size from giant hydroelectric plants and large public buildings to small industrial plants. Most plants which operate on three shifts employ from 3 to 8 stationary engineers, but some have as many as 60. In many establishments, only one engineer is at work on each shift.

Because stationary engineers work in so many different kinds of establishments and industries, they are employed in all parts of the country. Although some are employed in small towns and in rural areas, most work in the more heavily populated areas where large industrial and commercial establishments are located. New York, Pennsylvania, Illinois, Texas, California, and Ohio are leading States in the employment of these workers.

Training, Other Qualifications, and Advancement

Most of the people now working as stationary engineers started as helpers and acquired their skills largely through informal on-the-job experience. However, many training authorities recommend formal apprenticeship as the most desirable method for learning this occupation. Formal training is more necessary today because of the increasing complexity of stationary machinery and the varied training and experience required before a stationary engineer can obtain a first-class license. After completing apprenticeship, a stationary engineer usually must get further work experience before he can qualify for a first-class license. (This license is the accepted proof of a worker's qualifications and an important goal of his training.)

In selecting apprentices, most employers prefer young men between 18 and 23 years of age with high school or trade school education, who have received instruction in such subjects as algebra, geometry, trigonometry, shop mathematics, mechanical drawing, machine-shop practice, physics, and chemistry. Employers also look for young men with mechanical aptitude and manual dexterity.

A stationary engineering apprenticeship customarily lasts 4 years. Through on-the-job training, the apprentice learns to operate, maintain, and make repairs on stationary equipment, such as blowers, generators, compressors, boilers, motors, and air-conditioning and refrigeration machinery. He is taught how to use a variety of hand and machine tools, such as chisels, hammers, small electric grinders, lathes, and drill presses. He also may learn to use precision measuring instruments, such as calipers and micrometers. In addition, he may be taught how to move machinery by the use of blocks, chain hoists, or other equipment. This on-the-job training is supplemented by classroom instruction and home study in such related technical subjects as practical chemistry, elementary physics, blueprint reading, applied
electricity, and theory of refrigeration, air conditioning, ventilation, and heating.

Persons who become stationary engineers without going through a formal apprenticeship program usually do so only after many years of experience as assistants to licensed stationary engineers in such occupations as boiler, refrigeration, or turbine operator. This practical experience usually is supplemented by vocational or other school training or home study.

Almost every large or medium-sized city and a few States require stationary engineers to be licensed. Although requirements for obtaining a license differ from place to place, the following are usual: (1) The applicant must be over 21 years of age; (2) he must have resided in the State or locality in which the examination is given for a specified period of time; and (3) he must demonstrate that he meets the experience requirements for the class of license requested. A license is issued to the applicants meeting these requirements and passing an examination which may be written, oral, or a combination of both types.

There are generally three classes of stationary engineer licenses. These license classes specify the steam pressure or horsepower of the equipment the engineer may operate. The first-class license permits the stationary engineer to operate equipment of all types and capacities without restriction. The second- and third-class licenses limit the capacity of the equipment the engineer may operate. However, engineers with second- and third-class licenses may operate equipment restricted by their license class, provided they are under the supervision of a higher rated engineer—usually one with a first-class license.

Stationary engineers advance to more responsible jobs by being placed in charge of larger, more powerful, or more varied equipment. Generally, the engineer advances to such jobs as he obtains higher grade licenses. Advancement, however, is not automatic. For example, an engineer with a first-class license may work for some time as an assistant to another first-class engineer before a vacancy requiring a first-class licensed engineer occurs. In general, the broader the knowledge a stationary engineer has about the operation, maintenance, and repair of various types of equipment, the better are his chances for advancement in this field.

Stationary engineers may also advance to jobs as plant engineers and as building and plant superintendents.

Employment Outlook

A moderate increase in employment of stationary engineers is expected during the 1960’s. In addition, it is estimated that about 5,000 opportunities for new workers to enter this large field of employment will occur each year during the next decade because of the need to replace workers who retire or die. Transfers out of this occupation to other fields of work also will be a source of job openings for new workers.

Employment in this occupation is expected to rise mainly because of the continuing increase in the use of large stationary boilers and refrigeration and air-conditioning equipment in the Nation’s factories, powerplants, and commercial buildings. However, improved operating efficiency resulting from the use of more powerful, automatic, and more centralized equipment and better utilization of workers may limit the growth in the employment of stationary engineers.

The increasing use of atomic energy to generate power should not affect significantly the employment of stationary engineers. It is likely that both the number and skill requirements of operating jobs (i.e., stationary engineer, boiler operator, turbine operator, etc.) in a nuclear plant will be about the same as those in a new conventional powerplant.

Earnings and Working Conditions

According to wage surveys by the U.S. Department of Labor’s Bureau of Labor Statistics in 1959–60, the average straight-time hourly earnings of all classes of stationary engineers in plants in 30 large cities and metropolitan areas ranged from $2.03 in Miami, Fla., to $3.08 in the Newark and Jersey City, N.J., area. Stationary engineers who are in charge of a large boiler room operation may earn consider-
ably more than the average; some of these workers earn more than $160 a week.

Stationary engineers generally have steady year-round employment. They usually work a straight 8-hour day and 40 to 48 hours a week. In plants or institutions which operate around the clock, stationary engineers may be assigned to any one of three shifts—often on a rotating basis—and to Sunday and holiday work.

Many stationary engineers are employed in plants which have union-employer contracts. Most of these contracts provide benefits which may include hospitalization, medical and surgical insurance, life insurance, sickness and accident insurance, and retirement pensions. Similar benefits may also be provided in plants which do not have union-employer contracts. Among the unions to which these workers belong are the International Union of Operating Engineers and the International Union, United Automobile, Aircraft and Agricultural Implement Workers of America.

Most engine rooms, powerplants, or boiler rooms where stationary engineers work are clean and well lighted. However, even under the most favorable conditions, some stationary engineers are exposed to high temperatures, dust, dirt, contact with oil and grease, and odors from oil, gas, coal, or smoke. In repair or maintenance work, they may have to crawl inside a boiler and work in a crouching or kneeling position to clean or repair the interior.

Because stationary engineers often work around boilers and electrical and mechanical equipment, they must be alert to avoid burns, electric shock, and injury from moving machinery. If the equipment is not operated correctly or if it is defective, it may be dangerous to them as well as to other persons in the vicinity. However, modern equipment and safety procedures have reduced accidents greatly.

Where To Go for More Information

Further information on this occupation may be secured from State or local licensing agencies. Locals of the International Union of Operating Engineers also may be an important source of information. Additional information may be obtained from:

International Union of Operating Engineers,
1125 17th St. NW., Washington 6, D.C.

Welders and Oxygen and Arc Cutters

Nature of Work

Many of the parts used in automobiles, airplanes, refrigerators, and thousands of other products are joined by a metalworking process known as welding which is widely used in manufacturing and repair operations.

Welders join metals by applying intense heat and, sometimes, pressure to melt the edges to form a permanent bond with or without the use of filler metal. Closely related to welding is "thermal cutting" (also called oxygen and arc cutting). Oxygen and arc cutters use torches to cut or trim metal objects to a desired size or shape. They also remove excess metal from castings and cut scrap metal into pieces of manageable size.

Of the more than 35 different ways of welding metals, most fall under 3 basic categories: arc, gas, and resistance welding. Arc welders (D.O.T. 4–85.020) perform their work either by hand or machine methods. Gas welders (D.O.T. 4–85.030) usually join metals by hand operations, although they also may use automatic and semiautomatic gas-welding equipment. Resistance welding is mainly a machine process performed by semiskilled resistance-welding operators (D.O.T. 6–85.010, .020, .030, .060, .100). Semiskilled oxygen cutters (D.O.T. 6–85.215, .240) work with either hand-guided torches or with oxygen-fuel-gas-cutting machines.

The principal duty of the welder using the manual technique is to control the melting of the metal edges by directing the heat, either from an electric arc or from a gas-welding torch, and to add filler metal where necessary to complete the joint. In one of the most commonly used of the manual arc welding processes, the welder selects a suitable electrode and ad-
Special clothing and protective helmets guard arc welders against burns and eye injuries.

justs the electric current. The welder first “strikes” an arc (creates an electric circuit) by touching the metal. After the arc is made, the welder guides the electrode at a suitable distance from the joint seams to be welded. The intense heat caused by the arc melts the metal seams and the electrode tip. The molten metal from the electrode is deposited in the joint and together with the molten metal edges solidifies to form a solid connection. During the past decade or so, there has been a considerable increase in the use of arc welding processes employing inert gas for shielding the weld area. This type of welding was developed for welding hard-to-weld metals such as aluminum, magnesium, stainless steel, and titanium. Many welders are now specializing in this process.

In gas welding, the welder applies an intensely hot flame (obtained from the combustion of a mixture of fuel gas—most commonly acetylene and oxygen) from a gas welding torch to the metal edges. After the welder selects the proper types of welding rods and welding torch tips and adjusts the regulators on the oxygen and acetylene cylinders, he lights his welding torch. He then adjusts the oxygen and acetylene valves on the torch to obtain the proper size and quality of flame. The kind of flame selected depends on the type of metal to be joined and the type of joint to be made. The welder heats the metal parts to be welded by directing the flame against the metal until it begins to melt. He then applies the welding rod to the molten metal to supply additional metal for the weld.

Resistance-welding operators, unlike arc and gas welders who use manual as well as machine methods, operate machines which weld metal parts by bringing them together under heat and pressure. The operator sets the controls of the machine for the desired electric current and pressure, feeds and aligns the work, and removes it after the welding operation is completed. The principal types of resistance-welding equipment are spot, seam, projection, flash, upset, and portable spot-welding guns.

Thermal (oxygen and arc) cutters commonly use hand-guided torches to cut or trim metals. In the oxygen-cutting process, for example, the oxygen cutter directs a flame of oxygen and fuel gas on the work area until the metal begins to melt. He then releases an additional stream of oxygen to burn or cut the metal. The oxygen cutter prepares for the cutting job by attaching the proper torch tip for the particular job, connecting the torch to the gas and oxygen hoses, and regulating the flow of gases into the torch for the desired cutting flame. He then cuts through the metal, manually guiding the torch along previously marked lines or following a template or pattern. He may mark guidelines on the metal by following blueprints or other instructions. Arc cutting differs from oxygen cutting because an electric arc is used as the original source of heat. However, as in oxygen cutting, an additional stream of gas may be released in cutting the metal.

In addition to manual methods used in thermal cutting, cutters may operate a torch or torches mounted on a machine. These electrically or mechanically controlled machines automatically follow the proper guideline.

Where Employed

In mid-1960, an estimated 350,000 welders and oxygen and arc cutters were employed throughout the country. Their principal employers were the manufacturers of boilershop and sheetmetal products, motor vehicle and equipment plants, the aircraft industry, the con-
construction industry, and independent metalworking repair shops.

Important employers of arc, gas, and resistance welders were steel mills, metal-stamping establishments, machinery plants, and railroad shops. Federal, State, county, and city government agencies, such as arsenals, road commissions, and departments of public works, also employed many welders. Many manual arc and gas welders were employed in maintenance and repair work in railroad shops, electric power-plants, street-railway systems, and in the maintenance shops of manufacturing plants. Resistance-welding operators were employed in production work in automobile manufacturing establishments and other metalworking plants where large quantities of identical sheet-metal parts were manufactured. Among the major employers of oxygen and arc cutters were shipyards, steel mills, and machinery, fabricated structural-steel, and boilershop product plants.

The widespread use of the welding and cutting processes in American industry enables welders and cutters to find jobs in every State. However, most of these jobs are found in the major metalworking areas, with more than 40 percent of them concentrated in Michigan, Pennsylvania, Ohio, Illinois, and California. Large numbers of welders and cutters are employed in Detroit, Chicago, Philadelphia, Los Angeles, and other important metalworking centers.

Training, Other Qualifications, and Advancement

Skills of manual arc and gas welders, machine resistance-welding operators, and flame cutters vary widely. For most skilled arc- and gas-welding jobs, several years of training and a knowledge of blueprint reading, welding symbols, properties of metals, work planning, electricity, and welding techniques are desirable. Some of the less skilled manual welding jobs can be learned after a few months of on-the-job training.

Training requirements for the resistance-welding operator's job depend upon the particular type of equipment used; most of these operators learn their work in a few weeks. Little skill is required for most flame-cutting jobs and, generally, they can be learned in a few weeks of on-the-job training. However, the cutting of some of the newer alloys requires a knowledge of the properties of metals as well as greater skill in flame cutting.

Welding and oxygen- and arc-cutting work requires manual dexterity, a steady hand, good eye-hand coordination, and good eyesight.

Manual welders usually learn their trade through a study of welding methods, generally in public or private vocational schools, followed by several years of job experience. A formal apprenticeship generally is not required for this occupation. However, apprenticeship programs for many metal crafts include training in welding as one of the related skills. A few large companies offer apprenticeship programs for welders. The U.S. Department of the Navy, at several of its installations, conducts 4-year welding apprenticeship programs for its civilian employees.

Young persons entering the welding trade often start with simple manual welding production jobs where the type and thickness of metal, as well as the position of the welding operation, rarely change. Occasionally, they are first given jobs as flame cutters and later move into manual welding jobs. Some large companies employ general helpers in maintenance jobs who, if they show promise, may be given opportunities to become welders. After serving as a helper to an experienced welder, a young man may be promoted to a semiskilled, class B welding job where he will usually perform repetitive work, or work which does not involve critical safety and strength requirements. The work duties of the class B welder are primarily performed in only one position (flat, vertical, horizontal, or overhead).

The class A or skilled, all-round welder should be able to plan and lay out work from drawings, blueprints, or other written specifications. He should have a knowledge of the welding properties of steel, stainless steel, cast iron, bronze, aluminum, nickel, and other metals and alloys. He should be able also to determine the proper sequence of work operations for each job and be able to weld all types of joints in flat, vertical, horizontal, and overhead positions. Some skilled manual welders are required to know both arc
and gas welding. These craftsmen are usually called “combination welders.” The skilled manual arc welder may specialize in one of the many types of arc welding.

Before being assigned to work where the strength of the weld is a highly critical factor, welders may be required to pass a qualifying examination. The test may be given by an employer, a municipal agency, a private agency designated by local government inspection authorities, or a naval facility. Certification tests are also given to welders on some construction jobs or to those who may be engaged in the fabrication or repair of steam or other pressure vessels where critical safety factors are involved. In addition to certification, some localities require welders to obtain a license before they can do certain types of outside construction work. New developments in some manufacturing industries are increasing the skill requirements of welders. This is particularly true in fields such as atomic energy or missile manufacture, which have high standards for the reliability of welds and require more precise work.

With 2 years’ training at a vocational school or technical institute, the skilled welder can qualify as a welding technician. Generally, workers in this small but growing occupation interpret the engineers’ plans and instructions. Occasionally, welders may be promoted to jobs as inspectors where they check welds for general conformance with specifications and for quality of workmanship. Welders also may become foremen who supervise the work of other welders. A small number of experienced, all-round welders establish their own welding and repair shops.

Welding also is used widely in maintenance and repair work by workers other than welders. The boilermaker, the structural-steel worker, the machinist, and the plumber may at times be required to weld. Frequently, when welding is used as a repair process, as in the maintenance shops of large factories, it is done by workers who specialize in welding but who are not classified as welders.

**Employment Outlook**

A rapid increase in the number of welding jobs is expected in the 1960’s as a result of the generally favorable longrun outlook for metalworking industries and the wider use of the welding processes. In addition, about 4,500 to 5,500 job openings will occur each year during the 1960’s because of vacancies resulting from retirements and deaths.

Resistance welders, who make up the largest single group of welders, are expected to continue to be in demand. Employment prospects for this occupational group are favorable because of the increased use of the machine resistance-welding process in such activities as the manufacture of motor vehicles, aircraft and missiles, and the production of light, streamlined railroad cars. The use of faster and more highly automatic welding machines, however, will slow down the growth in the number of these welders.

Many more skilled manual welders will be needed for maintenance and repair work in the growing metalworking industries. The number of manual welders engaged in production work also is expected to increase in plants manufacturing structural-metal products, such as metal doors, boilers, and sheet-metal products. The construction industry will need an increasing number of workers skilled in welding as the use of welded steel structures expands.

The number of jobs for oxygen and arc cutters is expected to rise somewhat during the 1960’s as the result of the general expansion of metalworking activity. The increased use of oxygen- and arc-cutting machines, however, will tend to restrict the growth of this occupation.

**Earnings and Working Conditions**

The amount a welder can expect to earn depends to a great extent on the skill requirements of his job and on the industry or activity in which he is employed. Earnings of highly skilled manual welders generally compare favorably with those of other skilled metalworking occupations. Machine welders, such as resistance welders, who require little training, generally earn somewhat less than skilled manual welders.

Average straight-time hourly earnings for
skilled (class A) manual welders in machinery manufacturing industries in 21 cities and metropolitan areas in 1959-60 ranged from $2.12 to $2.95, with the highest rates in San Francisco-Oakland ($2.95). Semiskilled (class B) manual welders' average hourly earnings ranged from $1.76 to $2.68. (Welders who are covered by union contracts may earn considerably more than these average earnings.)

Many welders and cutters are union members. Among the labor organizations which include welders and cutters in their membership are the International Association of Machinists; the International Brotherhood of Boilermakers, Iron Shipbuilders, Blacksmiths, Forgers and Helpers; the International Union, United Automobile, Aircraft and Agricultural Implement Workers of America; the United Association of Journeymen and Apprentices of the Plumbing and Pipe Fitting Industry of the United States and Canada; and the United Electrical, Radio and Machine Workers of America. Labor-management contracts which cover welders and flame cutters provide employees with major benefit programs which may include paid holidays and vacations, hospitalization, medical and surgical insurance, life insurance, sickness and accident insurance, and retirement pensions.

Welders and cutters are exposed to some hazards in their work, but safety programs have kept the injury rate relatively low. For example, protective clothing, goggles, helmets with colored lenses, and other devices are provided for the safety and protection of the welder. Although lighting and ventilation are usually adequate, welders occasionally work in the presence of toxic gases and fumes generated by the melting of some metals. Welders are often in contact with rust, grease, paint, and other elements found on the surface of the metal parts to be welded. Operators of resistance-welding machines are largely free from the hazards associated with hand welding. A clear eye shield or clear goggles generally offer adequate protection to these operators.

Where To Go for More Information

The American Welding Society, 33 West 39th St., New York 18, N.Y.

International Association of Machinists, 1300 Connecticut Ave. NW., Washington 1, D.C.

International Brotherhood of Boilermakers, Iron Shipbuilders, Blacksmiths, Forgers and Helpers, 570 New Brotherhood Bldg., Kansas City 1, Kans.


United Association of Journeymen and Apprentices of the Plumbing and Pipe Fitting Industry of the United States and Canada, 901 Massachusetts Ave. NW., Washington 1, D.C.

State Supervisor of Trade and Industrial Education or the local Director of Vocational Education in the State and/or city in which a person wishes to receive training.
Some Major Industries and Their Occupations

OCCUPATIONS IN AIRCRAFT, MISSILE, AND SPACECRAFT MANUFACTURING

America’s entry into the space age has caused rapid growth in the aircraft, missile, and spacecraft field. By late 1960, about 1.1 million persons were employed in private industry and Federal agencies in the manufacture of aircraft, missiles, and spacecraft. Many thousands of new and interesting jobs have come into being, and many more will be created during the 1960’s.

Generally known as the “aerospace” industry, this field is one of the most rapidly changing in the country today, with a future full of exciting prospects and stimulating job opportunities. Because its products are complex and changing, the majority of its job openings are for workers with a college education or a specialized skill. Engineers, scientists, and technicians represent a much larger percentage of total employment in the industry than in most other manufacturing industries, and they probably will account for an even higher percentage during the 1960’s.

Increases are also expected in the number of skilled workers employed, such as tool and die makers, skilled assemblers and inspectors, welders, and various types of mechanics. Employment opportunities for semiskilled and unskilled workers, on the other hand, are not expected to grow during the 1960–70 decade and may even decrease.

Nature and Location of the Aircraft, Missile, and Spacecraft Industry

Aircraft, missiles, and spacecraft have the same main components: a frame to hold and support the rest of the vehicle, an engine to propel the vehicle, and a guidance and control system. A major difference is that most aircraft are manned whereas missiles and spacecraft are not, although spacecraft in the future may be manned. Another difference is that missiles and spacecraft can reach into space and attain speeds many times the speed of sound, whereas aircraft fly only in the earth’s atmosphere and at slower speeds.

Many types of aircraft are made. They vary from small personal planes, costing not much more than an automobile, to multimillion-dollar giant bombers and supersonic fighters. Aircraft plants also produce transport planes, helicopters, dirigibles, balloons, and gliders. About 80 percent of aircraft (in dollar value) is manufactured for military use; the rest is for commercial passenger and freight traffic, private business and pleasure use, and civilian instructional flying.

Missiles and spacecraft also vary greatly in the purposes for which they are made, and in their size and capabilities. Missiles are produced chiefly for military use and generally carry destructive warheads. Some can travel only a few miles and are intended for such purposes as the support of ground troops and defense against low flying aircraft. Others, such as the Atlas and Minuteman, have intercontinental ranges of 5,000 miles or more. Some missiles are designed for launching from land or underground sites, others for firing from aircraft, submarines, ships, or trains.

Spacecraft are sent aloft with a “payload” of instruments which measure conditions in space and transmit the data to receiving stations on earth. Payloads successfully launched by the United States have varied in weight from less than 25 pounds to nearly 1 ton; currently being developed is the Saturn rocket which will be able to launch 25-ton payloads. Some space vehicles probe the space environment and then immediately fall back to earth. Others are put into orbit and become artificial satellites around the earth, sun, or other celestial body. Nearly all this country’s missiles and spacecraft are built for the Air Force, Navy, Army, or the
Because the aerospace industry makes many kinds of finished products, it uses many kinds of engines, electronic systems, and other components. Aircraft engines may be reciprocating (piston), jet, or rocket. Missile engines may be jet or rocket. Spacecraft are always rocket powered, because rockets are the most powerful type of engine we have and also can operate in airless space whereas other engine types need oxygen from the air for combustion. Today’s rocket engines are powered by chemical propellants, which may be either liquid or solid. New sources of rocket propulsion may be available in the future, such as nuclear energy or ion power. Guidance, control, and instrument-pay-load systems are usually electronic. Because missiles and spacecraft are unmanned, they generally have more complex guidance and control systems than most aircraft.

An aircraft, missile, or spacecraft is manufactured usually under the technical direction of a prime contractor. He manages and coordinates the entire project, subject to periodic inspections by the Federal agency or the airline which ordered the vehicle. His engineering department prepares design drawings, blueprints, and other specifications. These go to the production department, where planners work on the many details regarding machines, materials, and operations needed to manufacture the vehicle in the quantity required. Decisions must be made as to what part of the production work the prime contractor will do and what part will be contracted to outside firms.

Special tools, dies, jigs, and fixtures must be made to manufacture the vehicle. Many sheet-metal workers, machinists, machine tool operators, and other metal processors produce the thousands of parts and components which go into the craft. All parts and equipment must be inspected and tested many times, both before and after they are assembled, and all assembly work must also be thoroughly inspected and checked. Assemblers and installers are needed in every stage of the production process to fit together, hook up, and install systems and components. After its final assembly, the vehicle is checked out by a team of mechanics, flight tested if an aircraft, and then prepared for delivery.

Many subcontracts are awarded for the parts and assembly work that go into the aircraft, missile, or spacecraft. It is estimated, for example, that about 50,000 subcontractors produce components and other equipment for missiles and that the average missile contains approximately 300,000 parts. The prime contractor may manufacture components of the craft and also do the final assembly.

Aerospace plants range in size from the large factories of major manufacturers, each with thousands of employees, to the shops of small subcontractors and suppliers with only a few workers each. Jobs in aerospace work may be found in practically every State, although roughly one-third are concentrated in California. Ohio has the next largest work force, with about 6 percent of industry employment. Other States with large numbers of aerospace jobs include New York, New Jersey, Connecticut, Massachusetts, and Maryland, in the East; and Washington, Texas, Missouri, and Kansas, west of the Mississippi River.

An estimated 1.1 million people—about one-fifth of them women—were working on aerospace products in late 1960. About 500,000 of these persons were producing aircraft, aircraft engines, and propellers; about 300,000 were making missiles and spacecraft; and approximately 135,000 worked in the electronics field producing electronic equipment for aircraft, missiles, and spacecraft. The rest of the 1.1 million persons were civilian employees of the Federal Government working in the aerospace field—approximately 150,000 in the Department of Defense and 16,000 in the National Aeronautics and Space Administration.

**Occupations in Aircraft, Missile, and Spacecraft Manufacturing**

Workers with many different kinds of educational backgrounds and job skills are needed to design and manufacture aircraft, missiles, and spacecraft. Engineers and scientists with advanced university degrees as well as plant workers who can learn their jobs after a few days or weeks of training are employed.
Occupational needs vary among establishments in the industry, depending on the work being done. Research and development laboratories employ mainly engineers, scientists, and supporting technicians and craftsmen. These laboratories are run by manufacturers, universities, independent research organizations, and Government agencies such as the Air Force, Navy, Army, and the National Aeronautics and Space Administration. Factories engaged in production, on the other hand, employ mostly plant workers such as assemblers, inspectors, tool and die makers, sheet-metal workers, machinists, and machine tool operators.

Some of the more important jobs found in aerospace-products manufacturing are described below, under three major categories: professional and technical occupations; administrative, clerical, and related occupations; and plant occupations. (Many of the jobs in this industry are found in other industries as well and are discussed in greater detail elsewhere in this Handbook, in the sections covering individual occupations. See index for page numbers.)

**Professional and Technical Occupations.** Before production of an aircraft, missile, or spacecraft can begin, a design must be approved. This requires many experiments and "feasibility" studies, to determine how well various design possibilities meet the conditions under which the vehicle will be operated. A scale model is made from the approved design. It is tested in wind, temperature, and shock tunnels, on ballistic ranges, and in centrifuges where actual flight conditions are simulated. The next step is to develop a full-size experimental model or prototype, which is thoroughly tested in the air and on the ground. If test results are satisfactory, production may begin. Many modifications in the craft are normally made during the course of design and development, and often even after production has started.

The pace of discovery and change is so rapid that much equipment becomes obsolete while still in the experimental stage or soon after being put into operation. Research and development are vital in the industry, particularly in the missile and spacecraft field. (In 1960, for example, only about half of missile and spacecraft spending was for production, the other half being for research and development.) An intensive effort is being made to develop aerospace vehicles with greater speeds, ranges, and reliability; engines with more power; and metals and plastics with wider capabilities.

Increasing emphasis on research and development makes the aerospace industry an important and growing source of jobs for engineers, scientists, and technicians. The industry was employing 83,000 engineers, 12,000 scientists, and 52,500 technicians in January 1959, according to a Bureau of Labor Statistics' survey of aerospace companies. Many more thousands of workers in these occupations were employed in aerospace establishments not covered by the survey. It is estimated that in late 1960 about one-fifth of all employees in all plants making aerospace products were engineers, scientists, and technicians, considerably more than the percentage of such personnel in most other manufacturing industries.

Many kinds of engineers and scientists are employed in aerospace work. For example, over 30 different college degree fields are represented...
among the engineers and scientists employed by the National Aeronautics and Space Administration. Among the more important types of engineers working in the industry are electronic, electrical, aeronautical, chemical, nuclear, mechanical, and industrial engineers. Some of the types of scientists employed in the industry include physicists, mathematicians, chemists, metallurgists, psychologists, physiologists, and astronomers. Aerospace engineers and scientists work in a wide and varied range of applied fields, such as materials and structures, energy and power systems, fluid and flight mechanics, measurement and control systems, communications and data systems, human factors and bioastronautics, and space sciences.

Engineers and scientists are assisted by aeronautical draftsmen, mathematics aids, laboratory technicians, electronic technicians, tool designers, research mechanics, and research electricians. They also work with production planners (D.O.T. 0-68.50), who plan the layout of machinery, movement of materials, and sequence of operations so that manufacturing processes will flow efficiently from one step to the next; and technical writers (D.O.T. 0-06.90) and technical illustrators (D.O.T. 0-48.32), who produce technical manuals and other literature used to describe the operation and maintenance of air and space craft and their many parts.

Administrative, Clerical, and Related Occupations. Managerial and supervisory jobs are generally comparable with similar jobs in other industries. Personnel in these jobs include executives, who are responsible for the direction and supervision of research and production, and officials in such departments as sales, purchasing, accounting, public relations, advertising, and industrial relations. Many thousands of clerks, secretaries, stenographers, typists, tabulating machine operators, and other office personnel are also employed.

Plant Occupations. Nearly 60 percent of all workers in the aircraft, missile, and spacecraft field were employed in plant jobs in late 1960. Plant jobs can be classified into the following groups: sheet-metal work; machining and tool fabrication; other metal processing; assembly and installation; inspecting and testing; flight checkout; and materials handling, maintenance, and custodial.

Sheet-metal occupations. Sheet-metal workers shape parts from sheet metal by hand or machine methods. When hand methods are used, the worker shapes the part by pounding it with a mallet and by bending, cutting, and punching it with handtools. Machine methods involve the use of power hammers and presses, saws, tube benders, and drill presses. The all-round sheet-metal worker (D.O.T. 4–80.050 and .060) lays out the sequence of operations on the basis of blueprints and other engineering information. He then fabricates complicated metal shapes, using handtools or machines. Less complex parts, as well as those produced in large numbers, are fabricated by less skilled sheet-metal workers or workers who specialize in operating a single machine. They have such titles as stretch press operator (D.O.T. 6–88.627), power brake operator (D.O.T. 6–94.207), power hammer operator (D.O.T. 6–94.221), power shear operator (D.O.T. 6–88.664), punch press operator (D.O.T. 6–88.622), and profile cutting torch operator (D.O.T. 6–85.240).

Machining and tool fabrication occupations. Another important group of workers engaged in shaping and finishing metal parts with machine tools are machinists (D.O.T. 4–75.010 and .120) and machine tool operators. The most skilled of these are the all-round or general machinists who can lay out the work and set up and operate several types of machine tools. They perform machining operations of a highly varied and nonrepetitive nature. They are most frequently employed in departments which are engaged in experimental and prototype production.

Machine tool operators are employed in the large-volume production of metal parts. They generally specialize in the operation of a single type of machine tool, such as a lathe, drill press, or milling machine. The more skilled machine tool operators are able to set up the work on a machine and handle difficult and varied jobs. The less skilled operators usually do more repetitive work.

Machinists and machine tool operators rep-
resent a higher proportion of the work force in engine and propeller plants, which are basically metalworking establishments, than in plants performing the final assembly of air and space vehicles. Among engine plants, those manufacturing reciprocating engines do relatively more machining and less sheet-metal work than those producing jet or rocket engines.

Many of the plants in the aerospace industry make a large proportion of the jigs, fixtures, tools, and dies they use. Fabrication of these items requires skilled metal-processing workers, chiefly jig and fixture builders (D.O.T. 5–17.060) and tool and die makers (D.O.T. 4–76.010, .040, and .210). Jig and fixture builders make the work-holding and tool-guiding devices used in production and assembly operations. On the basis of information received from the engineering department, they plan the sequence of metal machining operations involved in making a jig and carry the job through to completion. Tool and die makers make the cutting tools and fixtures used in machine tool operations and the dies used in forging and punch press work. They must be all-round experts in the use of machine tools.

Other metal-processing occupations. Other metalworkers, such as tube benders, riveters, and welders are also employed. Tube benders (D.O.T. 6–95.060) form tubings which are used for oil, fuel, hydraulic, and electrical conduit lines. Riveters (D.O.T. 6–95.080 and .081) and welders (D.O.T. 4–85.020, .030, .040, and .063) join fabricated parts by hand or machine riveting and by electric arc, gas, or electric resistance welding.

Additional metal fabricating is performed by skilled foundry workers such as patternmakers, molders, and coremakers. Drop hammer operators and other forge shop workers are employed in the forging departments.

Many aircraft, missile, and spacecraft parts are chemically and heat treated during several stages of their manufacture in order to clean, change, or protect their surface or structural condition. Sheet-metal parts are heat treated to keep the metal soft and malleable while it is being worked into the required shape. Many processes, such as painting and plating, are used on the surfaces of parts. Workers in these metal-processing jobs have such titles as heat treater (D.O.T. 4–87.020), painter (D.O.T. 5–16.940), and plater (D.O.T. 4–74.010).

Assembly and installation occupations. Assembly and installation workers are a major occupational group, employed in practically all plants in the industry. Many work in factories producing engines, electronic equipment, and auxiliary components, but the majority are found in plants which assemble air or space craft into completed form. They perform such final assembly work as the fitting together of major subassemblies and the installing of major components. In the case of aircraft, for example, this work involves joining wings and tail to the fuselage and installing the engine and such auxiliary equipment as the fuel system and flight controls. In the course of their duties, assemblers perform such operations as riveting, drilling, filing, bolting, soldering, cementing, and gluing.

A large proportion of assemblers are semi-skilled workers doing repetitive work, but some
are skilled mechanics and installers. Many of the latter perform diversified assembly or installation operations, and often work on experimental, prototype, or special craft. They assemble, take apart, inspect, and install complex mechanical and electronic assemblies. They read blueprints and interpret other engineering specifications. They may be called final assemblers of complete aircraft (D.O.T. 5-03.572), missile assembly mechanics (temporary D.O.T. 5-03.599), or rocket assembly mechanics (temporary D.O.T. 5-03.699).

Some skilled assemblers are employed in plants which produce relatively large numbers of aircraft and missiles rather than a few experimental types. These assemblers usually specialize in one or more fields of work. They are often assisted by less skilled assemblers who do the more routine work. For example, a class A armament assembler (D.O.T. 5-83.543) typically does such work as assembling, installing, and alining power turrets, weapons, gun cameras, and related accessories. Lower rated armament assemblers typically do such work as uncrating and cleaning weapons, loading ammunition, installing armor plate, and placing parts in jigs. Power plant installers (D.O.T. 5-03.572), sometimes known as engine mechanics, install, aline, and check the various types of engines and accessories. Skilled electrical assemblers (D.O.T. 4-97.910), sometimes called electricians, install, hook up, and check major units in electrical or radio systems. They are assisted by less skilled assemblers, who do the more routine installations and wire routings by following standard wiring diagrams and charts. Assemblers also specialize in other systems, such as plumbing, hydraulic, heating and ventilating, and rigging and controls.

Inspecting and testing occupations. Because aircraft, missiles, and spacecraft are extremely complex, thousands of painstaking inspections and tests must be made as each component and part moves toward final assembly of the whole system. Inspections are made not only by employees of the manufacturers but also by civilian employees of Federal agencies which have contracted for the equipment.

Some inspectors specialize in examining materials and equipment purchased from the outside, others inspect components during fabrication and subassembly within their own plants, while still others inspect completed craft after their final assembly. Many inspection jobs require highly skilled workers. On the other hand, some tests are made by automatic equipment which can be run by relatively unskilled persons. Such equipment not only checks the component or assembly under test but may also run simultaneous checks on itself to eliminate the possibility of error.

Some of the most skilled inspectors, especially in final assembly plants, are outside production inspectors (D.O.T. 4-76.220). They examine machined parts, subassemblies, and tools and dies which have been ordered from other firms. They also serve as liaison men between their own engineering departments and supplying companies. Other inspectors, frequently known as receiving inspectors (D.O.T. 7-03.810), with less responsibility than outside production inspectors, check purchased materials and parts for conformity with blueprints, armed services requirements, and other established standards.
They operate testing equipment and must be familiar with specifications of the parts and materials purchased from different sellers.

In the production department, machined parts inspectors (D.O.T. 4–78.671) determine, by the use of precision testing instruments, whether or not a part has been properly machined to conform to blueprint specifications. They may also test for hardness and porosity and determine the “machineability” of castings and forgings. Fabrication inspectors (D.O.T. 5–03.812) are generally skilled sheet-metal workers. They inspect fabricated sheet-metal work and complex parts which have required numerous fabricating operations.

As the parts are fitted together, they undergo numerous inspections by assembly inspectors (D.O.T. 5–03.814). These inspectors are employed, for the most part, in the later stages of the assembly process. They usually inspect complete major assemblies and installations, such as fuselage, wing, and nose sections, to insure their proper final fitting. They also check the functioning of such systems as hydraulics, plumbing, and controls. Subassemblies are usually inspected by less skilled assembly inspectors. Final testing must be especially rigorous with missiles and spacecraft since, unlike aircraft, they have no human guidance aboard to correct for improper working of components which may cause a target miss or other failure of the mission.

Flight checkout occupations. The job of checking out an air or space craft before its first flight requires a team of mechanics with different levels and types of skills. Sometimes the checking-out process involves making repairs or returning the craft to the plant for repairs. The chief mechanic or crew chief, who is the most skilled worker of the team, is responsible for the entire checking-out operation including repair work. He usually directs the work of a crew of mechanics, each of whom specializes in one or more fields. For example, engine mechanics specialize in checking out the power plant, including the engine, propellers, and oil and fuel systems. Engine mechanics use handtools, testing equipment, and precision measuring instruments in their work. The electronics checkout men perform or supervise the final operational checkout of such systems as radio, radar, automatic pilot, fire control, and complete electronic guidance systems. Other skilled workers may specialize in checking out and repairing armament, instruments, rigging and controls, plumbing, and hydraulic systems. In some cases, less skilled mechanics are employed to help conduct tests and make repairs.

Materials handling, maintenance, and custodial occupations. Aerospace plants employ large numbers of materials handlers, such as truckdrivers, crane operators, shipping clerks, stock clerks, and tool crib attendants. Maintenance workers, who keep equipment and buildings in good operating condition and make changes in the layout of the plant, include maintenance mechanics, millwrights, electricians, carpenters, plumbers, painters, and welders. Guards, firemen, and janitors make up a major portion of the plant’s protective and custodial employees.

Training, Other Qualifications, and Advancement

A college degree in engineering or in one of the sciences is usually the minimum requirement for engineering and scientific jobs in the aerospace industry. A few workers may get jobs as professional engineers without a college
degree, but only after years of semiprofessional work experience and some college-level training. Since many kinds of engineers and scientists are employed in aerospace work, college graduates in many different degree fields may qualify for professional jobs in the industry. Regardless of his degree field, the undergraduate student preparing for professional aerospace work is well advised to get as solid a grounding as possible in fundamental concepts and basic general areas of engineering and science. Mathematics and physics courses are especially important, since these sciences provide the necessary language understood by the variety of engineers and scientists working on any given project. Training in the more concentrated fields of specialization which exist in aerospace work is generally received in graduate school or through on-the-job experience.

An increasing number of semiprofessional workers, such as electronic technicians, engineering aids, draftsmen, production planners, and tool designers receive training for their jobs through 2 years of formal education in a technical institute or junior college. Others qualify for these jobs through several years of diversified shop experience rather than through institute or college training.

Training requirements for plant jobs vary from a few days of on-the-job instruction to several years of formal apprenticeship training. Apprenticeship programs are used to develop craftsmen, such as machinists, tool and die makers, sheet-metal workers, patternmakers, aircraft mechanics, and electricians. These programs vary in length from 3 to 5 years depending on the trade; during this time, the apprentice handles work of progressively increasing difficulty. Besides on-the-job experience, he receives classroom instruction in subjects related to his craft. Such instruction for a machinist apprentice, for example, would include courses in blueprint reading, mechanical drawing, shop mathematics, trade theory, physics, safe working practices, and other subjects.

Many levels of skill are required for other factory jobs. Workers with little or no previous training or experience are hired for the less skilled assembly jobs. On the other hand, skilled assemblers may need 2 to 4 years of plant experience in addition to a high school or vocational school education or its equivalent. Skilled assemblers must be able to read and interpret engineering blueprints, schematic diagrams, and production illustrations.

Skilled inspectors must have at least several years of machine shop experience. They must be able to install and use various kinds of testing equipment and instruments, read blueprints and other engineering specifications, and use shop mathematics. New workers with little or no experience in shop trades may also be hired and trained for jobs requiring less skilled inspectors.

Mechanics who perform the final checkout of air and space craft qualify for their jobs in several ways. Many gain experience as mechanics by working in earlier stages of the plant's production line, before final checkout of the craft. Others receive all their training in checkout work, or come from "line maintenance" jobs with commercial airlines.

Chief mechanics usually need 3 to 5 years of experience in the manufacture of aircraft, missiles, and spacecraft, including at least 1 year as a checkout mechanic. Specialized mechanics, working under the supervision of the chief mechanic, are usually required to have at least 2 years' experience. Workers with less experience serve as helpers or assistants and pick up the mechanic's skills on the job and through plant training courses.

Because of the manufacture of their complex and rapidly changing products requires workers who are highly trained and aware of new developments, the majority of aerospace plants support some kind of formal worker training. Instruction of this type supplements day-to-day job experience and helps workers advance more rapidly to higher skills and better paid work. A U.S. Department of Labor study of some of the industry's major producers showed that nearly three-fourths of them were sponsoring training programs in 1959. Many of these plants were conducting educational and training classes themselves, others were paying tuition and related costs for outside courses taken by their employees, and some were doing both. Some classes were held during working hours, in which case trainees were paid for class time, and others were after working hours. Courses
were available for practically every occupational group, and covered many skills and areas of knowledge. Examples of subjects typically offered include blueprint reading, drafting, welding, aircraft maintenance and repair, electronic data processing, shop mathematics, supervisory practices, and safe working practices. Most of the trainees were taking short-term courses designed to meet immediate skill needs. Only a relatively few employees were enrolled in long-term programs scheduled to run for several years, such as apprenticeship.

Employment Outlook

Thousands of employment opportunities are expected to develop in the aerospace field during the 1960’s. Many new jobs will be created by expanding activity in the industry, and many others will result from the need to replace workers who transfer to other industries, retire, or die. Retirements and deaths alone will probably result in an average of 15,000 to 18,000 openings each year during the 1960-70 decade.

The industry’s future depends largely on Government spending. Unless the international situation changes significantly from that prevailing in late 1960, Government expenditures for aerospace products are expected to rise during the decade ahead.

The overall picture for aerospace activity during the 1960’s is one of growth, but this is not true for every segment of the industry. Jobs in the spacecraft field will probably increase rapidly. Employment in the production of missiles is not expected to change much, after a sharp rise which occurred during the last few years of the 1950’s. Employment in military-aircraft manufacture will probably drop. Civil-aircraft production is not expected to change much during the first half of the 1960’s but may expand during the second half. Many new jobs will be created to produce electronic units for the industry. Electronic systems and components are major items of aerospace craft and their importance in the industry is growing.

Expenditures for research and development should rise rapidly during the 1960’s. Employment opportunities will, therefore, be particularly favorable for engineers and scientists, and for such workers as draftsmen, electronic technicians, mathematics aids, and research craftsmen. Many job openings in these specialties will become available not only in manufacturing concerns but also in university laboratories, independent research organizations, and Federal agencies such as the Air Force, Navy, Army, and the National Aeronautics and Space Administration.

Opportunities will also be favorable during the 1960’s for skilled plant personnel, such as tool and die makers, skilled assemblers and inspectors, and maintenance craftsmen. Because of the shift from the volume production of conventional items, chiefly aircraft, to the custom production of relatively small numbers of many diversified products, employment of semiskilled and unskilled plant workers is not expected to increase during the 1960-70 decade and may even decrease. Semiskilled and unskilled workers are also more likely to be laid off during production cutbacks than are skilled workers and office personnel. Aerospace employment has fluctuated sharply in the past, owing mainly to changes in the needs of the industry’s major customer—the Federal Government.

Earnings and Working Conditions

Plant workers’ earnings in the aerospace industry are higher than those in most other manufacturing industries. During January 1961, for example, production workers in plants making aircraft and parts earned an average of $114.13 a week or $2.75 an hour, while production workers in all manufacturing industries as a whole averaged $90.25 a week or $2.32 an hour. Production workers in the Department of Defense and other Federal agencies receive wages equal to prevailing rates paid for comparable jobs by local private employers.

Information on earnings for professional and technical workers in the aerospace field indicate that they are higher than earnings for similar work in most other industries. The relatively favorable position of these workers is due mainly to the recent rapid growth of research and development activity on missiles and space-
OCCUPATIONS IN AIRCRAFT, MISSILE, AND SPACECRAFT MANUFACTURING

craft, which has created an urgent need for well-qualified engineers, scientists, and technicians. (General information on earnings of professional and technical personnel may be found in the sections on individual occupations in this Handbook. See index for page numbers.)

The following tabulation was developed from examination of collective bargaining agreements of a number of representative aircraft and missile manufacturers. It indicates the approximate range of hourly wage rates for selected occupations in mid-1960. The ranges in the various jobs are rather wide, partly because wages within an occupation vary according to the worker's skill and experience and partly because wages differ from plant to plant depending upon plant size, locality, and other factors.

<table>
<thead>
<tr>
<th>Occupation</th>
<th>Wage Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aircraft mechanics</td>
<td>$2.35-$3.20</td>
</tr>
<tr>
<td>Assemblers</td>
<td>2.00- 2.95</td>
</tr>
<tr>
<td>Draftsmen</td>
<td>2.10- 3.05</td>
</tr>
<tr>
<td>Electronics technicians</td>
<td>2.50- 3.50</td>
</tr>
<tr>
<td>Heat treaters</td>
<td>2.10- 3.00</td>
</tr>
<tr>
<td>Inspectors and testers</td>
<td>2.00- 3.40</td>
</tr>
<tr>
<td>Jig and fixture builders</td>
<td>2.10- 3.40</td>
</tr>
<tr>
<td>Laboratory technicians</td>
<td>1.90- 3.25</td>
</tr>
<tr>
<td>Machine tool operators</td>
<td>2.05- 3.00</td>
</tr>
<tr>
<td>Machinists</td>
<td>2.50- 3.40</td>
</tr>
<tr>
<td>Maintenance craftsmen</td>
<td>2.15- 3.25</td>
</tr>
<tr>
<td>Riveters</td>
<td>1.95- 2.85</td>
</tr>
<tr>
<td>Tool and die makers</td>
<td>2.15- 3.40</td>
</tr>
<tr>
<td>Welders</td>
<td>2.10- 2.95</td>
</tr>
</tbody>
</table>

Fringe benefits are common in the industry. Workers usually get 2 weeks of paid vacation after 1 or 2 years of service, and 3 weeks after 10 or 12 years. They generally get 6 to 8 paid holidays a year and 1 week of paid sick leave. Other major benefits include life insurance; medical, surgical, and hospital insurance; payments in case of accident and sickness; and retirement pensions. Fringe benefits in Federal aerospace employment are comparable with those in the rest of the industry.

Most employees work in modern factory buildings which are clean, light, and airy. Some work is done outdoors. Operations such as sheet-metal processing, riveting, and welding may be relatively noisy, and some assemblers may work in cramped quarters. Aerospace plants are comparatively safe working places, with an injury-frequency rate which in 1960 averaged only about one-third that for manufacturing as a whole.

Most plant workers in the aerospace field are union members. They are represented by several unions, among them being the International Association of Machinists; the International Union, United Automobile, Aircraft and Agricultural Implement Workers of America; and the International Union of Electrical, Radio and Machine Workers. Some craftsmen, guards, and truckdrivers belong to unions which represent specific occupational groups rather than plant workers as a whole.

Where To Go for More Information

National Aeronautics and Space Administration, 1520 H St. NW., Washington 25, D.C.

Aerospace Industries Association of America, Inc., 15th and H Sts. NW., Washington 5, D.C.

International Association of Machinists, 1300 Connecticut Ave. NW., Washington 6, D.C.


International Union of Electrical, Radio and Machine Workers, 1126 16th St. NW., Washington 6, D.C.
AIR TRANSPORTATION OCCUPATIONS

The widespread use of airplanes has provided jobs for many thousands of workers in a variety of interesting and responsible occupations. Some of these jobs, such as pilot, copilot, and stewardess, are especially appealing to young men and women.

Nature of Air Transportation Activities

Many different types of employers have jobs for workers in the various air transportation occupations. The scheduled airlines (those which operate regularly scheduled flights over prescribed routes) employ workers in most of the major air transportation occupations. Other employers have workers in only a few of these occupations. These employers include the Federal Government; companies and individuals that provide commercial flying services, such as “air-taxi operators” who fly their own planes on special chartered flights to deliver cargo or transport passengers between cities not conveniently serviced by the scheduled airlines; and airlines that hold licenses to make nonscheduled flights, and fewer scheduled flights than scheduled airlines. These airlines—called “certificated supplemental airlines”—fly both domestic and international routes.

The 54 scheduled airlines that were operating in late 1960 employed about 168,000 workers. Of these workers, about 80 percent (134,000) were employed by 28 airlines to fly and service aircraft and passengers on domestic routes—between cities in the United States. About 29,000 other workers handled the operations of the scheduled airlines which flew international routes. The remaining workers were employed by airlines that handled only cargo, or by lines that were based in Alaska or Hawaii. About half of all scheduled airline employees (82,000) worked for the four largest domestic airlines.

Many thousands of workers in jobs concerned with air transportation—most of them either pilots or mechanics—are employed by several Federal Government agencies. They work for the Federal Aviation Agency (FAA), which develops air safety regulations, inspects and tests airplanes and airline facilities, provides ground electronic guidance equipment, and gives tests for licenses to such personnel as pilots, copilots, flight engineers, dispatchers, and airplane mechanics; the Civil Aeronautics Board (CAB), which establishes policy concerning such matters as airline rates and routes and investigates accidents; and the Department of Defense, which employs civilian mechanics to service their many aircraft. In addition to pilots and maintenance personnel, the FAA also employs about 12,300 air traffic control specialists to provide weather and other information to pilots and to guide planes around airports and through the Federal Airways System—a network of designated air lanes along which aircraft are guided from airport to airport. Most FAA personnel are civilian Federal employees whose major function is to serve those who use the airways.

Thousands of other workers—also mostly pilots and maintenance personnel—are employed in the field of commercial flying. Most of these workers are employed by air-taxi operators, and by companies that operate airplanes to transport their executives; do agricultural flying such as crop dusting, spraying, and seeding; run flying schools; and specialize in aircraft and engine repair. A small number of workers are employed by companies that do aerial photography and advertising through sky writing.

An additional 2,500 workers were employed by 26 certificated supplemental airlines which were operating in late 1960. These airlines operated a limited number of scheduled flights each month. The majority were small companies which operated charter flights between communities off the main airline routes.
Air Transportation Occupations

The scheduled airlines employ a great many workers to fly planes, maintain and repair equipment, provide services to passengers at terminals and during flights, and perform clerical and other business services. Mechanics and other aircraft maintenance personnel made up about 20 percent of scheduled airline employment in 1960; pilots and copilots, 8 percent; and stewardesses, stewards, flight engineers, and navigators, 9 percent. (See chart 26.) About 17 percent of all airline workers were traffic agents and clerks, and almost 3 percent worked at airline ground stations as communications personnel and dispatchers. The remainder (about 43 percent) were cargo and freight handlers, custodial and other aircraft servicing personnel, office workers, and administrative and professional personnel.

Flight crews consist of pilots, copilots, flight engineers, flight attendants (stewardesses and stewards), and sometimes navigators. All commercial airline flights have a pilot and at least one copilot who operate the aircraft. On many types of aircrafts, a flight engineer is on board to see that the engines, gages, and controls operate satisfactorily and to take proper emergency measures in flight. Navigators are carried on flights over water to aid the pilot in navigating and maintaining communications. Almost all passenger flights carry stewardesses or stewards to serve the passengers.

Ground operational personnel consist of workers such as dispatchers, controllers, radio operators, and mechanics. Dispatchers guide and give flight information to all planes operated by their company and flying within a given radius of their airport. Air-route and airport traffic controllers, mainly employed by the FAA, give landing and takeoff clearances and navigational information to all planes operating within their areas of control. Radio operators and teletypists assist dispatchers by making direct connections with the planes and relaying messages to flight crews and to other airports. Other flight service specialists who operate radio equipment help air traffic controllers perform their work. Mechanics make sure that planes are in good condition before each flight, do repair jobs, and overhaul and recondition aircraft and engines at periodic intervals.

A detailed description of the duties, training, qualifications, employment outlook, earnings, and working conditions for each of the following air transportation jobs appear in the later sections of this chapter: (1) pilots and copilots, (2) flight engineers, (3) stewardesses, (4) airplane mechanics, (5) airline dispatchers, (6) air traffic controllers, (7) ground radio operators and teletypists, and (8) traffic agents and clerks.

**Employment Outlook**

Total employment in air transportation occupations is expected to increase moderately in the 1960’s, although employment is not expected to change much during the early years of the decade. The new planes and equipment being introduced by airlines will enable them to handle more traffic in this early period with little or no increase in employment. Nevertheless, there will be many thousands of opportunities for young women and men to obtain jobs as stewardesses and traffic agents and clerks. In the latter part of the decade, overall employ-
ment is expected to increase, largely because of the anticipated growth in air transportation. The combination of anticipated increase in total employment and continuing replacement needs will result in larger numbers of job opportunities for new workers.

Airline traffic and employment have grown rapidly during most of the industry’s brief history. For example, during the 1950’s, the number of miles flown by paying passengers (revenue passenger miles) on the scheduled airlines more than tripled. Employment doubled over the same period.

Air traffic is expected to continue to grow in the 1960’s. The FAA has estimated that by 1970 the scheduled airlines will fly twice the revenue passenger miles flown in 1959. Among the factors which will contribute to greatly increased air travel are a larger population, increased consumer purchasing power, the trend toward longer vacations, the greater dependence upon air travel by businessmen, faster flights on jet aircraft which will save considerable time in long-distance travel, and more low-cost air coach service. An even larger increase is expected in air cargo traffic, which, however, represents a relatively small percentage of total traffic. Continued growth in commercial flying services, such as air-taxi operations and business executive flying, is also expected.

Despite the introduction of more efficient planes and equipment, employment in many air transportation occupations is expected to grow. The number of pilots, copilots, mechanics, and dispatchers employed by the airlines is expected to increase moderately during the 1960’s, but the number of flight engineers is expected to increase only slightly; employment of pilots and mechanics in the other areas of commercial flying is also expected to grow. Many more air traffic controllers will be hired. There will also be many employment opportunities in such airline jobs as stewardesses and traffic agents and clerks largely because of the high turnover in these occupations.

Earnings and Working Conditions

Earnings vary greatly among the air transportation occupations because of such factors as skill requirements, length of experience, and amount of responsibility for safe and efficient operations. The statements on individual occupations which follow contain detailed discussions of earnings.

As a rule, employees and their immediate families are entitled to free transportation on their companies’ domestic flights. In addition, they may fly at greatly reduced rates with other airlines. In overseas travel, employees and their immediate families receive fare discounts of up to 90 percent. Flight personnel may be away from their home bases about a third or more of the time. When they are away from home, the airlines either provide living accommodations or pay actual expenses.

Airlines operate flights at all hours of the day and night. Flight personnel, therefore, often have irregular work schedules. Maximum hours of work per month for these workers have been established by the FAA as a safety precaution against fatigue. In addition, union-company agreements often stipulate that persons in flight occupations be paid for a minimum number of hours each month, to guarantee a substantial proportion of their normal earnings.

Ground personnel who work as dispatchers, mechanics, traffic agents, communications oper-
Air transportation occupations usually work a 5-day, 40-hour week. Their working hours, however, like those of flight personnel, often include nights, weekends, or holidays. Air traffic controllers work a 5-day, 40-hour week; they are periodically assigned to night, weekend, and holiday work. Ground personnel generally receive extra pay for overtime work.

In domestic operations, employees usually receive 2 or 3 weeks' vacation with pay, depending upon length of service. Most flight personnel in international operations get a month's vacation. Employees also receive paid sick leave and retirement, insurance, and hospitalization benefits. FAA employees are entitled to the same benefits as other Federal personnel, including from 13 to 26 days of vacation leave and 13 days of sick leave a year, as well as retirement, life insurance, and health benefits.

Many of the workers in air transportation are union members. These unions are identified in the statements covering the individual jobs.

**Where To Go for More Information**

Information about job openings in a particular airline and the qualifications required, may be obtained by writing to the personnel manager of the company. Addresses are available from the Air Transport Association of America, 1000 Connecticut Ave. NW., Washington 6, D.C.

Inquiries regarding jobs with the Federal Aviation Agency should be addressed to the Personnel Officer, Federal Aviation Agency, at any of the following addresses:

- Region 1: Federal Building, New York International Airport, Jamaica, Long Island, N.Y.
- Region 2: Box 1689, Fort Worth 1, Tex.
- Region 3: 4825 Troost Ave., Kansas City 10, Mo.
- Region 4: Box 90007, Airport Station, Los Angeles 45, Calif.
- Region 5: Box 440, Anchorage, Alaska
- Region 6: Box 4009, Honolulu 12, Hawaii

National Aviation Facilities Center, Atlantic City, N.J.
Aeronautical Center, Box 1082, Oklahoma City, Okla.

Information concerning FAA-approved schools offering training for work as an airplane mechanic, pilot, or in other technical fields related to aviation may be obtained from the Correspondence Inquiry Branch, MS-126, Federal Aviation Agency, Washington 25, D.C.

Career information about dispatchers may be obtained from the Air Line Dispatchers Association, 4620 Lee Highway, Arlington, Va.

**Pilots and Copilots**

(D.O.T. 0-41.10 and .12)

**Nature of Work**

The men who have the responsibility for flying a multimillion dollar plane and transporting as many as 125 passengers safely are the pilot and copilot. The pilot (called "captain" by the airlines) operates the controls and performs other tasks necessary for getting a plane into the air, keeping it on course, and returning it safely to earth. He supervises a crew which may include—in addition to the copilot—a flight engineer, a navigator, and flight attendants. The copilot is second in command. He must be present on airline flights since he also operates the controls of the plane. On some jets, there may be two copilots in addition to the other crew members.

Both captain and copilot must do a great deal of planning before a plane may leave the ground. Before each flight, they confer with the company meteorologist about weather conditions and, in cooperation with the airline dispatcher, they prepare a flight plan along a route and at altitudes which offer the best weather and wind conditions so that a safe, fast, and smooth flight will be possible. This flight plan must be approved by Federal Aviation Agency (FAA) air traffic control personnel. The copilot plots the course to be flown and computes the flying time between various points. Just prior to take-off, both men check the operation of each engine and the functioning of the plane's many instruments.
Flight crew receiving training in operation of jet aircraft.

During the flight, the captain or copilot reports, by radio, to ground control stations. They radio information about their altitude, air speed, weather conditions, and other flight details. The captain also supervises the navigation for the flight and keeps close watch on the many instruments which indicate the plane’s fuel load and the condition of the engines, controls, electronic equipment, and landing gear. The copilot records the progress of the flight and also keeps close watch on all instruments.

Before landing, the pilot or the copilot perform such duties as rechecking the operation of the landing gear and requesting permission to land from the airport control tower. When visibility is limited, the captain must rely solely on instruments, such as radar, when landing. Both men must complete a flight report and file trip records in the airline office when the flight is ended.

Some pilots employed by airlines act as “check pilots.” They make at least two flights a year with each captain to observe his proficiency and adherence to Federal Aviation Agency (FAA) flight regulations and company policies. Airlines also employ pilot-instructors to train new pilots, as well as to train experienced ones in the use of new equipment. Airlines also employ some pilots to fly planes leased to private corporations.

Pilots not employed by the major airlines may fly planes that are smaller and less expensive and transport fewer passengers and less cargo. These pilots seldom have the assistance of flight crews. In addition to flying, they may perform minor maintenance and repair work on their planes. Those who are self-employed also have duties similar to those of other small businessmen.
Where Employed

Scheduled airlines employed about 11,500 pilots and copilots in domestic operations in late 1960. Another 1,500 were employed on scheduled international flights. In addition, approximately 800 pilots were employed by the certificated supplemental airlines (airlines that hold licenses to make nonscheduled flights and fewer scheduled flights than the scheduled airlines).

More pilots are employed outside of the scheduled airlines than by the scheduled airlines. For example, the FAA estimates that in mid-1960 about 6,200 pilots and copilots were employed by companies that used their private aircraft solely to transport their executives. A similar number were employed by about 2,600 air taxi operators who operate smaller planes to transport passengers and cargo on specially chartered flights. An additional 4,000 pilots were employed as “crop dusters”—scattering insecticides, fertilizers, and seeds from the air. The Federal Government employs approximately 700 pilots (about half in the FAA) to perform a variety of services, such as examining applicants for pilots’ licenses, inspecting navigation facilities along Federal airways, testing planes that are newly designed or have major modifications, enforcing game laws, fighting forest fires, and patrolling national boundries. In addition to employment in these fields, a few thousand pilots were employed by companies to transport engineers, scientists, and other technical personnel to branch plants in special or emergency situations, to inspect pipelines and installations for oil companies, and to provide other aerial services such as private flight instruction, and flights for sightseeing, sky writing, and aerial photography. A small number work for aircraft manufacturers as test pilots.

Qualifications, Training, and Advancement

To do any type of commercial flying, pilots or copilots must be licensed by the FAA. Airline pilots must have an “airline transport pilots’” license. Copilots, and pilots who do not work for the airlines, must have a “commercial airplane pilots’” license. In addition, airline copilots, and pilots who are subject to FAA instrument flight regulations or who anticipate flying on instruments when the weather is bad must have an “instrument rating.” Pilots and copilots must also have a rating for the class of plane they can fly, (single-engine, multiengine, or seaplane) and on the specific type of plane they can fly, such as DC-3 or DC-6.

To qualify for a license as a commercial pilot, applicants must be at least 18 years old and have at least 200 hours of flight experience. To obtain an instrument rating, applicants must have at least 40 hours of instrument flying time. Applicants for an airline transport pilots’ license must be at least 23 years old and have a total of 1,200 hours of flight time, including night flying time and instrument time.

Before a person may receive any license or rating, he must pass a physical examination and a written test given by the FAA covering such subjects as principles of safe flight operations, Civil Air Regulations, navigation principles, radio operation, and meteorology. He must also submit proof that he has completed the minimum flight-time requirements and, in a practical test, demonstrate flying skill and technical competence. His certification as a professional pilot remains in effect as long as he can pass an annual physical examination. An airline transport pilot’s license expires when the pilot reaches his 60th birthday.

A young man may obtain the knowledge, skills, and flight experience necessary to become a pilot through military service or from a private flying school. Graduation from flying schools approved by the FAA satisfies the flight experience requirements for licensing. Applicants who have appropriate military flight training and experience are required to pass only the Civil Air Regulations examination if they apply for a license within a year after leaving the service. Those trained in the armed services have the added opportunity to gain experience and accumulate flying time on large aircraft similar to those used by the airlines.

As a rule, applicants for a pilot’s job with the airlines must be between 20 and 27 years old, 5 feet 7 inches to 6 feet 4 inches tall, and weigh between 140 and 200 pounds. All applicants must be high school graduates; some air-
lines require 2 years of college and prefer to hire college graduates. Physical requirements for pilots, especially in scheduled airline employment, are very high. They must have normal (20/20) vision without the aid of glasses, good hearing, outstanding physical stamina, and no physical handicaps that would prevent quick reactions. Since flying large aircraft places great responsibilities upon a pilot, the airlines use psychological tests to determine an applicant's alertness, emotional stability and maturity, and his ability to assume responsibility, command respect, and make quick decisions and accurate judgments under pressure.

Men hired by the scheduled airlines (and by some of the larger supplemental airlines) usually start as copilots, although in a few airlines they may begin as flight engineers. An applicant for a copilot's job with a scheduled airline often must have more than the FAA minimum qualifications for commercial pilot licensing. For example, although the FAA requires only 200 flying hours to qualify for such a license, the airlines generally require from 500 to 1,000 flying hours. Airlines also require a "restricted" radio-telephone operator permit, issued by the Federal Communications Commission, which allows the holder to operate the plane's radio.

All newly hired airlines pilots go through company orientation courses. In addition, some airlines give beginning copilots from 3 to 10 weeks of training on company planes before assigning them to a scheduled flight. Trainees also receive classroom instruction in subjects such as flight theory, radio operation, Civil Air Regulations, and airline operations.

The beginning copilot generally is permitted only limited responsibility, such as operating the flight controls in good weather over safe terrain. As he gains experience and skill, his responsibilities gradually are increased. When he has proved his skill, accumulated sufficient experience and seniority, and passed the test for an airline transport pilot's license, a copilot may advance to captain as openings arise. A minimum of 2 or 3 years' service is required for promotion but, in actual practice, advancement often takes at least 5 to 10 years.

A few opportunities exist for captains with administrative ability to advance to chief pilot, flight operations manager, and other supervisory and executive jobs. Most airline captains, however, spend their entire careers flying. As they increase their seniority, they obtain a better selection of flight routes and schedules which offer higher earnings. Some pilots may go into business for themselves if they have adequate financial resources and business ability. They may operate their own flying schools or air-taxi and other aerial services. Pilots may also shift to administrative and inspection jobs in aircraft manufacturing and government aviation agencies, even when they are no longer able to fly.

Employment Outlook

A moderate increase in the employment of airline pilots is expected in the 1960's. The number of pilots will be affected by the larger, faster, and more efficient jet-powered and jet-powered propeller planes now being introduced. In these planes, a pilot is able to fly many more passenger and cargo miles than he can in piston aircraft. Thus, although air transportation is expected to continue to grow in the 1960's, there probably will be little or no need for additional pilots during the next few years. However, after the period of transition to new flight equipment, the continuing increase in traffic should result in an expansion of airline activity and lead to a slow rise in the employment of pilots.

The employment of pilots outside of the airlines is expected to grow in the 1960-70 decade. Flying of business executives, crop dusting, and air taxi and patrol work are among the activities expected to increase most rapidly.

Earnings and Working Conditions

Captains and copilots are among the highest paid workers in the Nation. Those employed by the scheduled airlines averaged about $15,700 a year in domestic air transportation and $18,500 in international operations, in late 1960. Most of the senior captains on large aircraft earned well over $20,000 a year; those assigned to the new jet aircraft may earn more than $30,000. Pilots employed by the scheduled airlines generally earn more than those employed elsewhere,
although pilots who work for supplemental airlines may earn almost as much. Beginning copilots generally earned $5,400 a year. Some experienced copilots were earning as much as $15,000 a year in domestic and more than $17,000 in international flying in late 1960.

The earnings of airline pilots and copilots depend on factors such as the type, size, and speed of the planes they fly, the number of hours and miles flown, and their length of service. They receive additional pay for night and international flights. Captains, and airline copilots with at least 3 years of service, are guaranteed minimum monthly earnings which represent a substantial proportion of their earnings.

Under FAA regulations, pilots cannot fly more than 100 hours a month or 1,000 hours a year in domestic operations. Pilots in international operations are limited either to 100 hours a month, 300 hours every 90 days, or 350 hours every 90 days, depending on the size of the flight crew. In actual practice, pilots and copilots average between 72 and 82 hours’ flying time a month, plus between 15 and 35 hours in ground duties before and after their flights.

Some pilots prefer the shorter distance flying usually associated with the local airlines and commercial flying activities such as air-taxi operations, because they are likely to spend less time away from their home bases and fly mostly during the daytime. These pilots, however, have the added strain of making more takeoffs and landings daily.

Although flying does not involve much physical effort, the pilot is often subject to stress because of his great responsibility. He must be constantly alert and prepared to make decisions quickly. Poor weather conditions also make his work more difficult.

Most airline pilots are members of the International Air Line Pilots Association.

(See introductory section for Where To Go for More Information and for general information on supplementary benefits and working conditions.)

## Flight Engineers

(D.O.T. 5-80.100)

**Nature of Work**

The flight engineer is responsible for the proper functioning of the airplane so that the pilot and copilot can concentrate on guiding the plane. Before takeoffs, he inspects the tires and other outside parts of the plane and makes sure that the plane's fuel tanks have been properly filled. In the plane, he assists the pilot and copilot in making preflight checks of instruments and equipment. Once the plane is in the air, the flight engineer watches and operates many instruments and devices to check the performance of the engines and the air-conditioning, pressurizing, and electrical systems. In addition, he keeps records of engine performance and fuel consumption. He reports any mechanical difficulties to the captain and, if possible, makes emergency repairs. Upon landing, he makes certain that mechanical troubles that may have developed are repaired by airport mechanics. Flight engineers employed by the smaller airlines may have to make minor repairs themselves at those few airports where mechanics are not stationed.

Flight engineers are employed on all commercial planes that have a maximum takeoff weight of more than 80,000 pounds, which includes almost all four-engine planes, and two-engine jet planes. Almost all of the 3,700 flight engineers were working for the major scheduled airlines, which operate virtually all such planes. Most flight engineers are stationed in or near large cities where long-distance flights originate and terminate.

**Qualifications, Training, and Advancement**

All flight engineers must be licensed by the Federal Aviation Agency (FAA). A man can qualify for a flight engineer's certificate if he has had 2 years of training or 3 years of work experience in the maintenance, re-
Flight engineer checking airplane's engines and air-conditioning, pressurizing, and electrical systems.

emergency procedures and his ability to discover and correct troubles which might arise while the airplane is in the air. He must also pass a rigid physical examination every year.

Young men can acquire the knowledge and skills necessary to qualify as airline flight engineers through military training as airplane pilots, mechanics, or flight engineers. They may also attend a civilian ground school and then gain experience as an airplane mechanic. Airlines which employ mechanic-trained flight engineers usually select men from among their own senior mechanics and give them additional training for 5 or 6 months to qualify them for flight duties.

In selecting licensed flight engineers, airlines generally prefer men 23 to 35 years of age, from 5 feet 7 inches to 6 feet 4 inches tall, and in excellent physical condition. They require a high school education but prefer men with 2 or more years of college. For employment in airlines which hire mechanic-trained flight engineers, applicants must have FAA mechanic certificates. Some airlines, however, hire pilot-trained flight engineers. In these airlines, pilots usually begin as flight engineers.

A flight engineer can become a chief flight engineer for his airline. His advancement, however, comes mainly by gaining enough seniority to enable him to select the routes and schedules which offer the highest earnings. In airlines that employ pilot-qualified flight engineers, he can be promoted to copilot, and then follow the regular line of advancement open to other copilots.

**Employment Outlook**

Employment of flight engineers is expected to increase slowly during the 1960's. The number of flight engineers probably will not change much during the early part of the 1960's, as faster and more efficient jet planes continue to be put into scheduled airline service. After this transition to the new type of planes, the anticipated growth in air traffic should result in a slow increase in the employment of flight engineers.
Earnings and Working Conditions

In late 1960, the earnings of flight engineers ranged from about $550 a month for new employees to $1,600 for experienced flight engineers on jet aircraft on international flights. Many flight engineers earned between $1,000 and $1,500 a month. Average monthly earnings for all flight engineers in domestic operations was $975; those employed on international flights averaged nearly $1,200. The earnings of flight engineers depend upon such factors as size, speed, and type of the plane; hours and miles flown; length of service; and the type of flight (such as night or international). Engineers are guaranteed minimum monthly earnings, which represent a substantial proportion of their earnings. Their actual flight time is restricted, under FAA regulations, to a maximum of 100 hours a month or 1,000 hours a year in domestic flying. Flight engineers in international operations are limited either to 100 hours a month, 300 hours every 90 days or 350 hours every 90 days, depending on the size of the flight crew.

Most flight engineers belong to the Flight Engineers’ International Association. Some are represented by the International Association of Machinists.

(See introductory section for Where To Go for More Information and for general information on supplementary benefits and working conditions.)

Stewardesses

(D.O.T. 2–25.37)

Nature of Work

Stewardesses or stewards (sometimes called flight attendants) are aboard almost all passenger planes operated by the commercial airlines. Their most important job is to make the passengers’ flight safe, comfortable, and enjoyable from the time the passengers board the plane until they arrive at their destinations. Like other flight personnel, they are responsible to the captain.

Before each flight, the stewardess attends the briefing of the flight crew. She sees that the passenger cabin is in order, that supplies and emergency passenger gear are aboard, and that necessary food and beverages are in the galley. As the passengers come aboard, she greets them, checks their tickets, and assists them with their coats and small luggage.

During the flight, the stewardess makes certain that seat belts are fastened and gives safety instructions when required. She answers questions about the flight and weather, distributes reading matter and pillows, helps care for small children and babies, and keeps the cabin neat. On some flights, she serves ready-cooked meals or light refreshments. On international flights, she also gives customs information, instructs passengers on the use of emergency equipment, and repeats instructions in several languages to accommodate foreign passengers. After the flight, she completes flight reports about the passengers, cabin, and supplies.

About 9,500 stewardesses and 1,000 stewards worked for the scheduled airlines in late 1960. About 80 percent were employed by the domestic airlines, and the rest worked for international lines. Most of the stewards were employed on

[Image of stewardess serving dinner to passengers]
overseas flights where heavier work was involved, such as making up berths on the older propeller aircraft. Airliners generally carry one to six flight attendants, depending on the size of the plane and whether the flight is tourist or first-class. Most flight attendants are stationed in major cities at the airlines' main bases. A few who serve on international flights are based in foreign countries.

Qualifications, Training, and Advancement

Because stewardesses are in constant contact with passengers, the airlines place great stress on hiring young women who are attractive, poised, tactful, and resourceful. As a rule, applicants must be 20 to 27 years old, 5 feet 2 inches to 5 feet 8 inches tall, with weight in proportion to height (but not to exceed 135 pounds), and in excellent health. They must also have a pleasant speaking voice and good vision. Most major airlines require that stewardesses be unmarried and require them to resign when they marry or shortly afterwards.

Applicants for stewardess' jobs must have at least a high school education. Those with 2 years of college, nurses' training, or business experience in dealing with the public are preferred. Stewardesses who work for international airlines generally must be able to speak an appropriate foreign language fluently.

Most large airlines give newly hired stewardesses about 5 weeks' training in their own schools. Girls may receive free transportation to the training centers and also may receive an allowance while in attendance. Training includes classes in flight regulations and duties, company operations and schedules, emergency procedures and first aid, and personal grooming. Additional courses in passport and customs regulations are given trainees for the international routes. Toward the end of their training, students go on practice flights and perform their duties under actual flight conditions.

(A few airlines which do not operate their own schools employ graduates who have paid for their own training at private stewardesses schools. Girls interested in becoming stewardesses should check with the airlines before entering a private school to be sure they have the necessary qualifications.)

Immediately upon completing their training, stewardesses report for work at one of their airline's main bases. They serve on probation for about 6 months, and an experienced stewardess usually works with them on their first flights. Until a regular flight is available, they may work as reserve flight attendants, during which time they serve on extra flights or replace stewardesses who are sick or on vacation.

Stewardesses may advance to jobs as first stewardess or purser, supervising stewardess, stewardess instructor, or recruiting representative. Such jobs are few in number. However, since stewardesses work only about 2 or 3 years on the average, and then resign to get married, advancement opportunities for those who continue to work are good. Stewardesses who can no longer qualify for flying, such as those who marry, may obtain jobs in traffic or public relations work.

Employment Outlook

Young women will have thousands of opportunities to get jobs as stewardesses each year in the 1960's. Most of these openings will occur as girls marry or leave the occupation for other reasons. (About 40 percent of the employed stewardesses leave their jobs each year.) In addition, total employment of stewardesses will grow moderately as a result of the anticipated large increase in passenger traffic and the need for additional stewardesses on the larger jet planes. This rise should more than offset any adverse effect that the introduction of faster jet planes may have on the employment of stewardesses.

Young women interested in becoming stewardesses should realize that thousands of girls apply for this type of work each year, because of the glamour attached to the occupation. Despite the large number of applicants, the airlines are finding it difficult to obtain enough young women who can meet their high standards of attractiveness, personality, and intelligence.
**Earnings and Working Conditions**

An examination of union-management contracts covering several large domestic and international airlines indicates that in 1960 beginning stewardesses earned approximately $300 to $345 a month for 85 hours of flying time. Stewardesses with 2 years' experience earned approximately $345 to $375 a month. Those assigned to jet flights usually earned more.

All stewardesses employed on domestic flights averaged $340 a month; those working on international flights averaged about $450.

Since commercial airlines operate around the clock, 365 days a year, stewardesses usually work irregular hours. They may work at night, on holidays, and on weekends. They are usually limited to 85 hours of flight time a month. In addition, they devote up to 35 hours a month to ground duties. As a result of irregular hours and limitations on the amount of flying time, some stewardesses may have 15 or more days off each month. Of course, some time off may occur between flights while away from home.

Airlines generally use the seniority bidding system for assigning home bases, flight schedules, and routes. Stewardesses with the longest service, therefore, get the more desirable flights.

The stewardess' occupation is exciting and glamorous, with opportunities to meet interesting passengers and to see new places. However, the work can be strenuous and trying. A stewardess may be on her feet during a large part of the flight. She must remain pleasant and efficient during the entire flight, regardless of how tired she may be.

Most stewardesses belong to a labor union.

(See introductory section for Where To Go for More Information and for general information on supplementary benefits and working conditions.)

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**Airplane Mechanics**

(D.O.T. 5–80.100, .120 and .130)

**Nature of Work**

Airplane mechanics have the important job of keeping airplanes operating safely and efficiently. Basically, they do either “line-maintenance” work at the larger airline terminals, or overhaul work at the airline’s main overhaul base. A line-maintenance mechanic may be instructed by the flight engineer or lead mechanic on which kinds of repairs to make, or he may examine the aircraft thoroughly to discover the cause of malfunction. He then makes the necessary repairs or adjustments, or he may install a new part; for instance, he may replace an entire engine when it cannot be fixed quickly. Line-maintenance mechanics must be all-round mechanics able to make repairs on all parts of the plane. They may also have to do maintenance work such as changing oil or cleaning spark plugs.

Mechanics who do overhaul work make major repairs or perform the periodic inspections that are necessary on all aircraft. These mechanics may specialize in work on a particular part of the airplane such as propellers, landing gear, hydraulic equipment, radio and radar, instruments, or on sheet metal work. They frequently take apart a complex airplane component, replace damaged or worn parts, put the component together, and test it to make sure that it is operating perfectly.

Airplane mechanics not employed by the airlines usually do maintenance and repair work comparable with that performed by line-maintenance mechanics. However, the planes which these mechanics service may be smaller and less complex than those flown by the airlines. One mechanic frequently does the entire servicing job with little supervision, and he works on many different types of planes and engines. Mechanics who work for such employers as the certificated supplemental airlines (airlines that hold licenses to make nonscheduled flights, and fewer scheduled flights than scheduled airlines), air-taxi operators (operators of small planes carrying passengers or cargo on specially charted flights), flying schools, and independent repair shops may also do overhaul work. Independent repair shops may also do overhaul work. Independent repair shops usually specialize in
either engine, instrument, or airframe overhauls. (The airframe consists of the plane's fuselage, wings, landing gear, and other parts which are not part of the engine, propeller, or instruments.)

Airplane mechanics use many different kinds of tools in their work. These may range from simple handtools, such as screwdrivers, wrenches and pliers, to large and expensive machines and equipment designed to diagnose troubles and help the mechanic to correct them. Examples of such equipment are propeller grinding machines and magnetic and black light inspection equipment which is designed to detect flaws and cracks in metal parts.

Where Employed

Approximately 34,000 mechanics were employed by the scheduled airlines in late 1960. The Federal Aviation Agency (FAA) estimates that about 38,000 mechanics were employed by firms that are engaged in the repair of airframes, aircraft engines, or instruments (known as FAA approved repair stations). Mechanics also were employed by the certificated supplemental airlines and by firms engaged in such activities as air taxiing, crop dusting (applying seeds, fertilizer or chemicals to land or crops), and selling airplanes. Organizations which maintain fleets of planes to transport their executives, scientists, or other key personnel employ mechanics to maintain and repair these planes. Many other airplane mechanics work in aircraft manufacturing plants. (These workers, whose duties are somewhat different from those of airline mechanics, are discussed in the chapter on Occupations in the Aircraft, Missile, and Spacecraft Field. See index for page numbers).

About 18,000 civilian airplane mechanics were employed by the Air Force in late 1960. Another 9,000 worked for the Navy. The FAA employs about 500 skilled men with maintenance experience to inspect aircraft manufacturing plants; examine airline and other commercial flying organizations' aircraft maintenance methods, training programs, and spare parts stock; and test applicants for FAA mechanic licenses. This agency also employs approximately 500 airplane mechanics to maintain its own planes. Most of these men are employed at the FAA Aeronautical Center in Oklahoma City. Some mechanics are employed by other Government agencies, principally the National Aeronautics and Space Administration.

Most airline mechanics are employed in the larger cities on the main airline routes. Each airline usually has one main overhaul base where more than half of its mechanics are employed. Large concentrations of mechanics are employed in such cities as New York, Chicago, Los Angeles, San Francisco, and Miami, all of which are important domestic and international air traffic centers.

Qualifications, Training, and Advancement

Because the safety of an aircraft in flight depends largely on good mechanical operation, mechanics who are responsible for any repair or maintenance operation must be licensed. Mechanics may be licensed by the FAA as "airframe mechanics" (to work on the plane's fuselage, covering surface, landing gear, and control surfaces such as rudder or ailerons); "powerplant mechanics" (to work on the plane's engines), or "airframe and powerplant mechanics"
A repairman's license is issued by the FAA to qualified mechanics. These licenses spell out the particular repairs that the mechanics are authorized to do. Mechanics who work on radio or radar equipment are required to have at least a Federal Communications Commission Second Class Radio Telephone Operator License.

At least 18 months' experience working with airframes or engines is required to obtain an airframe or powerplant license and at least 30 months' experience working with both engines and airframes is required for the combined airframe and powerplant license. This experience is not required of graduates of mechanics' schools approved by the FAA, however. In addition to meeting these requirements, applicants must pass a written test and give a practical demonstration of their ability to do the work. Repairman licenses are issued to mechanics who are able to perform those maintenance and repair operations for which his employer has received FAA authorization.

Mechanics may prepare for the trade and their licenses by working as trainees or apprentices, or as helpers to experienced mechanics. The larger airlines train apprentices or trainees in a carefully planned 3- or 4-year program of instruction and work experience. Men who have learned aircraft maintenance in the Armed Forces are usually given credit for this training toward the requirements of apprenticeship or other on-the-job training programs.

For trainee or apprentice jobs, the airlines prefer men between the ages of 20 or 30 who are in good physical condition. Applicants should have a high school or trade school education, including courses in mathematics, physics, chemistry, and machine shop. Experience in automobile repairs or other mechanical work is also helpful.

Other mechanics prepare for their trade by graduating from an FAA approved mechanics school. Most of these schools have an 18- to 24-month program. Several colleges and universities also offer 2-year programs that prepare the student for the FAA mechanic examinations and for jobs as engineering aids and research and development technicians in aircraft manufacturing.

Mechanics are generally required to have their own handtools which they must pay for themselves. They usually acquire their tools gradually.

Several advancement possibilities are available to skilled mechanics employed by the scheduled airlines. The line of advancement is usually mechanic, lead mechanic (or crew chief), inspector, lead inspector, shop foreman, and, in a few cases, supervisory and executive positions. In most shops, mechanics in the higher grade positions are required to have both airframe and powerplant ratings. In many cases, the mechanic must pass a company examination before he is promoted. A mechanic may also become a flight engineer after he qualifies for an FAA flight engineer’s certificate and satisfies other requirements that the airline may have.

To qualify for jobs as FAA inspectors, mechanics must have broad experience in maintenance and overhaul work, including supervision over the maintenance of aircraft. Applicants for this job must also have both airframe and powerplant ratings or a combined rating.

**Employment Outlook**

A moderate increase in the employment of airplane mechanics is expected during the 1960-70 decade. The number of mechanics employed by scheduled airlines is not expected to change much during the first half of the decade because of the increasing use of jet-powered and jet powered propeller planes which have larger capacities and fly at greater speeds than piston aircraft. Also, less complex engines in the jet aircraft may reduce somewhat the amount of maintenance required. Furthermore, the airline fleet will grow only slightly. An increase in the employment of airline mechanics, however, is expected in the latter part of the 1960’s as a result of the continued large expansion of air traffic and the increase in the total number of airline planes.

The rapid growth anticipated in the amount of business executive flying and a moderate expansion of other commercial flying services will also contribute to an increase in the number of planes and, therefore, mechanics employed by
firms providing such services. The number of mechanics employed outside of the scheduled airlines has been increasing rapidly. The FAA reports that the number of approved repair stations, which do most of the maintenance and repair work on nonairline planes, increased from 376 in 1955 to about 700 in mid-1960.

Employment opportunities for airplane mechanics in the Federal Government will depend largely on the size of the Government’s military aircraft program.

**Earnings and Working Conditions**

Mechanics employed by the scheduled domestic airlines earned, on the average, $540 a month in late 1960. Other airplane mechanics generally had lower average earnings.

Airline mechanics work in hangers or in other indoor areas, whenever possible. However, when repairs must be made quickly, which is sometimes the case in line-maintenance work, mechanics may work outdoors.

Mechanics employed by most major airlines are covered by union agreements. Most of these employees are members of the International Association of Machinists. Many others belong to the Transport Workers Union of America.

(See introductory section for Where To Go for More Information and for general information on supplementary benefits and working conditions.)

### Airline Dispatchers

(D.O.T. 0–61.61)

**Nature of Work**

Dispatchers (sometimes called flight superintendents) are employed by the airlines to coordinate flight schedules and operations within an assigned area and to make sure that all Federal Aviation Agency (FAA) and company flight and safety regulations are observed. After examining weather conditions, the dispatcher makes a preliminary decision as to whether a flight may be safely undertaken. He frequently must arrange to notify the passengers and crew if there is any change from the scheduled departure time. The dispatcher confers with the captain about the quantity of fuel needed, the best route and altitude at which the plane will fly, the total flying time, and the alternate fields that may be used if landing at the scheduled airport is hazardous. The dispatcher and the captain must agree on all details of the flight before the plane leaves the airport. In some instances, the dispatcher is also responsible for keeping records and checking such matters as the availability of aircraft and equipment; the weight and balance of loaded cargo; the amount of time flown by each plane and engine; and the number of hours flown by each crew member based at his station.

After the flight has begun, the dispatcher plots the plane’s progress as reported by the captain at regular intervals by radio, and keeps him informed of changing weather and other conditions that affect his flight.

The assistant dispatcher helps the dispatcher to plot the progress of flights, secure weather information, and handle communications with aircraft.

In late 1960, only about 700 dispatchers and 200 assistants were employed in scheduled domestic and international operations, primarily at large airports in the United States. A small
number work for the large certificated supplemental airlines and for private firms which offer dispatching services to small airlines.

**Qualifications, Training, and Advancement**

Dispatchers are required to have an FAA dispatcher certificate. Assistant dispatchers do not need certification. An applicant for such a certificate may qualify, in part, if he has spent at least a year engaged in dispatching work under the supervision of a certificated dispatcher. He may also qualify by completing an FAA-approved dispatcher's course at a school or an airline training center. If an applicant has none of this schooling or experience, he may also qualify if he has spent 2 of the previous 3 years in air traffic control work, or in such airline jobs as dispatch clerk or radio operator, or in similar work in military service.

An applicant for an FAA dispatcher certificate must pass a written examination on such subjects as Civil Air Regulations, weather analysis, air-navigation facilities, radio procedures, and airport and airway traffic procedures. In an oral test, he also has to demonstrate his ability to interpret weather information, his knowledge of landing and cruising speeds and other aircraft operational characteristics, and his familiarity with airline routes and navigational facilities. A licensed dispatcher is checked periodically by his employer to make sure that he is maintaining the skills required by Federal regulations. Some experienced dispatchers are given additional instruction by their airlines at special training centers so that they may become familiar with new flight procedures and with characteristics of new aircraft. Each year he is also required to “fly the line” as an observer over the portion of the system which he services, in order to maintain his first-hand familiarity with airline routes and flight operations.

For assistant dispatcher jobs, airlines hire men who have had at least 2 years of college or an equivalent amount of time working in some phase of air transportation, such as communications. Preference is given to college graduates who have had courses in mathematics, physics, and related subjects. Some experience in flying, meteorology, or business administration is also helpful.

Most airlines fill dispatcher positions by promotion or transfer from within the company. Men are preferred who have had long experience in ground flight operations work. As a result, most openings are filled by men who have been assistant dispatchers, meteorologists, or radio operators; a few jobs are filled by men who have been pilots.

**Employment Outlook**

The increase in airline traffic anticipated in the 1960's is expected to result in a slight increase in the number of workers employed in this very small occupation. Most of the new workers will be hired as assistant dispatchers. Job openings for dispatchers will be filled mainly by promoting or transferring experienced persons already employed by the airlines.

The need for some additional dispatchers will result from the increase in air traffic, the addition and extension of routes, and the extra difficulties in dispatching jet aircraft. Additional dispatchers probably will be employed by helicopter lines and supplemental airlines to service their increased air traffic. Foreign airlines which fly between overseas points and cities in the United States will also provide a few job opportunities for dispatchers. These factors are expected to more than offset any adverse employment effect of improved radio and telephone communication facilities. As communication facilities continue to improve, a dispatcher at a major terminal center will be able to service larger areas by dispatching aircraft at the smaller airports by radio and telephone.

**Earnings and Working Conditions**

Beginning dispatchers earned between $600 and $700 a month in early 1961. Dispatchers with 10 years' service earned between $900 and $1,000 a month. Assistant dispatchers earned $400 to $500 a month to start and $455 to $560
a month after 3 years. Assistant dispatchers with FAA certificates may earn $25 a month extra. Most dispatchers are members of the Air Line Dispatchers Association.

(See introductory section for Where To Go for More Information and for general information on supplementary benefits and working conditions.)

Air Traffic Controllers

Nature of Work

Air traffic controllers are the guardians of the airways. These employees of the Federal Aviation Agency (FAA) give instructions, advice, and information by radio to pilots in order to avoid collisions and minimize delays as planes fly between airports or in the vicinity of airports. All traffic controllers must take into consideration such factors as the weather, geography, the amount of traffic, and the size, speed, and other operating characteristics of aircraft. The men who control traffic in the areas around airports are known as airport traffic controllers (D.O.T. 0-61.60); those who guide planes between airports are called air-route traffic controllers.

Airport traffic controllers are stationed at airport control towers to give all pilots within the vicinity of the airport takeoff and landing instructions, such as what flight approach and airfield runway to use and when to land and take off. They also provide pilots with weather and location information. These workers keep records of all messages received from aircraft and operate runway lights, radar screens, and other airfield equipment. They may also send and receive information to and from air-route traffic control centers about flights made over the airport.

Air-route traffic controllers are stationed at air traffic control centers to coordinate the movements of planes which are being flown “on instruments.” They use the written flight plans which are filed by pilots and dispatchers before planes leave the airport. To make sure that planes remain on course, they check the progress of flights, using radar and other electronic equipment and information received from the aircraft, other control centers and towers, and from FAA or airline communication stations.

Where Employed

More than 12,300 air traffic controllers were employed by the FAA in mid-1961. Of these, about 5,600 airport traffic controllers were employed at airport control towers located at airports with heavy traffic. A few of these jobs are located at a small number of towers and centers outside the continental United States. About 6,700 air-route traffic controllers worked in the 36 control centers scattered throughout the United States.

Qualifications, Training, and Advancement

Applicants for positions as air-route or airport traffic controller must be at least 21 years of age and able to speak clearly and precisely. They enter the field through the competitive Federal Civil Service system after passing a rigid physical examination. Applicants must have had from 2½ to 3 years’ experience in one or a combination of several fields, such as flight
communications, radar operations, dispatching, and commercial flying. Education beyond high school may be partially substituted for some of this experience; however, some experience in air-ground communications is necessary.

Successful applicants for FAA air traffic controller jobs are given 6 to 8 weeks of formal training at the FAA aeronautical center in Oklahoma City, to learn the fundamentals of air traffic control. After completing this training, they qualify for a basic air traffic control certificate. They are then assigned to an FAA control tower or center for additional classroom instruction and receive on-the-job training to become familiar with specific traffic problems. After about 6 months, they generally qualify as assistant controllers and receive additional training. After they successfully complete this training which takes a minimum of 1 year, they are eligible for jobs as airport or air-route traffic controllers. All controllers must pass a rigid physical examination every year.

Controllers can advance to the job of chief controller. After this promotion, they may advance to more responsible management jobs in air traffic control and to a few top administrative jobs in the FAA.

Employment Outlook

The employment of air traffic controllers is expected to grow rapidly during the 1960’s. Additional controllers will be employed to work in airport towers that will be built to reduce the burden on existing facilities and to handle the increasing airline traffic. More controllers will also be needed to provide services to the growing number of pilots outside of the airlines, such as those employed by companies to fly their executives. There will be additional opportunities to enter this field because many air traffic controllers leave for other jobs. The FAA estimates that there will be approximately 1,100 job openings each year between 1962 and 1966 for young men who want to become air traffic controllers.

Competition for jobs as air traffic controllers will continue to be great. For example, the U.S. Civil Service Commission reports that there were approximately 1,000 to 2,000 qualified applicants for such jobs in 1960 in each of the four Federal Aviation Agency regions in the United States (exclusive of Hawaii and Alaska). By contrast, in that same year, only about 1,200 men began their careers as air traffic controllers.

To help the controller perform the routine functions of his job, the FAA is installing modern electronic equipment, such as computers, in many air traffic control centers and airports. Despite such improvements in air traffic control equipment, there will be many opportunities to get jobs as traffic control specialists.

Earnings and Working Conditions

The monthly salary for air traffic controllers during their first 6 to 12 months of training was about $400 in early 1961. After this training period, they receive about $490 monthly during their first year as an assistant air traffic controller. Air-route traffic controllers earn $580 to $700 a month depending on the type of work they do. Airport traffic controllers earn between $535 and $910 a month depending on the amount of traffic handled at their station and how long they have been on the job. In addition, all traffic controllers receive automatic wage increases every 12 or 18 months, depending upon their job grade. In areas that handle extremely large volumes of air traffic, a chief controller may earn from $1,100 to $1,200 a month. These employees receive the same annual, sick leave, and other benefits as other Federal workers.

FAA controllers work a basic 40-hour week; however, they may work overtime, for which they receive equivalent time off or additional pay. Because control towers and centers must be operated 24 hours a day, 7 days a week, controllers are periodically assigned to night shifts on a rotating basis. However, an additional 10 percent is paid for work between 6 p.m. and 6 a.m.

Because of the congestion in air traffic, a controller works under great stress. He is responsible for directing as many as 10 to 20 or more aircraft at the same time. He must simultaneously check flights already under his con-
trol, know the flight schedules of planes approaching his area, and coordinate these patterns with other controllers as each flight passes from his control area to another.

(See introductory section for Where To Go for More Information and for general information on supplementary benefits and working conditions.)

Ground Radio Operators and Teletypists
(D.O.T. 0–61.33 and 1–37.33)

Nature of Work

Ground radio operators and teletypists transmit highly important messages concerning weather conditions and other flight information between ground station personnel or between ground station personnel and flight personnel. Radio operators use a radio-telephone to send and receive spoken messages; some operators may use a radio-telegraph to transmit written messages. Radio operators occasionally may make minor repairs on their equipment. Teletypists transmit only written messages between ground personnel. They operate a teletype machine which has a keyboard similar to that of a typewriter.

Flight service station specialists employed by the Federal Aviation Agency (FAA) do work that is similar to that of airline ground radio operators and teletypists. They use radio-telephones, radio-telegraph, and teletype machines in their work. In addition to providing pilots with weather and navigational information before and during flights, these workers relay messages from air traffic control facilities to other ground station personnel, and to pilots.

Where Employed

More than 8,000 ground radio operators and teletypists were employed in air transportation in late 1960. Flight service station specialists employed by the FAA made up about half of these employees. The scheduled airlines employed about 3,200 radio operators and teletypists. An additional 400 were employed by a cooperative organization which offers the airlines, private pilots, and corporation aircraft its services over a centralized communications system. A few hundred were employed by the Army and Navy.

FAA flight service station specialists work at stations scattered along the major airline routes; some stations are located in remote places. Ground radio operators and teletypists employed by the airlines work mostly at airports in or near large cities.

Qualifications, Training, and Advancement

Applicants for airline radio operator jobs must usually have at least a third-class Federal Communications Commission radio-telephone or radio-telegraph operator's permit, a high school education, a good speaking voice, the ability to type at least 40 words a minute, and a basic knowledge of the language used in weather reports. Teletypists must be able to type at least 40 words a minute and have had training or experience in operating teletype equipment. Applicants for jobs as radio operators and teletypists must also have a knowledge of standard codes and symbols used in communications.

To qualify for entry positions as FAA flight service station specialists, applicants must be at least 18 years old and have from 2 1/2 to 3 years' experience in some phase of air communications, traffic control, or flying. Permanent appointments are made on the basis of Federal civil service examinations.

The airlines usually employ women as teletypists, and an increasing number are being hired as radio operators. Both airline radio operators and teletypists and FAA flight service station specialists serve probationary periods, during which time they receive on-the-job training. Skill gained in communications is helpful experience for transferring into such higher paying jobs as airline dispatchers or meteorologists.
Employment Outlook

There will be several hundred opportunities each year during the 1960's for new workers to get entry jobs as radio operators or teletypists, even though the overall employment of these workers may decline somewhat. These openings will arise as workers transfer to other fields of work, retire, or die.

The number of flight service station specialists employed by the FAA is expected to remain about the same during the 1960's, but the number of radio operators and teletypists employed by airlines probably will decrease. Communications systems are becoming more automatic and centralized, and the number of aircraft equipped with radios, which allow direct communication between pilots and traffic controllers are increasing. However, employment of flight service station specialists by the FAA is not expected to decline, as more of these employees will be needed to perform more services for pilots.

Earnings and Working Conditions

The beginning salary for airline radio operators who held the minimum third-class permit generally was about $400 a month in late 1960. Workers who held a second-class license generally received $10 or $15 more a month. Beginning FAA flight service station specialists received between $360 and $440 a month, depending on the amount of traffic for which they are responsible; experienced communicators earned up to $660 a month.

Radio operators and teletypists in a number of airlines are unionized. The major union in these fields is the Communications Workers of America.

(See introductory section for Where To Go for More Information and for general information on supplementary benefits and working conditions.)

Traffic Agents and Clerks
(D.O.T. 1-44.12, .27, and .32)

Nature of Work

Selling flight tickets, reserving seats and cargo space, and taking charge of the ground handling of planes are some of the duties of traffic agents and clerks. This group of workers includes ticket or reservation agents and clerks, operations or station agents, and traffic representatives.

Reservation agents and clerks give customers flight schedule and fare information over the telephone. They record reservations as they are made and report the reservations by teletype machine to clerks in other cities so that the same space will not be sold twice. They also receive teletype messages informing them of the sale of space. Ticket agents sell tickets and fill out ticket forms including such information as the flight number and the passenger's name and destination. They also check and weigh baggage, answer inquiries about flight schedules and fares, and keep records of tickets sold. Traffic representatives contact potential customers in order to promote greater use of the airlines' services.

Operations or station agents are responsible for the ground handling of airplanes at their stations. They supervise the loading and unloading of the aircraft and sometimes do this work themselves. They see that the weight carried by the planes is distributed properly, compute gas loads and the weight carried by the plane, prepare a list of the cargo, and keep records of the number of passengers carried. They may also make arrival and departure announcements and prepare the weather forms that pilots use when they plan their routes.

Where Employed

Nearly 30,000 men and women were employed as traffic agents and clerks by the scheduled airlines in late 1960. Some were also employed by the supplemental airlines. Traffic staffs are employed principally in downtown offices and at airports in or near large cities where most airline passenger and cargo business originates. Some are employed in smaller communities where airlines have scheduled stops.
Qualifications, Training, and Advancement

Traffic agents and clerks must deal directly with the public, either in person or by telephone. For this reason, airlines have strict hiring standards with respect to appearance, personality, and education. A good speaking voice is essential because these employees frequently use the telephone or public address systems. High school graduation generally is required, and college training is considered desirable. Experience with freight, passenger, or express traffic in other branches of transportation is also desirable.

College courses in air transportation, such as traffic and fare analysis and aviation management, as well as experience in other areas of air transportation, are helpful for higher grade jobs. Both men and women are employed as reservation and ticket agents; however, most operations agents are men.

Traffic agents may advance to positions as traffic representative and supervisor. A few may eventually move up to jobs as city and district traffic and station manager. Some are able to transfer to better paying jobs with travel agencies or to the traffic departments of big corporations.

Employment Outlook

There will be many thousands of opportunities for new workers to get jobs as traffic agents and clerks in the 1960's, mainly because of high turnover. Total employment in these jobs is expected to increase only slightly. Airlines will be able to handle the anticipated large expansion of air traffic expected in the 1960-70 decade with only a slight increase in traffic personnel, because of the increased use of electronic equipment to process information. Most of the major airlines are installing new machines to record and process reservations, keep records, and perform a variety of other routine tasks. The job of reservation clerk, in particular, will be affected by this mechanization. The employment of ticket agents, however, whose main job involves personal contacts, will not be affected very much, although their paper work will be reduced considerably. In addition, improved equipment for the handling of baggage and freight will tend to reduce the need for workers in these jobs. The small group of traffic representatives probably will increase substantially as the airlines compete for new business.

Earnings and Working Conditions

Beginning salaries of reservations and ticket agents ranged from $330 to $375 a month in late 1960. Station and operations agents started at about $350 a month.

Many reservation and transportation agents belong to labor unions. Most of the organized agents belong to the Transport Workers Union of America or the Brotherhood of Railway and Steamship Clerks, Freight Handlers, Express and Station Employees. The Air Line Agents Association also represents some of these workers.

(See introductory section for Where To Go for More Information and for general information on supplementary benefits and working conditions.)
OCCUPATIONS IN THE APPAREL INDUSTRY

Well over a million men and women are employed in the factories which make clothing for the Nation’s population. This industry annually produces about $70 worth of clothing for every man, woman, and child.

The apparel industry is an important field of employment for people with a wide range of skills and interests. Some of the jobs in this industry can be learned in a few weeks; others can be filled only by persons who have had several years of experience or training.

Four out of five garment workers are women, making this industry the Nation’s largest employer of women in manufacturing. Women work mainly as sewing machine operators. Many others also work in jobs as trimmers and basters as well as in office occupations. Men usually predominate in such jobs as cutters, markers, and pressers.

Many thousands of job openings in this industry are expected each year during the 1960’s. Most of the opportunities will be for sewing machine operators.

Nature and Location of the Industry

Of the more than 1,210,000 men and women employed in the apparel industry in 1960, about 538,000 make women’s and children’s garments, such as suits, dresses, skirts, blouses, and undergarments. Approximately 450,000 of the apparel industry’s workers produce men’s and boys’ suits, coats, shirts, slacks, work clothes, undergarments, and other men’s and boys’ clothing and furnishings. Hats for men, women, and children are made by over 18,000 workers, and fur garments by about 9,000 employees. Over 60,000 workers produce accessories such as gloves, belts, handkerchiefs, robes, and raincoats. About 135,000 workers in this broad industry make other fabricated textile products, including curtains, draperies, tents, and awnings.

Apparel factories are small; only a handful of them employ more than a thousand people. The great majority of the 31,000 apparel establishments in the United States employ less than 100 workers each. Plants which manufacture garments that are subject to rapid style changes tend to be smaller than plants which make standardized garments having little or no style change.

The New York metropolitan area is the center of the Nation’s apparel industry. Nearly half of all garment plants and nearly a third of the industry’s workers are located in this area. The rest of the workers are employed in many cities throughout the United States; none of these other cities, however, has more than 5 percent of the workers. The major centers of the men’s tailored clothing industry are New York, Philadelphia, Chicago, Baltimore, Rochester, Boston, Cleveland, and Cincinnati. Jobs for workers who manufacture women’s dresses, coats, and suits are concentrated in New York, Philadelphia, Los Angeles, Boston, Chicago, and St. Louis. Dallas and Miami are two manufacturing centers which have grown rapidly in the last 15 years as a result of the trend toward highly styled garments especially designed for resort wear. Plants making underwear, children’s apparel, and work shirts are found in many Southern States including Georgia, North Carolina, Tennessee, Virginia, and South Carolina.

Occupations in the Industry

The major operations in making apparel are: Designing the garment, cutting the cloth, sewing the pieces together, and pressing the assembled garment. Generally, high-grade clothing and style-oriented garments involve more handwork and fewer machine operations than cheaper and more standardized garments. For example, making men’s high quality suits re-
quires a great amount of hand tailoring and pressing. Similarly, much hand detailing goes into a high-priced woman's fashionable cocktail dress. In contrast, standardized garments, such as men's undershirts, overalls, and work shirts are usually sewn entirely by machine.

To make the many different types, styles, and grades of garments, workers with various skills and educational backgrounds are employed in the apparel industry.

**Designing Room Occupations.** Typically, the manufacturing process begins with the designer (D.O.T. 0-46.01) who creates original designs for new types and styles of apparel. He may get ideas for designs by visiting museums, libraries, and major fashion centers in both the United States and Europe. He makes sketches of his designs and presents them to the management and sales staff for approval. The sketches include information about type of fabric, trimming, and color. The designer makes an experimental garment in muslin from approved sketches. He cuts, pins, sews, and adjusts the muslin on a dress form or on a live model until the garment matches his sketch. In large manufacturing plants, a sample stitcher (D.O.T. 4-26.202) or skilled all-round tailor (D.O.T. 4-26.201) prepares these sample garments by following the designer's sketch.

Since designing is a creative job, designers usually work on their own as long as they produce a satisfactory number of successful styles during a season. A large garment manufacturer generally has one designer and several assistants who often have specialized designing responsibilities of their own. Most small plants and plants making standardized garments do not employ designers but purchase readymade designs or patterns.

When the sample garment has been approved, it is sent to a patternmaker (D.O.T. 4-27.432) who constructs a full-size master pattern. Working closely with the designer, the patternmaker translates the sketch or sample garment into paper or fiberboard pattern pieces to be used as guides for cutting fabric. In drawing and cutting pattern pieces, the patternmaker must make allowances for pleats, tucks, yokes, seams, and shrinkage. In some shops, designers or all-round tailors make patterns, whereas in other shops the assistant designer performs the patternmaking tasks.

The master pattern serves as a guide for the pattern grader (D.O.T. 4-27.431) who makes a wide range of sizes in each garment style. In a sense, the pattern grader is a specialized draftsman. He measures the pieces that make up the master pattern and modifies them to fit all sizes. The pattern grader then draws an outline of each revised pattern piece on fiberboard and cuts out the pieces by following the outlines. After he completes a set of pattern pieces for each garment size, he attaches a label to identify the part and size of the garment.

**Cutting Room Occupations.** Workers in the cutting room prepare cloth for sewing into articles of wearing apparel. There are six basic operations in the cutting department: marking, spreading, cutting, assembling, and ticketing. In small shops, two or more of these operations may be combined into a single job. Most jobs in the cutting room are held by men.

In most plants, markers (D.O.T. 6-27.011) trace the fiberboard pattern pieces on large sheets of paper, making several carbon copies of these tracings at the same time. In plants
which make men's and boys' suits and coats, the pattern pieces are traced with chalk directly on the cloth itself, rather than on paper. In order to get the greatest number of cuttings from a given quantity of cloth, markers arrange pattern pieces so that there is just enough distance between them for the cutter to work. Figured materials must be marked in such a way that adjoining garment parts will match when the garment is assembled.

The fabric that has been selected by the designer to use with a particular garment style is laid out on long tables by spreaders. Hand spreaders (D.O.T. 6–27.016) lay out bolts of cloth by hand, neatly piling the layers into exact lengths on the cutting table. In large plants, machine spreaders (D.O.T. 6–27.015) do this work, using a machine which lays the cloth by traveling back and forth over the table.

The job of a cutter (D.O.T. 6–27.054) is to cut out the various garment pieces from the layers of cloth which are spread on the cutting table. He follows the outline of the pattern on the cloth with an electrically powered cutting knife which cuts through all the layers at once. Sometimes layers of cloth are as high as 9 inches. The work of a cutter and a marker is often combined into the single job of cutter-marker.

Other types of cutters are employed in shops making high-quality garments. Hand cutters or shapers (D.O.T. 4–27.043) trim and cut the pieces for these garments to make them conform exactly to the original pattern. Sometimes cutters sit in sewing rooms so that they can trim and shape garments as they advance through sewing operations; for example, they may trim excess canvas around armholes of a suit.

The pieces of cloth that have been cut out are prepared for the sewing room by another group of specialized workers. Assemblers, sometimes called bundlers, (D.O.T. 6–27.137) bring together and bundle garment pieces and accessories (linings, tapes, and trimmings) needed to make a complete garment. They sort the pieces by matching color, size, and fabric design. In addition, assemblers may mark locations for pockets, buttonholes, buttons, and other trimmings with chalk or thread. They identify each bundle with a ticket. The ticket is also used for figuring the earnings of workers who are paid on the basis of the number of pieces they produce. The bundles are then routed to the various sections of the sewing room.

Sewing Room Occupations. Nearly three out of four clothing workers are in some kind of sewing job. Most of the employees in these jobs are women. Sewers stitch the garment cuttings together either by machine or by hand. The quality and style of the finished garment usually determine how much handwork is involved. Generally, higher priced clothing, such as suits and coats, require more handwork than do standardized garments. In the average plant, however, the work is broken down into a large number of machine operations with some handwork when the garment nears completion.

Sewing machine operators (D.O.T. 6–27.530 through .589) use power-driven sewing machines which are generally used to stitch material together. These machines are usually heavier and capable of faster speeds than the...
Sewing machine operators are the largest group of workers in the apparel industry.

Sewing machine operators are the largest group of workers in the apparel industry.

Sewing machines found in the home. Special devices or attachments that hold buttons, guide stitches, or fold seams are often used to aid sewing operations. Some sewing machine operators specialize in a single operation such as sewing shoulder seams, attaching cuffs to sleeves, or hemming blouses. Others make garment sections such as pockets, collars, or sleeves. Still others assemble these completed sections and join them to the main parts of the garment. Some sewing machine operators are classified according to the type of machine they use, such as single-needle sewing machine operator or blind-stitch machine operator. Others are known by the type of work performed, such as collar stitcher, sleeve finisher, or cuff tacker. (Further discussion of Sewing Machine Operators is included elsewhere in this Handbook. See index for page numbers.)

Hand sewing is done on better quality or highly styled dresses, suits, or coats to produce garments which are superior in fit and drape. Hand sewers (D.O.T. 4–27.070 through .119, 6–27.071, .074, .075, .082, and .098) use needle and thread to perform various operations ranging from simple sewing to complex stitching. Many hand sewers specialize in a single operation such as buttonhole making, lapel basting, or lining stitching.

In a typical garment factory, bundles of cut garment pieces move through the sewing department where the garments take form as they pass through a series of sewing operations. Each operator performs one or two assigned tasks on each piece in the bundle and then passes the bundle to the next operator. Some plants employ work distributors (D.O.T. 9–88.40), often called floor boys or floor girls, who move garment pieces from one sewing operation to another.

At various stages of the sewing operations, inspectors (D.O.T. 4–27.121) and checkers (D.O.T. 6–27.120, .121, .125, and .126) examine garments for proper workmanship. They mark such defects as skipped stitches or bad seams, which are repaired before passing the garments on to the next sewing operation. Inspectors sometimes make minor repairs. Thread trimmers and cleaners (D.O.T. 6–27.122) remove loose threads, basting stitches, and lint from garments.

Tailoring Occupations. Tailors (D.O.T. 4–26.101 and .201) and dressmakers (D.O.T. 4–25.025 and .030) are skilled hand and machine sewers who are able to perform all or most of the sewing operations needed to make a garment. These skilled workers are usually employed in shops which specialize in making better quality or styled dresses, suits, and coats. Because their duties vary widely from shop to shop and from one type of garment to another, some tailors and dressmakers are more highly skilled than others.

All-round tailors and dressmakers are able to make a garment from start to finish by hand or by machine. Some skilled tailors who are employed in plants making men’s, women’s, and children’s outer garments may make up sample garments from the designer’s specifications. In other plants, they may also perform the duties of designer and patternmaker.

Head tailors are often known as “quality men.” They supervise all-round tailors and the machine sewers to make certain that standards of workmanship set by the shop are met and that garment parts which have imperfections are returned to the operator for correction.

Bushelman, or alteration tailors, repair de-
fects in finished garments that were rejected by the inspector. They alter garment parts that have not been sewn correctly, rearrange padding in coats and suits, and do other sewing necessary to correct defects.

Shop tailors perform specialized hand or machine sewing tasks required for making many types of high quality garments. They may set in sleeves by machine, hand-sew canvas linings in suits and coats, stitch shoulder padding, or baste collars to coat bodies. Shop tailors are usually known by the type of work they do; for example, there are coat basters, or sleeve tailors. Although the work of shop tailors is generally limited to one or two operations, some of them can do all-round tailoring because of their training and experience. In some plants, a skilled tailor may be responsible also for a thorough final inspection of garments.

Pressing Occupations. The shape and appearance of the finished garment depend to a large extent on the amount of pressing that is done during and after sewing operations. Pressing is particularly important in making high-quality garments. For example, from time to time during the sewing of suits, coats, and better quality dresses, seams are pressed open in order to produce a better fitting and neater garment and to make it easier to assemble the garment. In the manufacture of lighter weight garments, on the other hand, pressing is done only after completion of all the sewing operations.

Pressers (D.O.T. 7–57.501, .510, and .511) use various types of steam pressing machines or hand irons to flatten seams and to shape garment parts and finished garments. Pressers may specialize in one type of pressing or ironing. For example, in a shirt factory, a collar pointer (D.O.T. 6–27.211) operates a pressing machine which shapes and presses points of shirt collars; in a necktie plant, a roller presser (D.O.T. 6–27.218) feeds neckties between heated rollers of a roller press.

There are two basic types of pressers—underpressers and finish pressers. Underpressers specialize on particular garment parts, such as collars, shoulders, seams, or pockets. Their duties vary from simple smoothing of cloth and flattening of seams to skillful shaping of garment parts. Finish pressers generally do final pressing and ironing at the end of the sewing operations. Their duties vary from operating a machine which presses a dozen folded shirts at a time to hand pressing delicate ruffles on an evening gown.

Fur Shop Occupations. The apparel industry includes plants which manufacture garments made of fur. Because furs are expensive materials and difficult to work with, each operation in making a fur garment requires skilled handwork by an experienced craftsman. Although fur shops employ only about 9,000 workers altogether, a large proportion of these workers have special skills which are not found in plants that make other types of apparel.

The most skilled job in a fur garment manufacturing plant is that of a cutter who sometimes is also the foreman in the shop. A fur cutter (D.O.T. 4–21.210) selects and matches enough fur skins to make a single garment such as a fur coat or jacket. He arranges and cuts the skins on pattern pieces so that the choice sections of fur are placed where they will show. Following the sewing instruction given by the cutter, fur machine operators (D.O.T. 6–21.110)
stitch these pelts together to form the major garment sections. A fur nailer (D.O.T. 6–21.210) wets the sewn garment sections, stretches them by hand, and nails them on a board so that they will cover the pattern. When the sections are dry, the nailer removes the nails and trims the fur exactly along the outline of the pattern. The fur machine operator then finishes sewing the various sections together to make the complete garment. Fur finishers (D.O.T. 4–21.110) sew in the lining, tape edges, make pockets, and sew on buttons and loops.

Office, Sales, and Related Occupations. The majority of the administrative positions in an apparel plant are in the production department. The production manager and his assistants plan the flow of work, make up the work specifications, and supervise all the operations that are used to make a finished garment.

Clerks, bookkeepers, stenographers, and other office workers make up payrolls, prepare invoices, keep records, and attend to other paperwork required in this industry. Salesmen, purchasing agents, models, credit managers, and accountants are among other types of workers in the apparel industry. (Discussions of many of these jobs can be found elsewhere in this Handbook. See index for page numbers.)

Training, Other Qualifications, and Advancement

Training requirements for production (plant) jobs in the apparel industry range from a few days of on-the-job training to several years of training and experience. The difference in training time needed before an employee can reach his maximum speed and efficiency depends on the type of job and the worker's aptitude. Most plant workers pick up their skills while working as helpers or assistants to experienced workers. Apprenticeship is infrequent and is limited mainly to designing, cutting, or tailoring jobs. Some private and public schools in garment manufacturing centers offer instruction in occupations such as designing, patternmaking, and cutting as well as machine and hand sewing.

Physical requirements for most production jobs in the apparel industry are not high, but good eyesight and manual dexterity are essential. Many occupations are well suited for handicapped workers since the majority of the jobs are performed while seated and require little physical exertion. Older workers and women workers also perform well in a variety of jobs. Many workers in their fifties and sixties are among the industry's most skilled and productive workers. Women are employed in most of the occupations in this industry, although men hold most of the cutting, tailoring, and pressing jobs.

Designers enter the industry in various ways. Many designers receive their training by working on the job with experienced designers, by advancing from cutting or patternmaking jobs, or through apprenticeship. Some designers have worked in related fields such as designing textiles; others have attended schools or colleges which offer specialized training in design. Some young people with a background in designing may take jobs as designers with small firms and once their reputations have been established, transfer to jobs in larger, better paying firms. In large firms, young people may start as assistant designers.

A designer should have artistic ability, including a talent for sketching; a thorough knowledge of fabrics and a keen sense of color; as well as the ability to translate design ideas into a finished garment. He should also be acquainted with garmentmaking techniques so that he can make, or supervise others in the making of, sample garments.

Most patternmakers pick up the skills of the trade by working for several years as helpers to experienced patternmakers. Pattern graders and cutters are occasionally promoted to patternmaking jobs. Patternmakers must have the ability to visualize from a sketch or model furnished by the designer the size, shape, and number of pattern pieces required. Patternmakers must also have a detailed understanding of how garments are made as well as a knowledge of body proportions. Like the designer, they must also have a thorough knowledge of fabrics.

Pattern graders are usually selected from employees working in the cutting room or in other plant jobs. Training in drafting is helpful since
much of the work requires the use of drafting tools and techniques.

Most workers enter the cutting room by taking jobs as assemblers, or bundlers. Patience and the ability to match colors and patterns are necessary qualifications for these jobs. Assemblers, or bundlers, may sometimes be promoted to such jobs as spreaders. Several years of experience in the cutting room are required before an employee can become a skilled marker or cutter. A small number of the larger plants have apprenticeship programs which usually last 4 years and include training in spreading, cutting, marking, and patternmaking.

Entry into beginning hand- or machine-sewing jobs is relatively easy since there are few restrictions regarding education, physical condition, age, or sex, though women hold most sewing room jobs. Some previous training in sewing operations is preferred, but most apparel plants hire workers who have had no experience in sewing. Training is generally informal and received on the job. As a rule, inexperienced workers start by sewing rags in order to get used to operating a sewing machine. After about a week, they are assigned to a simple sewing task in the sewing room under the supervision of a section foreman or experienced coworker.

Most sewing jobs require the ability to do routine work rapidly. The same sewing operation is repeated on each identical garment piece. Since almost all these workers are paid on the basis of the number of pieces produced, any clumsiness of hand may reduce the worker's earnings. Good eyesight and ability to work at a steady and fast pace are essential for both hand- and machine-sewing jobs.

The average sewer has little opportunity for promotion beyond section foreman although some sewers have worked their way up to the job of production manager. Most sewers stay on the same general type of operation throughout most of their working lives. Promotion is largely from beginning sewing jobs to more skilled and better paid sewing jobs in the same field.

Some tailors enter the trade through apprenticeship programs, but most of them become tailors by first acquiring experience in less skilled operations. The skills of the trade are usually learned by working beside experienced tailors. Training time varies from the few months required to become a shop tailor to the many years of experience necessary to become a head tailor. Generally, men are employed in tailoring jobs, but more and more women are entering the field.

Head tailors and all-round tailors must be able to do all the operations involved in making a garment and also be familiar with their firm's quality standards. Much more training is needed by these tailors than by the bushelman whose work is restricted to the correction of defects, or by the shop tailors, who are limited to one or two sewing operations.

The head tailor is considered to be the top craftsman since he must have the most skill and experience. A possible path of promotion is from bushelman to all-round tailor to head tailor. In some cases, all-round tailors with artistic ability may advance to assistant designer or designer. Supervisory jobs in apparel plants are often filled by workers who were once all-round tailors. Promotion for shop tailors is limited because of the specialized nature of their job, although some may have an opportunity to become section foremen or bushelmen. Some tailors open their own tailoring shops since the amount of capital needed for such a business is low. Highly skilled tailors and dressmakers may qualify for jobs as fitter or alteration tailor in department stores, clothing stores, cleaning and dyeing shops, or custom tailoring shops.

Pressers usually begin as underpressers working on simple seams and garment parts. This job can be learned in a very short time. After the pressers gain experience, they work on more difficult operations and eventually may be promoted to the job of finish presser. Pressing, like tailoring, is one of the few needle trades in which workers can find similar employment in stores and in cleaning and dyeing shops. There is some transferring back and forth between pressing jobs inside and outside the apparel industry.

Employment Outlook

The apparel industry will offer many thousands of job opportunities for new workers each
year in the 1960's. Although total employment in the industry is expected to increase only moderately above the 1.2 million employed in 1960, a considerable number of employment opportunities in the needle trades will arise because of the need to replace workers who retire, die, or transfer out of this area of work, or to replace women who leave their jobs to marry, or have children.

Demand for apparel in the 1960's will grow substantially and will be the major reason for the rise in employment. The increased need for apparel will be due mainly to clothe our rapidly growing population, but other factors will also be important. For example, the number of people in their teens and early twenties will rise greatly in the next decade, and these are the age groups in which spending for apparel is greatest. The trend toward more workers in clerical, sales, professional, and other white-collar occupations will increase the demand for apparel since these workers spend more for apparel than other workers. Increasing numbers of working women, particularly those in secretarial and other office jobs that require “dressing up,” will stimulate apparel purchases. Men, also, are buying more clothing that is highly styled because they are becoming more fashion-conscious.

Changing buying habits of consumers, however, will largely offset the greater demand for apparel. Despite rising incomes, people have been spending only a small share of their earnings for apparel. They are spending more on automobiles, television sets, radios, and similar products. Also, young couples tend to buy homes in the suburbs and spend more of their incomes for household products rather than apparel.

Taking into consideration all the factors that affect employment in this industry, it is expected that the number of workers will increase moderately by 1970. However, most opportunities for young people to enter the apparel industry will occur because of the large numbers of people who will leave the industry. About 80 percent of needle trades’ employment is made up of women, and a large number of them leave the industry each year to marry or to raise families. Also, because there are more older workers in this industry than in other industries, many opportunities will arise for younger workers to replace those who retire or die.

Most of the opportunities for employment will be in sewing machine operator jobs because this is the largest occupational group and because this group is made up mostly of women. Some job openings will occur in tailoring occupations in which a large proportion of the employees are older workers. There will be a limited number of new employment opportunities in designing, patternmaking, and cutting room jobs. These relatively small occupational fields have little employment turnover because workers in these jobs have high earnings and prestige.

The nature of the jobs in this industry will remain about the same since it is much less mechanized than most manufacturing industries. However, some new and improved equipment that is being introduced speeds production and reduces the physical and skill requirements of certain jobs. For example, new compressed-air pressing machines which require less physical effort than the older pressing machines make it possible to employ more women in these jobs.

One development, still in its infancy, may bring about a change in the manufacture of clothing and thus affect employment. This is the production of disposable garments, such as protective coveralls, made of cheap, felted fabrics similar to heavy quality paper napkins. If paper clothing should become widespread, bonding or fusing of seams rather than sewing, would be the most economical method of manufacture. Substitution of these methods would reduce the need for sewing machine operators.

**Earnings and Working Conditions**

Earnings in the apparel industry as a whole are well below the general level for all manufacturing industries. In 1960, the average earnings of production workers in this industry were $55.69 a week or $1.56 an hour, compared with $90.91 a week or $2.29 an hour for those in all manufacturing industries. Production workers in this industry generally worked fewer hours per week than those in manufacturing as a whole. Production workers have much higher earnings in some kinds of garment fac-
OCCUPATIONS IN THE APPAREL INDUSTRY

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Stories than in others. For example, those making women's suits, coats, and skirts averaged $69.01 a week in 1960, whereas those producing men's work shirts averaged $42.60 a week. There is also a wide range of earnings among the different occupations in the apparel industry and the States in which garment factories are located. The following tabulation indicates the approximate average hourly earnings or the range of such earnings in selected jobs in three apparel industries in 1960:

**Men's and boys' coats and suits**

<table>
<thead>
<tr>
<th>Occupation</th>
<th>Approximate average hourly earnings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cutters</td>
<td>$2.50</td>
</tr>
<tr>
<td>Markers</td>
<td>2.40</td>
</tr>
<tr>
<td>Spreaders</td>
<td>1.80</td>
</tr>
<tr>
<td>Pressers, machine, finish</td>
<td>2.45</td>
</tr>
<tr>
<td>Sewing machine operators</td>
<td>1.97</td>
</tr>
<tr>
<td>Tailors, all-round</td>
<td>2.15</td>
</tr>
</tbody>
</table>

**Range of approximate average hourly earnings in 10 major garment centers**

**Women's and misses' coats and suits**

<table>
<thead>
<tr>
<th>Occupation</th>
<th>Range of approximate average hourly earnings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cutters and markers</td>
<td>$2.25-$3.55</td>
</tr>
<tr>
<td>Pressers, machine</td>
<td>2.35-4.35</td>
</tr>
<tr>
<td>Sewers, hand</td>
<td>1.65-2.50</td>
</tr>
<tr>
<td>Sewing machine operators</td>
<td>1.55-2.50</td>
</tr>
<tr>
<td>Thread trimmers</td>
<td>1.05-1.40</td>
</tr>
</tbody>
</table>

**Range of approximate average hourly earnings in 12 major garment centers**

**Women's and misses' dresses**

<table>
<thead>
<tr>
<th>Occupation</th>
<th>Range of approximate average hourly earnings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cutters and markers</td>
<td>$2.02-$3.21</td>
</tr>
<tr>
<td>Pressers, hand</td>
<td>1.25-4.26</td>
</tr>
<tr>
<td>Sewers, hand</td>
<td>1.25-1.85</td>
</tr>
<tr>
<td>Sewing machine operators</td>
<td>1.56-2.58</td>
</tr>
<tr>
<td>Thread trimmers</td>
<td>1.12-1.39</td>
</tr>
</tbody>
</table>

Because most production workers in this industry are paid on the basis of the number of pieces they produce, their total earnings depend mainly upon speed as well as skill. Sewing machine operators, hand sewers, and pressers are generally paid on a piecework basis. Cutters are paid either piecework rates or hourly wages, depending upon the practice in the area or shop in which they work. Most of the other workers, including tailors, patternmakers, graders, inspectors, and work distributors, are paid by the hour or week.

Almost all apparel employees work in shops which have labor-management contracts. New employees in plants which have these agreements are required to join the union after 30 days of employment. These agreements deal with such subjects as wages; hours of work; vacation and holiday pay; seniority; health, insurance, and pension plans; and other employment matters. Among the unions to which apparel workers belong are the Amalgamated Clothing Workers of America (ACWA), International Ladies' Garment Workers' Union (ILGWU), and United Garment Workers of America (UGW). The ILGWU sponsors vacation resorts for union members and their families. Both the ACWA and the ILGWU operate health centers for garment workers in major producing areas.

Workers in the apparel industry can expect to lose very little work time as a result of strikes or other work stoppages because the industry has had many years of peaceful labor-management relations. However, workers making certain types of garments may have layoffs of several weeks during slack seasons. Generally, such layoffs occur more often in plants making seasonal garments, such as women's coats and suits, than in plants producing standardized garments, such as pajamas and men's shirts which are worn all year long. In many plants, the available work during slack periods is divided so that workers can be assured of at least some earnings.

Plants in which garment workers are employed are generally clean, without the dust, grease, or noise often found in many other manufacturing plants. Large shops are generally in modern factory buildings with ample space and good lighting. Many have cafeterias and health clinics with a trained nurse on duty. Small apparel plants which are located in older garment manufacturing centers have much less favorable working conditions than modern plants.

Most sewing jobs are performed while sitting and are not physically strenuous. The working pace is rapid because workers' earnings depend on their production speed. In addition, many tasks are extremely monotonous. Serious accidents among sewers are rare, although a sewer may occasionally pierce a finger with a needle. On the other hand, pressing may be strenuous work and sometimes is done in hot and humid rooms.

Working conditions in cutting rooms and in designing rooms are pleasant. Jobs in these operations are more interesting and less monot-
onous than most other apparel jobs. Moreover, since accuracy, skill, as well as individual talent and judgment in these jobs are valued more than speed, the work pace is less rapid.

Where To Go for More Information

Information relating to vocational and high schools which offer training in designing, tailoring, and sewing may be obtained from the Division of Vocational Education of the Department of Education in the State capital. Information concerning apprenticeships may be obtained from the Apprenticeship Council of the State Labor Department or the local office of the U.S. Employment Service. Some local Employment Service offices offer training courses for sewing machine operators. Others give tests to determine hand-eye coordination.

Information of a general nature may be obtained from the following sources:

- Amalgamated Clothing Workers of America, 15 Union Square, New York 3, N.Y.
- Clothing Manufacturers Association of U.S.A., 220 Fifth Ave., New York 1, N.Y.
- International Association of Garment Manufacturers, 347 Fifth Ave., New York 16, N.Y.
- International Ladies' Garment Workers' Union, 1710 Broadway, New York 19, N.Y.
- United Garment Workers of America, 31 Union Square, New York 3, N.Y.
OCCUPATIONS IN THE ATOMIC ENERGY FIELD

The rapid growth in the use of atomic energy and the continuing development of new applications will provide many thousands of job opportunities for young people in the atomic energy field in the 1960–70 decade. In 1960, approximately 200,000 workers had jobs in a variety of atomic energy activities. Large numbers of these workers were employed in research and development work. Others were engaged in such activities as the production of nuclear fuels and the design and manufacture of nuclear reactors. Scientists, engineers, technicians, and craftsmen accounted for a large proportion of atomic energy workers.

Applications of Atomic Energy

Atomic energy is a tremendous source of heat and radiation which can be used in many important ways for both peaceful and military purposes. A major use of this energy is the production of commercial electricity, using nuclear reactors as the heat source. A nuclear reactor (see chart 27) can be thought of as an atomic furnace, although there is no fire and no combustion in the usual sense. Several reactors are already producing electricity which is being fed into electric utility lines for public consumption, and many others are being built. Rapid...
progress is being made in the development of portable nuclear power plants to provide electricity and heat for buildings at remote installations. Nuclear reactors are being used to power submarines and shortly will be used to propel surface ships. Intensive research toward developing nuclear propulsion systems for missiles, space vehicles, and some types of ground vehicles is in progress. Reactors which have been built primarily as radiation rather than heat sources are used for many kinds of research and may be used, for example, to initiate chemical reactions and to produce radioisotopes.

Radioisotopes, once considered only byproducts of nuclear reactors, have become immensely valuable as research tools in agriculture, medicine, and industry and for use in industrial inspection and control devices. Their value lies in their unique property of emitting radiation which can alter materials and which can be detected even in minute quantities by sensitive instruments.

One important use of radioisotopes is as tracers. Radioisotopes can be placed in the blood stream of men and animals, for example, and their movements traced by instruments. In medicine, this aids the physician in diagnosing a patient’s illness. Tracers may also be used to study such diverse processes as the assimilation of fertilizer by plants and the wear on automobile engine parts.

Radioisotopes are also used as high intensity radiation sources to kill bacteria, to destroy cancerous tissue, to sterilize insect pests, and to develop better strains of plants. They are used in radiography units (similar to X-ray machines) to detect flaws in metal castings and welds. Radioisotope gages are used to measure and control, automatically, the thickness of products manufactured in sheet form and the level of liquids in closed containers.

How Atomic Energy Is Produced

Atomic energy, or more accurately nuclear energy, may be produced through two processes, called fission and fusion. In fission, the nucleus of an atom is split, thereby releasing energy in the form of heat and radiation. In fusion, energy is produced by combining the nuclei of two atoms. The detonation of nuclear bombs is an application of the explosive release of the tremendous energy created through the fission and fusion processes. Nonweapon applications require that release of this energy be carefully controlled and regulated so that it proceeds at a manageable rate. Scientists have developed practical methods of controlling the fission reaction, but have not yet mastered control of the fusion (or thermonuclear) reaction.

Controlled fission is produced in a nuclear reactor. The reactor, being a kind of furnace, needs fuel to operate. The principal source material for reactor fuel is natural uranium, which contains a small percentage of the readily fissionable material, uranium U–235. Although natural uranium may be used as reactor fuel, a more concentrated fuel, called “enriched uranium,” can be made by separating the U–235 atoms from the remaining atoms which are difficult to fission. U–235 is the only naturally occurring material that undergoes fission readily, but two manmade fissionable materials (plutonium and uranium U–233) can also be used as reactor fuel.

Fissionable fuel is placed in the nuclear reactor in a particular arrangement with certain other elements. The fuel will sustain a “chain reaction”—the continuous fissioning (or splitting) of the nuclei of atoms—resulting in the release of energy in the form of heat and radiation. When the fissionable atoms in the fuel split, they release neutrons (so-called “atomic bullets”) which can be made to split other fissionable atoms. These, in turn, release additional neutrons which can similarly split more atoms. This is how the fission process is maintained. The level of the chain reaction is carefully controlled, usually by inserting special neutron-absorbing rods into the fuel chamber, or “core” of the reactor. In this way, the rate of the fission reaction and of the energy produced can be regulated or stopped completely.

Thus, harnessed atomic energy is produced in a nuclear reactor in the form of heat and radiation. However, if reactors are to be used for power, the heat must be removed from the reactor and put to work. This is done by converting the heat to electricity through the use of conventional generating equipment. The
major difference between nuclear and conventional electric power stations is that a nuclear reactor replaces the conventional steam-generating boiler fueled with coal, gas, or oil.

During the fission process, neutrons and other forms of nuclear radiation are released. Nuclear radiation, which is identifiable only by sensitive instruments, can be ruinous to equipment and highly dangerous to personnel. Therefore, special metals which are resistant to damage by radiation are used in reactors and great care is taken to protect personnel; for example, the nuclear reactor is housed in a special container and surrounded by shielding materials, such as concrete, water, and lead, to absorb nuclear radiation.

A valuable byproduct of reactor operation is the production of radioisotopes. The major method of producing radioisotopes is to expose stable atoms of various elements to the neutrons emitted from the reactor core. Radioisotopes can also be produced by bombarding materials placed in a particle accelerator (also known as an "atom smasher"), a machine which accelerates electrically charged particles to speeds of thousands of miles per second.

Nature of the Atomic Energy Field

Many different kinds of research and industrial activities are required for the production and application of nuclear energy. These include the mining, milling, and refining of uranium bearing ores; the production of nuclear fuels; the manufacture of nuclear reactors, reactor components, and nuclear instruments; the production of special materials for use in reactors; the designing, engineering, and construction of nuclear facilities; the operation and maintenance of nuclear reactors; the disposal of radioactive wastes; the processing and packaging of radioisotopes; the production of nuclear weapons; and research and development work.

These activities are performed in plants in many different industries, as well as in laboratories and other types of facilities. Much of this work, such as ore mining and milling, manufacture of heat transfer equipment, and construction of facilities, differs little from similar nonatomic energy work. Other activities, such as manufacture of the fuels needed to run reactors, are unique to the atomic energy field.

The Federal Government supports most of the basic atomic energy activities. The Atomic Energy Commission (AEC) directs the Federal Government's atomic energy program and regulates the use of nuclear materials by private organizations. Most of the AEC's work program is contracted out to private organizations, including the operation of Commission-owned facilities. The AEC-owned facilities include laboratories, uranium processing plants, nuclear reactors, and weapon manufacturing plants. More than half of all workers in the atomic energy field are employed in these facilities. Private firms in their own installations are engaged in every type of atomic energy activity except development and production of military weapons and certain nuclear fuel processing operations.

A large amount of research and development work is done in the atomic energy field. Much of this work is carried on by the AEC-owned research centers and by university and college laboratories, other nonprofit institutions, and industrial organizations under Commission contracts. Additional research in atomic energy is carried on without financial assistance from the AEC.

Jobs in the atomic energy field are found in every State, although employment is most heavily concentrated in Tennessee, New Mexico, California, and Ohio.
Employment consisted of semiskilled and unskilled workers in production work, and plant protection and other service workers. The following tabulation shows the distribution of employment among major occupational groups as reported in a 1960 Bureau of Labor Statistics’ survey covering about two-thirds of the workers in the atomic energy field:

<table>
<thead>
<tr>
<th>Total employment</th>
<th>125,900</th>
<th>100.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engineers</td>
<td>15,100</td>
<td>12.0</td>
</tr>
<tr>
<td>Scientists</td>
<td>9,500</td>
<td>7.5</td>
</tr>
<tr>
<td>Administrative and other professional workers</td>
<td>12,400</td>
<td>9.9</td>
</tr>
<tr>
<td>Clerical and other office workers</td>
<td>18,500</td>
<td>14.7</td>
</tr>
<tr>
<td>Technicians and other technical workers</td>
<td>18,400</td>
<td>14.6</td>
</tr>
<tr>
<td>Skilled workers</td>
<td>23,900</td>
<td>19.0</td>
</tr>
<tr>
<td>All others</td>
<td>28,100</td>
<td>22.3</td>
</tr>
</tbody>
</table>

Although some engineers in the atomic energy field are highly trained in nuclear technology, engineers in all major engineering fields are employed. Mechanical engineer is probably the largest single job specialty, but large numbers of electrical, chemical, nuclear reactor, civil, and metallurgical engineers are also employed. Many of these engineers do research and development work, whereas others are engaged in designing nuclear reactors, nuclear instruments, and other equipment used in the atomic energy field, and in the supervision of construction activities or the operation of production plants.

Mainly because of the emphasis given to basic and applied nuclear research, a large number of scientists are employed by research laboratories and other organizations engaged in atomic energy work. Physicists and chemists predominate, but nearly all types of scientists are employed, including many mathematicians, metallurgists, biological scientists, and health physicists.

Among the large number of technicians who are employed in the atomic energy field to assist engineers and scientists in research and development work and in the designing and testing of equipment and materials are draftsmen; electronic, instrument, chemical, and other engineering and physical science technicians; and radiation monitors.

Many highly skilled workers are employed in the atomic energy field because of such factors as the need to fabricate special parts and equipment for use in experimental and pilot work and the need for large maintenance forces to care for the considerable amount of complex equipment and machinery. Machinery repairmen and millwrights, who maintain and repair machinery and other mechanical equipment, and all-round machinists are employed extensively in most atomic energy activities. A large number of chemical operators, who operate chemical-processing equipment, are employed in the production of defense materials and reactor fuel materials. In addition, many other skilled workers are employed, such as electricians, carpenters, plumbers, pipefitters, and steamfitters in construction and maintenance activities; welders and sheet-metal workers to fabricate reactor components and other equipment; and instrument repairmen to install and repair electronic and other instruments. The following tabulation shows the employment of skilled workers by occupation, as reported in the 1960 survey mentioned previously:

<table>
<thead>
<tr>
<th>Skilled workers, total</th>
<th>23,900</th>
</tr>
</thead>
<tbody>
<tr>
<td>Machinery repairmen and millwrights</td>
<td>3,640</td>
</tr>
<tr>
<td>Chemical operators</td>
<td>3,230</td>
</tr>
<tr>
<td>All-round machinists</td>
<td>3,070</td>
</tr>
<tr>
<td>Electricians</td>
<td>2,260</td>
</tr>
<tr>
<td>Plumbers, pipefitters, and steamfitters</td>
<td>1,460</td>
</tr>
<tr>
<td>Welders</td>
<td>1,320</td>
</tr>
<tr>
<td>Instrument repairmen</td>
<td>1,270</td>
</tr>
<tr>
<td>Carpenters</td>
<td>720</td>
</tr>
<tr>
<td>Sheet-metal workers</td>
<td>650</td>
</tr>
<tr>
<td>Instrument makers</td>
<td>540</td>
</tr>
<tr>
<td>Tool and die makers</td>
<td>500</td>
</tr>
<tr>
<td>Other skilled workers</td>
<td>5,240</td>
</tr>
</tbody>
</table>

The following is a brief description of the types of workers employed in some important atomic energy activities. In several of these activities, such as mining, the percentage distribution of employment by occupation is similar to that in comparable nonatomic work.

Uranium Mining. The 4,100 workers employed in nearly 1,000 uranium mines in 1960 had jobs similar to those in the mining of other metallic ores. Their jobs were largely concentrated in the Colorado Plateau area of the Far West, in the States of New Mexico, Utah, Colorado, Wyoming, and Arizona. A relatively few mines ac-
counted for the bulk of production and employment. Most workers in uranium mines were in production jobs, such as miners and drillers in underground mines, and truckdrivers, bulldozer operators, and machine loaders in open pit mines. A small proportion of the employees in uranium mining were in professional jobs, such as mining engineer and geologist.

Uranium Ore Milling. In uranium mills, metallurgical and chemical processes are used to extract uranium from the mined ore. The basic steps included are ore preparation (primarily crushing and grinding), leaching to extract the uranium, and product recovery—operations similar to those used in the milling of other metallic ores. There are 25 uranium mills, most of which are located on the Colorado Plateau. They employed 3,400 workers in 1960, distributed among major occupational groups in the following proportions:

<table>
<thead>
<tr>
<th>Occupational Group</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total employed</td>
<td>100</td>
</tr>
<tr>
<td>Engineers and scientists</td>
<td>6</td>
</tr>
<tr>
<td>Administrative and other professional workers</td>
<td>9</td>
</tr>
<tr>
<td>Clerical and other office workers</td>
<td>8</td>
</tr>
<tr>
<td>Technicians and other technical workers</td>
<td>7</td>
</tr>
<tr>
<td>Skilled workers</td>
<td>27</td>
</tr>
<tr>
<td>Other workers</td>
<td>43</td>
</tr>
</tbody>
</table>

More than a third of the skilled workers were machinery repairmen and millwrights, and nearly 20 percent were chemical operators. Chemists, metallurgists, and metallurgical engineers accounted for over half of the engineers and scientists employed in the uranium mills.

Uranium Refining and Enriching. There are three uranium refining plants, in which milled uranium is chemically processed to remove impurities and then converted to metal or intermediate chemical products for reactor fuel preparation. Conventional chemical and metallurgical processes are used, but they must meet more exacting standards than in most other industries. The output of the refining plants may be further processed to obtain enriched uranium. Enriched uranium, used as the fuel for most reactors, is produced in three huge plants. In 1960, nearly 12,000 workers were employed in these plants, distributed among major occupational groups in the following proportions:

<table>
<thead>
<tr>
<th>Occupational Group</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total employment</td>
<td>100</td>
</tr>
<tr>
<td>Engineers and scientists</td>
<td>10</td>
</tr>
<tr>
<td>Administrative and other professional workers</td>
<td>13</td>
</tr>
<tr>
<td>Clerical and other office workers</td>
<td>13</td>
</tr>
<tr>
<td>Technicians and other technical workers</td>
<td>7</td>
</tr>
<tr>
<td>Skilled workers</td>
<td>36</td>
</tr>
<tr>
<td>Other workers</td>
<td>21</td>
</tr>
</tbody>
</table>

Among skilled workers, the largest single occupation was chemical operator in processing operations. Maintenance workers, particularly in the highly automatic uranium enriching plants, accounted for a large proportion of the skilled workers. Chemical engineers and chemists accounted for half of the engineers and scientists at these plants. Many of the technicians worked in chemical analytical laboratories associated with production processes.

Reactor Manufacturing. An estimated 20,000 workers were employed in the design and manufacture of nuclear reactors and unique reactor components in 1960. Reactor manufacturers do extensive research and development work on reactors and auxiliary equipment, design the reactor, and generally fabricate some of the intricate components, such as fuel elements, control rods, and reactor cores. Many reactor components are similar to standard power equipment and, therefore, are purchased from plants manufacturing such products.

About a third of the employees in firms that design and manufacture reactors were professional and administrative workers. Engineers alone represented about 20 percent of employment, with nuclear reactor engineers, who are specialists in reactor technology, and mechanical engineers predominating. Among the scientists, the largest group were physicists, but there were also many chemists, mathematicians, and metallurgists. Assisting these engineers and scientists were a great many draftsmen, engineering aids, and physical science technicians.

Skilled workers were employed by reactor manufacturers in experimental, production, and maintenance work. All-round machinists, weld-
ers, and sheet-metal workers accounted for about two-thirds of these craftsmen. Other craftsmen, such as instrument makers, machinery repairmen, instrument repairmen, and electricians, were also employed. In addition, reactor manufacturers employed nuclear reactor operators to operate experimental and test reactors.

Fuel elements and other unique components are fabricated not only by reactor manufacturers, but in specialized plants. Many mechanical engineers and metallurgists, technicians, all-round machinists, welders, and machine tool operators were employed in the fabrication of fuel elements in 1960.

**Reactor Operation and Maintenance.** Only a few hundred workers were engaged in the operation and maintenance of nuclear reactors producing commercial electricity in 1960. Workers typically employed in the operation of a nuclear power station include mechanical and electrical engineers, health physicists, instrument technicians, chemical analysts, radiation monitors, reactor operators, and other power plant operators and attendants. Among the employees needed to maintain and repair reactors are machinery repairmen, instrument repairmen, electricians, welders, and pipefitters.

**Research and Development Facilities.** The Atomic Energy Commission research and development laboratories and other research facilities (which are operated for the AEC by colleges and universities and industrial concerns) are the major centers for basic and applied nuclear research in the physical, engineering, and life sciences and the development of nuclear reactors and other nuclear equipment. In 1960, these facilities employed about 42,000 workers, distributed among major occupational groups in the following proportions:

<table>
<thead>
<tr>
<th>Total employment</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engineers</td>
<td>15</td>
</tr>
<tr>
<td>Scientists</td>
<td>13</td>
</tr>
<tr>
<td>Administrative and other professional workers</td>
<td>9</td>
</tr>
<tr>
<td>Clerical and other office workers</td>
<td>17</td>
</tr>
<tr>
<td>Technicians and other technical workers</td>
<td>22</td>
</tr>
<tr>
<td>Skilled workers</td>
<td>12</td>
</tr>
<tr>
<td>Other workers</td>
<td>12</td>
</tr>
</tbody>
</table>

Metallurgist, shielded by a lead glass window and concrete walls, operates controls of Master-Slave Manipulator in working with radioactive materials.

Approximately half of the employees in the AEC research and development facilities were engineers, scientists, and supporting technical personnel. Among the engineers and scientists were physicists, mechanical engineers, electrical engineers, chemists and chemical engineers, mathematicians, nuclear reactor engineers, metallurgists and metallurgical engineers, biological scientists, and health physicists. Assisting scientists and engineers were many draftsmen, electronic technicians, physical science and engineering aids, biological technicians, and radiation monitors.

Administrative and clerical workers together accounted for another large proportion of employment. The skilled worker group included large numbers of all-round machinists, electricians, and machinery repairmen and millwrights, as well as substantial numbers of tool and die makers, welders, instrument makers, and pipefitters. Nuclear reactor operators were employed to operate research and test reactors and many service workers were employed in plant protection and security operations.

In addition to the atomic energy research.
performed by the AEC research and development facilities, additional research is performed by educational institutions and other nonprofit institutions, and by industrial concerns in their own laboratories. Like the AEC facilities, these laboratories employed a high proportion of workers in scientific, engineering, and other technical jobs.

**Production of Plutonium and Other Defense Materials.** Special defense materials, such as plutonium, are produced in nuclear reactors at two giant production facilities located in the States of Washington and South Carolina. A great deal of research and development work is also done in these plants. Nuclear weapons and other defense materials are manufactured in other plants which are almost exclusively devoted to production activities, such as the metallurgical and chemical processing of materials and the manufacture and assembly of weapons components.

More than 35,000 workers were employed in these defense production facilities in 1960, distributed among major occupational groups in the following proportions:

<table>
<thead>
<tr>
<th>Percent</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Engineers and scientists</td>
</tr>
<tr>
<td>11</td>
<td>Administrative and other professional workers</td>
</tr>
<tr>
<td>13</td>
<td>Clerical and other office workers</td>
</tr>
<tr>
<td>9</td>
<td>Technicians and other technical workers</td>
</tr>
<tr>
<td>24</td>
<td>Skilled workers</td>
</tr>
<tr>
<td>33</td>
<td>Other workers</td>
</tr>
</tbody>
</table>

About one out of every four workers in the defense production facilities was a skilled worker in production and maintenance jobs. Included among these skilled workers were large numbers of machinery repairmen and millwrights, chemical operators, all-round machinists, electricians, instrument repairmen, pipefitters, welders, boilermakers, operating engineers, and other building trades craftsmen.

More than 600 nuclear reactor operators and assistants were employed at the two facilities producing plutonium and other special defense materials.

**Other Atomic Energy Activities.** Several thousand workers were employed in 1960 to produce special materials such as beryllium, zirconium, and hafnium for use in reactors. About two-thirds of these workers were in production, maintenance, and service jobs. Chemical operators, all-round machinists, and machinery repairmen were the most numerous among the skilled workers. Some chemists and chemical engineers were also employed.

Many thousands of workers were engaged in designing and constructing nuclear reactor housing, atomic energy laboratories, and reactor fuel processing plants in 1960. Many mechanical, civil, and electrical engineers, designers, and draftsmen were employed in the design of these facilities. Pipefitters, electricians, carpenters, welders, boilermakers, operating engineers, and other building trades craftsmen were employed in the actual construction.

Several thousand workers were employed in 1960 by companies that manufacture reactor control instrumentation, radiation detection and monitoring devices, and other instruments for the atomic energy field. Production of these instruments involves work similar to that in instrument manufacturing in general. Engineers and scientists represented a substantial proportion of employment in such companies. Among the technicians and craftsmen were draftsmen, electronic technicians, machinists, and instrument makers.

A few companies specialize in the manufacture of particle accelerators— machines which enable scientists to study the structure and properties of the elementary particles that make up the nucleus of an atom. Workers typically employed in the design and manufacture of these machines include mechanical and electrical engineers, physicists, electronic technicians, and machinists.

Other workers in the atomic energy field in 1960 were engaged in such activities as processing and packaging radioisotopes, manufacturing radiography units and radiation gages, packag-
ing and disposing of radioactive wastes, and industrial radiography. Among the workers in these activities were engineers, chemists, chemical technicians, radiographic equipment operators (radiographers), remote handlers and packagers of radioisotopes, and mechanics and other workers who repair equipment containing radioisotopes.

**Government Employment.** The Atomic Energy Commission, which directs the Federal Government’s atomic energy program, employed nearly 6,700 workers in its national and field offices in 1960. About 1,000 engineers and scientists were employed by the Commission, including personnel in nearly every major engineering and scientific occupation, such as nuclear reactor, civil, and electrical engineers, chemists, health physicists, and physicists. Since the AEC is primarily an administrative and regulatory agency, nearly 70 percent of Commission employees were in administrative and other professional positions and in clerical and other office jobs. Another large group was engaged in protective and security activities.

In addition to those employed by the Atomic Energy Commission, Government employees were engaged in atomic energy work in other Federal agencies and in health and labor departments of State and local governments. Their duties involved atomic energy research and application, and preparing and carrying out radiation health and safety measures. Outside the AEC, most of the scientists, engineers, and other professional and supporting workers in atomic energy work in Federal Government agencies were employed by the Department of Defense, Geological Survey, Department of Agriculture, and Department of Health, Education, and Welfare. The Department of Health, Education, and Welfare in cooperation with the AEC aids States in establishing measures to meet radiation health hazard problems.

**Unique Atomic Energy Occupations.** Most of the occupations discussed in the preceding sections are similar to those found in other industrial activities, although engineers, scientists, and other workers may have job titles unique to the atomic energy field (such as nuclear engineer, radiation chemist, and nuclear reactor operator), and their jobs may require some specialized knowledge of atomic energy in addition to the training typical of their occupations. A detailed discussion of the duties, training, and employment outlook for most of these occupations appears elsewhere in this Handbook. (See index for page numbers.)

The health physics’ occupations, which are unique to the atomic energy field, and some other occupations that are unique in that they require training in the handling and use of radioactive materials or radiation producing equipment are discussed briefly in the following sections.

**Health physicists** (also called radiological physicists) are concerned with the problem of radiation safety for workers in atomic energy installations and for people in the surrounding community. They have a very responsible job of protecting individuals and property from the hazards of radiation by detecting radiation and controlling exposures to it. These professional workers usually are assisted by radiation monitors. In 1960, there were more than 700 health physicists (left) using meter containing a geiger counter to make sure personnel are not exposed to dangerous amounts of radiation.
physicists in radiation protection work, research, or teaching.

Health physicists are responsible for planning and organizing radiological health programs at atomic energy facilities. For example, they set up standards of inspection and establish procedures for protecting employees and eliminating radiological hazards. They supervise the inspection of work areas with potential radiation hazards and prepare instructions covering safe work procedures for use by employees working in these areas. Health physicists are also responsible for the inspection of shipments of equipment and materials and for the inspection of radioactive waste disposal activities to insure compliance with Government standards and regulations. Another duty involves the preparation of reports on radioactive contamination, radiation levels, and radiation exposure.

Health physicists may also plan and supervise training programs dealing with radiation hazards and may advise public authorities on methods of dealing with radiation hazards. In some cases, they are employed on research projects dealing with the effects of human exposure to radiation and may develop procedures to be followed in using radioactive materials. Finally, they assist in the development of better methods and equipment for the detection and control of radiation hazards. These scientists are employed at nuclear reactor sites and wherever there are sizable amounts of radioactive materials.

Radiation monitors (also called health-physics technicians) generally work under the supervision of health physicists. They use special instruments to monitor (check) work areas, tools, and equipment to detect radioactive contamination. They monitor incoming and outgoing shipments of equipment and materials for radiation levels and contamination. Soil, water, and air samples are taken to determine radiation levels. Monitors may also collect and analyze radiation monitoring equipment worn by workers, such as film badges and pocket detection chambers, to measure each worker's exposure to radiation.

Monitors inform their supervisors when a worker's exposure to radiation or the level of radiation in a work area approaches specified maximum permissible limits and they recommend work stoppage in potentially unsafe areas. They calculate the amount of time that personnel may work in contaminated areas, considering maximum radiation exposure limits for workers, as determined by a health physicist, and the radiation level in the area. Monitors may also determine clothing requirements and other safety precautions to be followed by workers entering radiation zones.

Other duties may include instructing workers in radiation safety procedures, checking and servicing radiation detection instruments, and maintaining records on individual radiation exposures and the location and intensity of radioactivity in contaminated areas.

In addition to the health physics occupations, other job specialties require training which is unique to the atomic energy field. For example, although a nuclear reactor operator's job in a nuclear power station is similar to a boiler operator's job in a conventional power station, he must learn to operate the controls of a nuclear reactor rather than the controls of a conventional steam-generating boiler. In addition, reactor operators may perform work in connection with reactor fuel handling operations, such as the loading and unloading of nuclear fuel. Power reactor operators may also be trained as turbine operators and switchboard operators in order to provide interchangeability of jobs, and in small nuclear power plants there may be some combining of these jobs.

Nuclear reactor operators who work with research and test reactors check reactor control panels and adjust controls to maintain specified operating conditions within the reactor, such as power and radiation levels, working under the direction of the scientist in charge of the experiment. They also assist in setting up and conducting tests and experiments; for example, they may insert objects into the reactor core for exposure to radiation.

Accelerator operators set up and coordinate the operation of particle accelerators. The operator adjusts the machine controls to accelerate electrically charged particles, in accordance with instructions from the scientist in charge of the experiment, and sets up target materials which are to be bombarded by the
accelerated particles. He may also assist in the maintenance of the equipment.

Radiographers take radiographs of metal castings, welds, and other objects by adjusting the controls of an X-ray machine or by exposing a source of radioactivity to the object to be radiographed. These workers, taking into consideration the object to be radiographed, select the proper type of radiation source and type of film to use and apply standard mathematical formulas to determine exposure distance and exposure time. While taking radiographs, they use radiation detection instruments to monitor the work area for potential radiation hazards. Radiographers also remove and develop the film or plate and may assist in its analysis.

Many other specialized workers are employed in the atomic energy field. Hot-cell technicians operate remote-controlled equipment to test radio-active materials which are placed in hot cells—rooms which are enclosed with radiation shielding materials, such as lead and concrete. By controlling “slave manipulators” (mechanical devices which act as a pair of arms and hands) from outside the cell and observing their actions through the cell window, these technicians perform standard chemical and metallurgical tests involving radioactive materials. Hot-cell technicians may also enter the cell wearing protective clothing (after clearance by a radiation monitor) to set up experiments or to decontaminate the cell and equipment. Decontamination men have the primary duty of decontaminating equipment, plant areas, and materials exposed to radioactive contaminants. They use radiation-detection instruments to locate the contamination; eliminate it by the use of special equipment, detergents, and chemicals; and then verify the effectiveness of the decontamination measures. Waste-treatment operators operate heat exchange units, pumps, compressors, and other equipment to decontaminate and dispose of radioactive waste liquids. Waste disposal men seal contaminated wastes in concrete containers and transport the containers to a burial ground or arrange for sea burial. Radioisotope-production operators use slave manipulators and other equipment to prepare radioisotopes for shipping and to perform chemical analyses to ensure that radioisotopes conform to specifications. The tasks performed by employees in the above five jobs may also be done by chemical process operators.

Training, Other Qualifications, and Advancement

The training and educational requirements and advancement opportunities for most workers in atomic energy activities are generally similar to those for comparable jobs in other fields and are discussed elsewhere in this Handbook under the specific occupations. (See index for page numbers.) However, specialized training is required for many workers because the atomic energy field is a relatively new field of work, and one which requires rigorous work standards in both its research and production activities and has unique health and safety problems.

Engineers and scientists at all levels of professional training are employed in the atomic energy field. Many of them have had advanced training, particularly those engaged in research, development, and design work. Of the scientists employed by major AEC contractors in 1958, about one in three had a Ph.D. degree or equivalent academic training. The proportion of engineers with Ph.D. degrees is small. However, graduate training is preferred for an increasing number of engineering jobs, and training in nuclear engineering is available almost exclusively at the graduate level.

Specialized knowledge of nuclear energy is not required for many engineering and scientific positions in the atomic energy field, although some basic knowledge of it is preferred. However, specialized knowledge of nuclear energy is essential for some engineers and scientists. For example, health physicists must be specially trained in health physics, and other positions may require engineers specially trained in nuclear engineering or chemists with special training in radiochemistry. This specialized training may be obtained through taking graduate work at a university or on-the-job training. It emphasizes problems dealing with the properties and control of radiation and its effects on materials or living systems.

Colleges and universities have rapidly expanded their facilities and curriculums in order
to provide training in nuclear energy. Engineers and scientists who plan to specialize in the atomic energy field generally take graduate work in nuclear energy, although introductory or background courses may be taken at the undergraduate level. Some colleges and universities award graduate degrees in nuclear engineering or nuclear science. Others offer graduate training in these fields, but award degrees only in the traditional engineering or scientific fields.

Craftsmen in some atomic energy jobs may need more training than most craftsmen in comparable nonatomic jobs. Stricter performance requirements may be needed because of the extreme precision that is usually required to ensure efficient operation of equipment and because complex equipment and machinery must be maintained. For example, pipefitters on atomic projects may have to fit pipe to tolerances of less than one ten-thousandth of an inch and work with pipe made from rare metals costing more than $1,000 a foot. Welders, who may also work with rare metals, may have to maintain higher standards for reliability of work than in most nonatomic fields. Craftsmen in the atomic energy field generally obtain the required special skills through on-the-job training. Most AEC installations have apprentice training programs to develop craft skills. Some union craft training programs give particular attention to the special work requirements of the atomic energy field.

The following discussion of training, education, and other qualifications relates to jobs which are unique to the field of atomic energy or which require specialized training which is unique to the field. Such training mainly gives workers an understanding of radiation, methods of handling radioactive materials or radiation producing equipment, and procedures to follow when working in radioactive areas.

Employers prefer that health physicists have a bachelor's degree in physics, chemistry, or engineering and a year or more of graduate work in health physics. In some cases, related technical training and experience can be substituted for part of the academic requirement. Under an AEC fellowship program, health physicists attend lectures at a university during the academic year to obtain a fundamental knowledge of radiation physics and biophysics, instrumentation, the interaction of radiation with matter and living systems, and the principles of permissible radiation exposure and prevention of undesirable exposure. During the summer months, they work at Commission installations on problems of monitoring (measurement of radiation level), instrument adjustment, shielding, and waste disposal associated with the operation of nuclear reactors and particle accelerators, the processing of nuclear fuels, and the handling of radioisotopes.

To qualify for on-the-job training as a radiation monitor, a high school education with courses in mathematics, physics, and chemistry usually is sufficient. Completion of some college courses in the physical or biological sciences is preferred and experience in working with laboratory equipment is desirable. Radiation monitors must become familiar with some of the characteristics of radiation, maximum permissible radiation exposure levels, and methods of calculating exposure periods. They must also learn how to use radiation detection instruments.

Nuclear power reactor operators need a basic understanding of reactor theory and a working knowledge of reactor controls. The minimum requirement for an operator trainee usually is a high school education, although college-level training may be required by some employers. To become a fully qualified operator, the trainee must get experience in power station operation and complete 6 months to 1 year of intensive on-the-job training in reactor theory and operation. Power reactor operators usually are selected from conventional power plant personnel having experience as boiler or turbine operators. Operators of research and test reactors must also be high school graduates. Preference is given to those who have completed courses in science and engineering at a college level. They need from 2 to 4 years of on-the-job training, covering all phases of reactor operation, before being considered fully qualified. Workers who operate the controls of private nuclear reactors must be licensed by the AEC. To qualify for a license, the trainee must pass an operating test, a written test given by the Commission, and a medical examination.
To qualify for on-the-job training as an accelerator operator, a high school education, including courses in mathematics and physics, is usually required. Extensive training in electronics or a bachelor's degree in engineering or physics may be required for operators of very high-energy machines. Accelerator operators receive on-the-job training covering operating, repair, and safety procedures. Such training may last from 2 to 7 months or more, depending on the type of accelerator. To qualify for on-the-job training as radiographers, a high school education, including courses in mathematics, chemistry, and physics is usually sufficient. High school graduates with some mechanical experience usually can qualify for on-the-job training as hot-cell technicians. They are given about 1 to 2 years of in-plant training. High school graduates can become decontamination men after receiving 3 to 15 months of formal technical instruction and on-the-job training. For the job of radioisotope-production operator, a high school education, with courses in chemistry, is usually required. One or 2 years of on-the-job training may be necessary to become fully qualified. High school graduates can qualify as waste-treatment operators, but experience in reading electronic instruments or in a chemical laboratory is desirable. After 15 to 18 months of on-the-job training in the operation of equipment and use of instruments, they are fully qualified. High school graduates can also qualify for employment as waste-disposal men. They receive on-the-job training in the operation of equipment and the avoidance of radiation hazards.

Many other workers in the atomic energy field also need special training because of the presence of potential radiation hazards. Employees who work in the vicinity of such hazards should have some training in the nature of radiation and the procedures to follow in case of its accidental release. Workers who handle radioisotopes or maintain radioisotope gages need a basic knowledge of health physics in addition to specific training related to their particular jobs. Technicians, chemical process operators, and maintenance craftsmen in nuclear power plants and fuel processing facilities also require some health physics training if they work with radioactive materials or perform work in radiation contaminated areas. Such training is generally provided through in-plant programs—for example, through apprentice training programs for craftsmen—and may range from less than an hour to several weeks or more, depending largely on the degree of potential exposure to radiation. In some States, workers may obtain such training through adult vocational educational programs.

Individuals who handle classified (restricted for reasons of national security) data or who work on classified projects in the atomic energy field must have a security clearance. This is a finding based on an investigation of a person's character, loyalty, and associations. All Atomic Energy Commission employees must have such clearance.

The Atomic Energy Commission supports extensive on-the-job and specialized training programs to help prepare scientists, engineers, technicians, and other workers for the growing atomic energy field. The AEC offers graduate fellowships in specialized fields, trains people at its contractor-operated facilities, conducts training schools, and provides uranium and other materials as well as financial aid to educational institutions.

Several kinds of graduate fellowships are offered by the AEC. The largest number of fellowships are offered for the study of nuclear energy technology. About one hundred and fifty such fellowships are available for first, intermediate, and final years of graduate work at 53 participating universities. The prerequisite is a bachelor's degree in engineering or physical science with courses in mathematics through differential equations.

Fellowships in radiological (or health) physics provide for 9 months' training at a university, followed by 3 months' training at a Commission laboratory. Approximately 90 such fellowships are available each year to students with bachelor's degrees in biology, chemistry, engineering, or physics with courses in mathematics through calculus. About 10 additional fellowships are available for advanced training in health physics leading to a doctorate. The AEC also offers about 10 fellowships each year leading to the master's degree in industrial
hygiene for students who hold bachelor's degrees with a major in physics, chemistry, or engineering.

Additional educational and training opportunities are offered in cooperative programs arranged by the AEC laboratories with colleges and universities. Temporary employment at AEC-owned laboratories is available to faculty members and students. Engineering undergraduates may work at the laboratories and other Commission facilities on a rotation basis with classroom studies, and graduate students may do their thesis work at laboratories.

The AEC sponsors institutes at which college and high school faculty members can obtain training in the latest developments in nuclear energy technology, in radiation biology, and in the use and safe handling of radioisotopes. Courses in health physics are offered by the AEC to State and local government employees who will be concerned with licensing and inspecting functions in the atomic energy field. The AEC also sponsors the Oak Ridge Institute of Nuclear Studies, which conducts a school to train physicians, scientists, and engineers in radioisotope technology.

Many Commission contractors offer technical and graduate instruction at their own plants or at nearby colleges to prepare new employees for work in their organizations or to give further training to experienced personnel. Some contractors send employees outside the immediate area to receive graduate level instruction, and pay their transportation, tuition, and other expenses. Contractors often give tuition assistance to employees desiring to attend college and university courses on their own time.

**Employment Outlook**

Continued employment growth is expected in most atomic energy activities in the 1960's as a result of the growth of existing uses of atomic energy and the development of new applications. Job opportunities will be especially good for highly trained technical and skilled personnel. In addition to opportunities provided by employment growth, a few thousand additional job openings will result each year from the need to replace workers who transfer to other fields of work, or who retire or die.

Increasing research and development expenditures should lead to further employment growth in laboratories engaged in atomic energy work. More workers are already employed in such laboratories than in any other atomic energy activity. Employment is also expected to continue to increase in the design and manufacture of nuclear reactors and reactor components, in the manufacture of nuclear instruments, and in the processing and packaging of radioisotopes. As more nuclear reactors are built and put into operation, employment will increase both in the operation and maintenance of reactors and in such related activities as the fabrication and reprocessing of reactor fuel elements and the disposal of radioactive wastes. In contrast, employment in the mining, milling, refining, and enrichment of uranium probably will increase little, and may even decline.

The expanding number of activities developing from the widespread application of nuclear energy will create an increased need for trained technical workers and skilled craftsmen. Particular need will exist for scientists (such as physicists, chemists, mathematicians, metallurgists, biological scientists, and health physicists) and engineers (such as mechanical, electrical, chemical, nuclear reactor, and metallurgical). There will also be an increased need for electronic and other technicians and for skilled workers, such as machinery repairmen, machinists, electricians, plumbers and pipefitters, welders, and instrument repairmen.

**Earnings and Working Conditions**

Information on earnings in individual occupations in atomic energy activities is not available. However, indications are that the earnings of the work force as a whole in some nuclear energy activities were higher than in most non-nuclear energy activities. In 1960, blue-collar workers employed by contractors at AEC laboratories and other installations had average straight-time hourly earnings of $2.84. This compares, for example, with an average of $2.29 an hour for production workers in all manufacturing industries.
Professional workers employed at AEC installations averaged $792 a month in base pay in 1960, and other white-collar workers (largely clerical and other office personnel), $462. (Earnings data for many of the occupations found in the atomic energy field are included in the statements on these occupations elsewhere in this Handbook. See index for page numbers.)

Most workers in the atomic energy field receive 2 or 3 weeks' vacation with pay, depending on their length of service. In addition, most firms in this field have group life, health, and accident insurance coverage and retirement plans.

Working conditions in uranium mining, milling, instrument and auxiliary equipment manufacturing, and facilities construction are similar to those in comparable nonatomic energy activities. In other atomic energy activities, in which the major proportion of workers in the field are employed, working conditions generally are unusually good. Buildings and plants are relatively new and are well lighted and ventilated. Equipment, tools, and machines are modern and sometimes the most advanced of their type. The surroundings are also pleasant because the buildings are often spread out over wide land areas. In some cases, plants are located in remote areas.

Extensive safeguards have been established to insure the health and safety of workers in the atomic energy field. However, only a small proportion of employees in the atomic energy field work in areas where direct radiation dangers exist.

The AEC regulates the possession and use of radioactive materials and AEC personnel inspect nuclear facilities to insure compliance with the AEC's health and safety requirements. Because the hazards of radiation are unique, constant efforts are being made to provide better safety standards and regulations.

Workers in uranium mines are subject to some hazard from the presence of radioactive gas in the air, which, if inhaled over a number of years, could cause lung injury. However, practically all mines have mechanical ventilation systems to reduce concentrations of this gas. Uranium mills and other fuel processing facilities employing modern processes usually have no difficulty in maintaining safe working levels of radioactivity.

The AEC and its contractors, who employ more than half of all atomic energy workers, have maintained a good safety record. In 1960, the average number of disabling injuries for all AEC operations was 1.7 for each million employee hours worked, compared with an average of over 11 for all manufacturing industries. Of the lost-time injuries in 1960, only one was caused by radiation. From 1943 through 1960, only 35 lost-time injuries in AEC operations were due to overexposure to radiation.

Most plant hourly paid workers belong to unions. Among unions which have members in the atomic energy field are unions in the Metal Trades Department, AFL-CIO, such as: The International Association of Machinists; the International Brotherhood of boilermakers, Iron Shipbuilders, Blacksmiths, Forgers and Helpers; the International Brotherhood of Electrical Workers; the International Chemical Workers Union; and the United Association of Journeymen and Apprentices of the Plumbing and Pipe Fitting Industry of the United States and Canada. The Oil, Chemical and Atomic Workers International Union also represents workers in this field.

Where To Go for More Information

Information about employment in the atomic energy field may be obtained by writing to the Office of Industrial Relations, Atomic Energy Commission, Washington 25, D.C.
AUTOMOBILE MANUFACTURING OCCUPATIONS

In the 60 or more years of its existence, the automobile industry has grown from an experiment concerned with the development of a horseless carriage to one of the most important of America's manufacturing industries. This industry, which in the 1890's occupied the attention of a few inventive mechanics working in small sheds and shops, is now among the Nation's largest employers with about three-fourths of a million workers.

By the end of 1960, an estimated 73.9 million cars, trucks, and buses were traveling the Nation's streets and highways. About 7.9 million of these motor vehicles were built during 1960. The industry has produced an average of nearly 7 million vehicles each year since 1950.

Not only has the automobile industry helped to develop existing industries but it has also created new ones. Many businesses, including automotive repair shops, service stations, and truck and bus transportation facilities, have been created as a result of the automobile. Moreover, this industry is the most important consumer of such basic commodities as steel, rubber, and plate glass.

The automobile industry, like other large industries, is a source of employment for workers with widely different levels of education and skill. Requirements for jobs vary from college degrees for engineers and other professional and technical personnel to a few hours of on-the-job training for some of the less skilled assemblers, material handlers, and custodial workers. The largest number of employees work in factory (or plant) occupations. Plant jobs range from the skilled tool and die makers, millwrights, and electricians to the less skilled machine tool operators, assemblers, material handlers, and custodial workers. A great number of automotive employees also work in office and administrative jobs as clerks, business machine operators, stenographers, accountants, purchasing agents, market analysts, and industrial relations personnel.

Nature and Location of the Industry

This industry's tremendous growth over the years has been due mainly to the mass production of standardized parts. Thousands of identical parts are produced by workers whose jobs are divided into a limited number of operations on high-speed automatic machinery. These mass-produced parts are then put together by assemblers to form the completed vehicle. Because of the minute division of labor, cars can be driven off assembly lines at the astounding rate of one every 45 seconds.

The automobile industry in 1960 consisted of more than 2,000 plants which manufactured parts or subassemblies and assembled these parts into motor vehicles of all types. These plants ranged in size from huge assembly plants employing many thousands of workers to parts plants employing a small number of workers. About 50 percent of the 780,000 automobile workers in 1960 were employed in establishments with 2,500 or more employees.

Hundreds of companies supply the parts or subassemblies for new automobiles and also produce the replacement parts necessary to keep the millions of vehicles already on the road in operation. These firms often specialize in producing certain parts—for instance, brakes and clutches. About a third of the automobile workers are employed in these parts-manufacturing plants. Only a few companies produce the completed vehicles—passenger cars, trucks, buses, and special-purpose vehicles, such as ambulances, fire engines, and taxicabs.

Automobile manufacturing is concentrated in the Great Lakes region where roughly four out of every five workers are so employed. Michigan alone accounted for about 45 percent of the industry's employment in 1960. Ohio, Indiana,
and New York together had another 25 percent. Seven other States each employed 10,000 or more workers. They were Wisconsin, California, Illinois, Pennsylvania, Missouri, New Jersey, and Georgia.

The Detroit metropolitan area is the center of the industry. About one out of every three of the Nation’s automobile workers is employed within its industrial area, which includes the nearby communities of Dearborn and Pontiac. Several other Michigan cities, especially Flint, Lansing, and Saginaw, employ large numbers of automobile workers. The Great Lakes region has many other important centers: Cleveland, Lorain, Toledo, and Cincinnati, Ohio; South Bend, Indianapolis, and Fort Wayne, Ind.; Chicago, Ill.; Buffalo, N.Y.; and Milwaukee and Kenosha, Wis.

Much of the automobile manufacturing on the East Coast is centered in the New York–North-eastern New Jersey–Philadelphia industrial area in such localities as Newark, Paterson, Linden, and New Brunswick, N.J.; and New York, N.Y. The Los Angeles industrial area is the leading automobile manufacturing center in the Pacific Coast region. The Bay area (Oakland) is another automobile manufacturing center in California.

How Automobiles Are Made

The modern mass-produced automobile represents an engineering triumph matched by few other mechanical products. Mass production of standardized parts and assembly-line manufacturing methods enable the automobile industry to produce millions of these complex products each year.

Motor vehicles are produced in three major stages. The first step is preliminary designing and engineering, the second is the production of motor vehicle parts and subassemblies, and the third is the final assembly of parts into completed vehicles.

Planning for New Model Production. Approximately 3 to 4 years of designing, planning, and testing often precede the actual production of an automobile. Stylists constantly strive to improve the appearance of the automobile. They work closely with engineers and other technical personnel who are concerned with improving mechanical operation, design, and safety. The creative designs of the stylists are transferred to drafting boards and then skilled modellers convert the blueprints into clay, wood, and plastic models of the new automobile. From these models, refinements in styling and design of the new car are developed.

For the mass production of the car, master dies are made from the finally accepted model. Throughout this initial stage of producing an automobile, companies which produce parts work closely with the automobile manufacturers on questions of designing, engineering, and tooling. Problems of production methods, costs, and scheduling also are worked out long before the actual manufacturing process begins.

Making Automobile Parts. The manufacture of motor vehicle parts and subassemblies is the second stage of automobile production. After the design of the new model automobile is developed, automobile parts plants begin produc-
tion of the various components of the car. Because parts are made by many different firms, rigid quality control is maintained to insure that the parts fit properly on the final assembly line. Quality control is also stressed to insure the safety of the finished automobile product.

Motor vehicle parts are made of many different materials. Although most of the parts are made from steel, other materials such as aluminum, copper, and zinc also are used. Some of the parts contain plastic, rubber, fabric, or glass.

Metal parts for motor vehicles can be shaped in several ways depending upon the purpose for which the part is to be used, the size of the part, and the type of metal used. The principal methods of shaping metal are casting, forging, machining, and stamping. Most metal parts are produced by foundry workers, forge shop workers, machining workers, and operators of stamping or pressing machines.

Castings are made in foundries where molten metal is poured into molds and allowed to cool and harden into the desired shape. Bulky parts, such as engine blocks, generally are made by the casting process. In the forge shops, metal is heated and then shaped into the desired form by mechanical steam hammers and forging presses.

The forging process shapes metal objects which are required to withstand great stress, such as automobile crankshafts, axles, and connecting rods. Generally, parts that are produced by casting or forging must undergo further processing, usually machining, before being ready for assembly.

Machining is the metalworking process generally best adapted for the production of parts to precise sizes. It is a process of cutting or chipping excess metal from rough castings, forgings, and bars by the use of power-driven machine tools. Among the more common types of machine tools are lathes, boring machines, drill presses, grinding machines, milling machines, and gear cutters. The machine tools are used to turn, drill, grind, cut, and finish metal parts to exact sizes. Hundreds of machining operations are required to complete some of the more intricate parts, such as engine blocks, pistons, ring gears, connecting rods, camshafts, and crankshafts.

The automobile industry has taken the lead in trying to develop continuous automatic production for many machining operations. This approach to production has been called "automation," which is the use of instruments to direct and control manufacturing processes. In applying automation to machining processes, automobile manufacturers have linked automatic machine tools to perform a variety of machining operations. Less labor is required because the parts or pieces being machined are not handled manually.

For example, one large motor vehicle producer has built an automated engine plant in which a rough engine block goes through 555 different cutting, drilling, and grinding operations with the use of little or no manual labor. The engine block is moved into and out of load stations mechanically, machined automatically by a battery of machine tools, and transferred by conveyors to the next machining operation. Much of the inspection is done automatically. The machine tools, the conveyors, and the inspection equipment often are controlled by electronic, hydraulic, or air control mechanisms. Workers tend the automated lines of machine tools by watching the panel-control boards for interruptions of the machines' normal functioning.

Metal stamping is another important manufacturing operation. The large sections of the body of the car are formed from sheet steel shaped by huge electronically controlled presses. Smaller parts of the vehicle also are stamped or pressed out of sheet steel or aluminum.

The production of parts does not entirely consist of metalworking operations. For example, to make body parts rustproof and attractive, they are spray painted and then baked in ovens lined with infrared lights. Also, upholstery for the car interior is cut, sewn, and installed.

Throughout the production of parts, numerous inspections are made to insure that the quality of the assembled vehicles will meet established standards. Such inspection begins with a spot check of incoming raw materials from which parts are to be made. All machined
Inspector checking engine before installation in automobile.

parts are carefully inspected so that they will not vary from the specified size limits.

Assembling the Final Product. The last stage of motor vehicle manufacturing takes place on the final assembly line. Final assembly is the process of putting together in sequence the individual parts and the subassemblies, with the completed vehicle rolling off the end of the line. Overhead wires feed electric power to nut tighteners, welding equipment, and other tools used by workers on the assembly line. A conveyor carries the motor vehicle forward while men at work stations attach the necessary parts and subassemblies in proper sequence.

Generally, large and heavy subassemblies, such as the engine and the body, are lowered by hoists into position on the chassis as it comes down the line. The finishing accessories, such as bumpers, hubcaps, and floor mats, are added near the end of the line. Finally, the headlights are adjusted, the wheels are aligned, and gasoline is pumped into the fuel tank, and thus another new motor vehicle is driven off the line. The finished car is inspected before it leaves the factory.

As the many chassis move down the assembly line, "banks" of material located in aisles along the line are continually fed to the assemblers in accordance with a careful system of scheduling arranged by the production control department. Behind the movement of the parts and subassemblies to the assembly line is the work of the materials control men who, months before, coordinated the movement of material from outside suppliers with a planned production schedule.

The sequence of the models to be built may be transmitted to the various stations along the line by either teletype or telex Autograph. The information on color and on the special equipment desired in each car is obtained from car orders placed by automobile dealers. By this scheduling program, cars of different colors and types follow each other down the assembly line—for example, a light blue sedan may be followed by a beige station wagon.

Automobile Manufacturing Occupations

About 780,000 workers were employed in hundreds of occupations in the automobile industry in 1960. Approximately 8 percent of the workers were employed in scientific, engineering, and technician jobs. Many thousands of other workers were in administrative, supervisory, and clerical positions. The rest of the automobile workers were employed in assembling, metalworking, inspecting, material handling, maintenance, and other plant occupations. The duties and training requirements of some of the important occupations are described briefly below. (Detailed discussions of professional, technical, mechanical, and other occupations found in the automobile industry as well as in many other industries are given elsewhere in this Handbook, in the sections covering individual occupations. See index for page numbers.)

Professional and Technical Occupations. The modern automobile is a product of the research, design, and developmental work of thousands of
engineers, chemists, metallurgists, physicists, mathematicians, statisticians, and other professional and technical personnel employed by the automobile companies. According to a Bureau of Labor Statistics survey of manpower in American industry, about 32,000 scientists and engineers were employed in the automobile industry in January 1959. Engineers make up the largest group of professional and technical workers in the automobile industry. Automobile companies hire engineers specializing in mechanical, electrical, industrial, metallurgical, and other fields. For example, the mechanical engineer continually seeks ways of improving the engine, transmission, or other parts of the automobile through research and development and better design. The electrical engineer works on the design of electrical parts such as, ignition systems, voltage regulators, and generators. The industrial engineer concentrates on the layout of plant equipment, improved processes, and production scheduling. The industry also employs civil, chemical, and ceramic engineers.

Although most of these professional workers are employed in research and development departments, some also supervise the more technical production jobs. For example, a metallurgist may be employed to supervise the melting operations in the precision casting and forging departments.

The industry also employs many semiprofessional workers or technicians, such as draftsmen, engineering aids, laboratory assistants, and other technical aids to assist engineering and scientific workers. About 25,000 technicians were so employed in January 1959, according to the Bureau of Labor Statistics survey mentioned above.

Administrative, Clerical, and Related Occupations. Many types of workers are employed in the industry to perform the many administrative functions needed to operate the automobile companies. Included in this group are executives who determine, among other things, how many vehicles to produce, what styles to make, what prices to charge, which parts the company should produce and which parts it should buy, and where it is best to locate plants. On the second level of administrative jobs are those such as personnel manager and purchasing agent, who direct individual departments or special phases of operations. Among those who assist the administrators are accountants, lawyers, market analysts, economists, statisticians, and industrial relations experts. This large industry also has many supervisory employees in charge of specific groups of office or plant workers.

A large staff of clerical workers also is employed by the industry, including secretaries, stenographers, bookkeepers, clerks and typists, key punch operators, and business machine operators. A large proportion of these office workers are women.

Plant Occupations. About three-fourths of the workers in the automobile industry are employed in plant jobs. Most of these workers make automobile parts, assemble them into the complete vehicles, and put the finishing touches on the cars and trucks. Other plant workers service and maintain the vast amount of machinery and equipment needed for automobile manufacturing. The plant work force is predominantly male. Only about 10 percent of the workers in automobile plants in 1960 were women.

After the stylists, engineers, and draftsmen have planned and designed the new model car, the production process gets under way. First, the parts must be made. Parts are principally metal and are shaped by a variety of metal-forming processes which require workers in a number of metalworking occupations. For example, bodies must be stamped out by huge presses, cylinder blocks must be cast in foundries, crankshafts must be forged in forge shops, and pistons must be ground by machine tools.

Machining occupations. Automobile parts are manufactured to precise dimensions by machining workers. One of the largest metalworking occupations in the automobile industry is that of machine tool operator. These workers operate power-driven machines (machine tools) which hold both the piece of metal to be cut and a cutting instrument, or “tool,” and bring them together so that the metal can be cut, shaped, drilled, or ground. The job titles of these workers depend on the type of machine tool they
Machine tool operator using highly automatic machine which bores cylinders in engine blocks.

operate, for example, engine lathe operator, drill press operator, and milling machine operator.

The most highly skilled workers who use machine tools are the tool and die makers. Toolmakers make the jigs, fixtures, and other accessories that hold the work which is being machined. Diemakers construct the dies that are used in stamping, pressing, forging, and other metalforming operations. Tool and die makers read blueprints, set up and operate machine tools, use precision measuring instruments, and make shop computations in their work. They must work to closer tolerances (more exact dimensions) and do more precision handwork than most other machining workers.

Foundry occupations. Some parts of the automobile are made in foundry departments which make castings for such units as engine blocks. Patternmakers make a wood or metal pattern in the shape of the final casting desired. Coremakers shape the bodies of sand, or "cores," which are placed inside molds in order to form hollow spaces needed in castings. Machine molders make the sand mold into which the metal is poured. Castings are produced by pouring metal into molds where it cools and hardens in the shape of the molds.

Many other workers are in less skilled occupations in the foundries. Melters operate electric furnaces and cupolas used to melt metal for castings. The actual pouring is done by metal pourers. After the casting cools, the shakeout men remove it from the mold. Other workers clean the castings and remove the excess metal.

Forging occupations. Some automobile parts, such as crankshafts and connecting rods which are required to withstand great stress, are shaped by forging hammers and presses in the forge shop. Hammermen operate drop hammers which pound metal into various shapes between closed dies. The hammermen are assisted by heaters who heat the metal stock in a furnace to prepare it for forging and then pass the stock to the hammermen. Other forge shop workers are engaged in cleaning, finishing, heat treating, or inspecting forgings.

Other metalworking occupations. The automobile industry employs large numbers of workers in other metalworking occupations. Included among these are punch press operators who run power-driven presses which vary in size from

Press operator removing a wheel rim.
small presses used for forming brackets, clips, or other small parts to the massive presses which form, trim, and pierce holes in the doors, body panels, and frame.

Automobile plants employed many thousands of welders in mid-1960. These welders operate equipment used to join metal parts. Welding can be performed manually or by machine. Some manual electric-arc welders and gas welders work in production jobs in parts and body manufacturing plants, and others work in maintenance jobs repairing and rebuilding machinery and equipment. Machine (resistance) welders are primarily employed on the assembly lines to weld the separate parts of the bodies and subassemblies.

**Inspection occupations** (D.O.T. 5–02.700 through .799, 5–81.630, 6–78.671, and 7–02.700 through .799). Automobiles can be produced on a mass basis because parts and assemblies for the same make of automobile are interchangeable. They are made to exact measurements and are subject to close quality control and inspection. (The industry employs statisticians and engineers in quality control departments who use statistical techniques designed to control the quality of the product.) Inspectors check incoming raw materials when received, examine parts during the manufacturing stages, and make quality and conformity checks during the subassembly and assembly operations. Micrometers, specially designed gauges, and other measuring and testing instruments are used by inspectors and testers in performing their duties.

**Finishing occupations.** Many finishing operations must be performed before a car is completed. For example, the metal surfaces must be readied for finishing, the exteriors painted, the interiors covered, the seats upholstered, and finally, the finished product must undergo a thorough inspection. Among those employed in the finishing departments are metal finishers, platers, sprayers, polishers, sanders, trim cutters, sewing machine operators, and trimmers. **Metal finishers** (D.O.T. 6–77.040, and .530 and 8–77.10) file and polish rough surface areas of metal parts in preparation for painting. **Platers** put a thin coat of metal on automobile bumpers and “hardware” for ornamentation and protection against corrosion. **Sprayers** (D.O.T. 7–16.210, and .500 through .629) operate spray guns to apply paint or other finishes to the metal parts. **Polishers** (D.O.T. 6–77.020, .025, .080, and .330) rub the finished surfaces by hand or polish them with a portable motor-driven buffing wheel.

Cutters, sewing machine operators, and trimmers combine their skills to provide comfortable and attractive interiors. With hand shears or an electric knife, the **cutter** (D.O.T. 4–62.020 and 6–27.054) cuts fabric or leather to the specific shape according to a pattern. The **sewing machine operator** (D.O.T. 6–27.508), using a power-driven machine, sews together the upholstery sections after they have been cut to size. **Trimmers** (D.O.T. 4–35.610) arrange and fasten springs and padding or foam rubber for the seats and backs, and tack the covering material in place.

**Assembling occupations** (D.O.T. 5–02.300 through .399, 5–25.570, 7–02.300 through .399, and 9–02.01, and .81). The workers who do the assembling make up the largest occupational
group in the automobile industry. Assemblers may work on small units or subassemblies or they may assemble large units. Those employed on subassemblies may work in parts plants or on the subassembly lines of the larger automobile manufacturers. Line assemblers work on the final assembly line where they may bolt parts and subassemblies to make the completed car.

Most assembly jobs are repetitive and require little skill; however, they do require coordination and may be strenuous. Division of labor is carried to its extreme degree on the assembly line. For example, one worker may start nuts on bolts and the next worker may tighten the nuts with a power-driven tool called a nut-runner. Each worker is assigned the amount of work he can do within the time it takes the automobile to pass his work station.

Material handling, custodial, and plant protection occupations. The production of motor vehicles by the assembly-line process requires an elaborate system of material movement to supply the assembly lines and to remove finished products. A considerable number of workers are employed to move materials in automobile and automobile parts plants. Drivers operate power trucks which deliver parts or subassemblies to the assembly line or move materials between plants. Material handlers load and unload material from trucks or into and out of containers. Crane operators use machines to move raw steel stock, heavy dies, and other materials that cannot be lifted by hand.

Many persons are needed to keep the production workers supplied with tools, parts, and materials, and to keep records of materials. Factory clerks, such as checkers, stock chasers, and stock clerks, coordinate the delivery of parts to the proper location on the assembly line. They check, receive, and distribute materials and keep records of incoming and outgoing shipments.

The automobile industry also employs many workers in plant protection and custodial work. These workers include plant patrolmen, gate-men, janitors, and porters.

Maintenance occupations. A large staff is required to keep machines and equipment in good operating condition and to make changes in the layout of automobile plants. Because breakdowns in the assembly lines and in the highly mechanized machining lines are particularly costly, the automobile industry employs many skilled maintenance employees to service this complicated production system. The maintenance and repair of complex electrical, electronic, and hydraulic equipment require well-trained electricians, electronic technicians, and machinery repairmen. Millwrights move, install, and maintain heavy machinery and mechanical equipment. Plumbers and pipefitters lay out, install, and repair piping, valves, pumps, and compressors. Other maintenance workers in automobile plants include carpenters, stationary engineers, tool and die makers, and sheet-metal workers.

Training, Other Qualifications, and Advancement

The training requirements for jobs in the automobile industry range from a few hours of on-the-job training to years of preparation. Many of the plant workers can learn their jobs in a day or two. On the other hand, engineering and scientific jobs, as well as craft jobs, are filled by persons who have spent years in training for their occupations.

The automobile industry's emphasis upon new design and mechanical improvements has made it an important employer of persons with engineering and scientific backgrounds. The minimum requirement for professional engineering jobs is a bachelor of science or a bachelor of engineering degree from a recognized college. Advanced degrees are often required for scientists, particularly for those engaged in research and development work. Many of the companies give their newly hired engineers and scientists specialized training courses. It is from this group of professional workers that some companies have selected many of their top executives.

The requirements for other technical workers vary according to their specialties. For example, engineering aids, laboratory assistants, and draftsmen are often technical institute or junior college graduates. Some automobile companies train their own semiprofessional technical workers at company-run schools or subsidize students at local junior colleges or technical institutes.
These workers may also take advanced training and acquire engineering degrees.

Administrative positions are usually filled by men and women who have college degrees in business administration, marketing, accounting, industrial relations, or other specialized fields. Some companies have advanced training programs for workers in these specialties. Most of the top administrative jobs are filled by promotion from within the organization.

Most automobile firms hire persons who have had commercial courses in high schools or business schools for office jobs such as clerks, bookkeepers, key punch operators, stenographers, and typists. These workers usually have not been trained specifically for jobs in this industry.

Applicants for most plant jobs must be physically able, dependable, and have aptitude for mechanical work. For semiskilled jobs, the industry looks for applicants who are high school graduates and who can do routine work at a steady and fast pace. As noted earlier, many assembling jobs can be learned in a few hours or days. Some of the less skilled machine operating jobs can be learned in a few weeks. Other plant production jobs require about a month of on-the-job experience before the worker can perform his job satisfactorily.

Extensive periods of training are required for craft jobs in the automobile industry. Tool and die makers, patternmakers, electricians, millwrights, and machinery repairmen are some of the highly skilled workers who generally require at least 4 years of training before they can perform their specialized jobs. Although many of the workers in craft jobs have acquired the skills of their trade by working for many years with experienced workers, most training authorities agree that apprenticeship training is the best way to learn a skilled trade. Automobile firms, in cooperation with labor unions, conduct apprenticeship programs for many of the skilled trades. The industry’s apprenticeship program enables several thousand young men each year to prepare themselves for skilled jobs.

Applicants for apprenticeship training are generally required to be between the ages of 18 and 26 (50 percent of the apprentices can be workers between the ages of 26 and 41 who are already employed in automobile companies) and graduates of a high school, trade, or vocational school. Training authorities stress that young persons interested in apprenticeship training should prepare themselves by taking courses in mathematics and other sciences. Apprentice applicants are given physical examinations, mechanical aptitude tests, and other qualifying tests.

Apprenticeship training includes both on-the-job training and classroom instruction related to the occupation. Mathematics, blueprint reading, shop theory, and specialized subjects are studied in the classroom, while the operation and use of tools of a particular trade are learned in the shop.

Most automobile companies select their foremen from among workers already employed. Frequently, persons who have completed apprenticeship training in a company are selected for supervisory jobs after they have acquired further experience. Applicants for foreman jobs, if selected, go through a training period when promoted to the foreman level.

**Employment Outlook**

The automobile industry will provide thousands of job opportunities for new workers during the 1960’s. Most of the new job openings will result from the need to replace experienced workers who transfer to other fields of work, retire, or die. Retirements and deaths alone should result in an average of 15,000 to 17,000 openings annually during the 1960-70 decade.

Since the end of World War II, employment in the automobile industry has fluctuated sharply in response to such factors as changes in general business conditions, shifts in consumer preference, availability of credit, and defense production needs. In 1960, employment averaged 780,000. During the 1960’s, employment is expected to rise somewhat over this level, primarily because of the expected increase in the production of motor vehicles.

The major factor affecting motor vehicle production and, therefore, employment is the demand for cars. Demand, in turn, is affected by factors such as the level of economic activity, the level of income and its distribution among various income groups, the growth of popula-
tion and household formations, the continuation of the movement to the suburbs, prices, credit availability, and the growth of multiple car ownership. Another important element in the demand for automobiles is the total number of cars in use because a certain percentage of new vehicles is needed each year to replace the cars which are scrapped. An examination of the above factors, which influence the sale of automobiles, indicates a long-term increase in the number of vehicles which will be produced during the 1960's.

Other important factors contributing to the growth of employment are the expected increases in the production of trucks and buses and replacement parts for all types of motor vehicles. The demand for trucks and buses is affected by many of the same factors that affect the demand for automobiles, notably the level of economic activity and the growth of population. The principal factor affecting the production of replacement parts is the number of vehicles in use.

Employment is not expected to increase as fast as production, mainly because of the industry's emphasis upon mechanized production methods, such as automatic assembly operations, which are expected to continue to result in increased output per worker. Increased expenditures for new plants and equipment also are expected to lead to further efficiencies in production which would tend to reduce labor requirements. Imports of automobiles and parts also will have some adverse effect on employment.

The addition of new or improved equipment in motor vehicles, greater complexity of design of many models, and continuing style changes could, to some extent, offset the effect of increased production efficiency. Automatic transmissions and power steering are examples of equipment changes which tend to offset reduced manufacturing man-hour requirements. On the other hand, although the production of compact cars appears to require fewer man-hours per automobile produced, the sales of these cars should result in an increase in total automobile sales. This development could favorably affect employment.

The distribution of employment in the industry has been changing as a result of the industry's emphasis upon research and development activity and its increasing use of automatic manufacturing operations. In 1950, production worker (blue collar) employment made up about 85 percent of total employment and white-collar employment represented 15 percent of the total. In 1960, white-collar employment accounted for nearly 25 percent of the industry's work force.

Continuing recent occupational trends, the number of engineers, scientists, and other professional and technical personnel is expected to increase at a faster rate than other occupational groups in the 1960-70 decade because of the anticipated expansion in research and development activities. Emphasis upon research and development will create more job opportunities for engineers and scientists with advanced degrees. The growing complexity of the automobile industry will lead to a greater need for more accountants, particularly those specializing in tax accounting. Because the industry is expected to expand its use of electronic data processing equipment in the future, programmers will be employed in greater numbers. The employment of clerical and administrative workers is expected to increase at a somewhat faster rate than some other occupational groups although the introduction of data processing equipment may limit the growth of some types of clerical workers. There will be a growing need for stenographers and typists.

The employment of skilled workers, such as tool and die makers, millwrights, pipefitters, electricians, and machinery repairmen, will grow at a relatively faster rate than many other occupational groups. Semiskilled workers, such as assemblers and machine operators, probably will increase at a slower rate than total employment.

Earnings and Working Conditions

The earnings of production workers in this industry are among the highest in manufacturing. In February 1961, production workers employed in the automobile industry earned, on the average, $105.56 a week, or $2.80 an hour. This compares with the average earnings of
$90.25 per week, or $2.32 an hour, for production workers in all manufacturing industries in the same month.

As a result of collective bargaining contracts negotiated between employers and unions, most employees in the industry receive benefits such as life insurance, accidental death and dismemberment benefits, weekly accident and sickness benefits for temporary disability, and hospitalization, surgical, and medical benefits. These are financed solely by employers or jointly by employers and employees. Supplemental unemployment benefit plans (paid for solely by the employers) cover the majority of workers. These plans provide cash payments ranging from $2 to $30 a week to all hourly rated and some salaried employees with at least 1 year of service. In most States, these benefits are in addition to those received from State unemployment compensation plans. Most employees also receive paid vacations (or payments in lieu of vacations) ranging from 1 to 3 weeks, depending on length of service, and an average of 7 paid holidays a year.

A great majority of the automobile workers are covered by pension programs, almost all of which are paid for entirely by the employer. Retirement benefits vary with length of service. In a typical case, a retiring employee, age 65, with 30 years' service, receives a monthly company pension of $72 in addition to his Federal social security benefits.

The great bulk of the production workers in the automobile assembly plants and a majority employed in the parts plants belong to the International Union, United Automobile, Aircraft and Agricultural Implement Workers of America. In some automobile parts plants, the International Union, Allied Industrial Workers of America is the bargaining agent for employees. Other unions with membership in the automobile industry include the International Association of Machinists; the Pattern Makers' League of North America; the International Molders and Foundry Workers Union of North America; the Metal Polishers, Buffers, Platers and Helpers International Union; the United Plant Guard Workers of America (Ind.); the Mechanics Educational Society of America; the International Brotherhood of Electrical Workers; and the International Die Sinkers' Conference (Ind.).

In general, the work surroundings in automobile plants are more favorable than those in most other types of metalworking facilities. Most automobile workers are employed in plants which are relatively clean and free from dust, smoke, and fumes. Some work surroundings, however, particularly in the foundry and forge departments, may be hot and the worker may be exposed to noise, dust, and fumes. In recent years, the working conditions in foundries and forge departments have been greatly improved by the introduction of ventilation systems that are larger and better than those previously used.

Automobile plants are, on the whole, comparatively safe places to work, although safety conditions vary somewhat among the individual departments or facilities. The rate of disabling injuries in automobile plants was less than half as great as for all manufacturing industries in 1959. Some automobile plants have fully equipped hospital facilities with doctors and nurses in attendance.
OCCUPATIONS IN THE BAKING INDUSTRY

The baking industry serves an everyday need in every community. Baking is the largest food processing industry in the United States in terms of employment. Almost 9 cents out of every dollar spent for groceries goes toward the purchase of bakery products. The baking industry offers steady, year-round employment to several hundred thousand workers throughout the country. Replacement needs, as well as the increasing food requirements of a rapidly growing population, will provide thousands of opportunities for young people to find jobs in this industry in the 1960's.

The industry employs men and women with many interests and talents to make bakery products and to deliver them to stores, homes, and restaurants. For those who like to use their hands, the industry provides hundreds of opportunities each year to learn a skilled trade as a baker or other skilled baking specialist. For those who like to meet people and to sell, it offers jobs as driver-salesman and sales supervisor. For the mechanically inclined, the industry has openings for skilled workers to maintain and repair the increasing amount of machinery and equipment used in today's modern bakery. For those who like to work in an office, the industry offers the familiar types of clerical jobs. In addition, large baking firms employ many administrative and managerial specialists to direct the firms' operations.

Nature and Location of the Industry

The baking industry produces bread and other perishable bakery products, such as cakes, pies, pastries, and doughnuts. Most of these products are made by several types of industrial baking firms. Large wholesale bakeries make products for sale to grocers, restaurants, hotels, and other establishments which then resell them to the public. Bakeries owned and operated by grocery chainstores make and distribute baked products to their own stores. Home-service bakeries deliver their products directly to customers' homes. Multioutlet bakeries make their products in a central bakery for resale through their own retail stores. In addition to these industrial bakeries, neighborhood retail shops bake cakes, pies, and other specialties on the premises and sell them to local customers.

The baking industry employs more people than any other food industry. In 1960, about 260,000 men and women were employed in about 6,000 industrial bakeries; about three-fourths of them were in wholesale bakeries. About 85,000 other men and women, including shopowners, were employed in nearly 12,000 neighborhood retail bake shops.

Most baking plants are small because they serve only their own community or neighborhood. A small number of bakeries serves markets up to 100 miles away; only a few distribute baked foods farther away. Nearly half of the industrial bakeries had fewer than 10 employees each in 1958; neighborhood bake shops averaged 6 each. In contrast, 9 industrial baking plants employed more than 1,000 workers each, and 34 employed from 500 to 1,000 each.

Almost every community in the United States has at least one bakery. This is important to young people considering a career in the industry because it means that there are job opportunities in their own communities or in almost any other part of the country.

Occupations in the Baking Industry

Nearly 55 percent of the workers perform the actual baking operations, receive and store raw materials, or maintain and repair machinery and equipment. Driver-salesmen and other sales personnel make up nearly 20 percent of the industry's work force. An additional 5 percent are truckdrivers who deliver bread to retail stores but have no selling duties. The re-
mainder are in administrative, professional, or clerical jobs.

About one out of every five industrial bakery workers is a woman. Most women workers are employed as secretaries, typists, bookkeepers, and in other office jobs. Others are employed in production jobs, such as slicing machine operator, wrapping machine operator, or pie and cake packer; very few work as bakers. In neighborhood bakeshops, many women work as sales clerks.

Production Occupations. Baking processes in industrial plants are similar to those used in the home, only on a much larger scale. In large baking plants, each operation in the baking process is handled by a specialized worker. In general, these workers feed and unload machines, watch their operation, and visually or physically inspect the output. Mixers (D.O.T. 4-01.600 through .700) weigh ingredients and combine them in a mixing machine. They carefully control timing and temperature in order to produce a uniform well-blended dough. The dough then goes through a lengthy fermenting process which prepares it for the next operation. Dividermen (D.O.T. 6-02.123) separate the fermented dough into equal portions and form each portion into the shape of a ball. The divided dough is sent to a warm room for rising (proofing). Molding machine operators (D.O.T. 6-02.124) knead and roll the raised dough into loaves and place them into baking pans. When fancy shaped bread and rolls are made, bench hands (D.O.T. 4-01.200) knead and form the dough by hand into various shapes and place the bread and rolls in pans ready for the oven. Ovenmen (D.O.T. 4-01.800) adjust temperature and timing devices on ovens to produce finished baked products.

In small bakeries, all-round bakers (D.O.T. 4-01.100) assisted by helpers usually carry through all the steps needed to turn out finished baked products. Large bakeries employ all-round bakers as working foremen in charge of one or more operations. These workers supervise the men and machines in their department and coordinate their activity with the work in other departments in order to meet production schedules.

A considerable number of helpers (D.O.T. 8-02.10) are employed in baking operations. They may assist all-round bakers and specialized bakery workers. They have job titles such as dough mixer helper, bench hand helper, and ovenman helper. Helpers also perform such jobs as greasing pans, removing bread from pans, pushing troughs and racks, and washing pans.

After baked foods leave the oven and are cooled, several types of workers prepare them for delivery to grocers' shelves. Slicing-and-wrapping machine operators (D.O.T. 6-02.220 and .420) feed loaves of bread on conveyors leading into the machines and watch the slicing and wrapping operations. They adjust the machines and keep them supplied with waxed paper and labels. The wrapped loaves leave the machines and travel along a conveyor belt to the shipping platform.

Many bakery employees work in icing departments where cakes, pastries, and other sweet goods are given their finishing touches. Icing mixers (D.O.T. 4-02.321) prepare cake icings and fillings, following special formulas
Baker examining bread dough to see if it is ready for the oven.

of the bakery. They weigh and measure ingredients and mix them by machine. They also prepare cooked fillings for pies, tarts, and other filled pastries. In small plants, icing mixers may also spread icing on cakes and cookies. *Hand icers* (D.O.T. 4–02.311 and 6–02.311) and *machine icers* (D.O.T. 6–02.331) cover baked cakes and pastries with icing or frosting, either by hand or by machine, depending on the type of product and the extent of mechanization in the plant.

Bakeries employ many workers in their storage, warehousing, and shipping departments. Receiving and stock clerks check and keep records of incoming supplies and ingredients used in making baked foods and deliver them to various departments. Packers and checkers make up orders of bakery products for delivery by driver-salesmen.

*Maintenance Occupations.* Baking firms employ skilled maintenance workers and their helpers to keep machinery and equipment in good operating condition. Large plants, which are usually highly mechanized, employ many of these workers, such as automobile mechanics, electricians, machinists, and stationary engineers. The largest group is automobile mechanics who keep thousands of bakery trucks and other company vehicles in operating condition. Small and medium size plants employ maintenance workers who do repair work on many types of plant equipment.

*Sales and Driving Occupations.* Selling and delivery of finished baked foods to grocers, restaurants, hotels, homes, and other customers provide jobs for many thousands of the industry's workers. Some of these workers sell baked foods and others drive trucks, but most of them perform a combination of these jobs. *Driver-salesmen*, called routemen, (D.O.T. 7–35.100) work for either wholesale bakeries or home-service bakeries. They deliver bread and other baked foods to grocery stores or to homes along their assigned routes and collect payment for delivered products. A major part of their job is to try to increase customers' orders and to gain new customers on their routes. Wholesale driver-salesmen arrange their baked products on shelves or display racks in grocery stores. At some busy stores, they may restock the shelves several times a day. Home-service driver-salesmen make deliveries directly to customers' homes with a basket of bread, rolls, pies, and cakes from which housewives can make their selection. Driver-salesmen return to the bakery at the end of each day to make an accounting of the day's transactions. They turn in money collected from their customers and return unsold baked foods. They make up a list of various types of baked foods that represents their estimate of what grocers or housewives on their routes will buy the next day. These estimates, assembled from driver-salesmen on all routes, serve as guides for production managers in making up production schedules for the next morning.

A large bakery may employ several route supervisors, each in charge of a group of from 6 to 10 driver-salesmen. In a small bakery, one route supervisor may be in charge of all the salesmen. When one of the salesmen is absent, the supervisor takes over the route until the salesman returns or is replaced. Route supervisors also train new driver-salesmen.
Chain grocery store bakeries and multioutlet retail bakeries generally employ truckdrivers rather than driver-salesmen. These employees drive large vans, delivering baked foods to each of the company's stores. Truckdrivers for chain-store bakeries deliver wrapped bread and other bakery products to loading platforms of the stores. The display of baked foods in chain-stores is arranged by stock clerks. In bakeries which operate their own retail bakery outlets, unwrapped baked foods are wheeled from the van to each store in enclosed metal racks. Sales clerks then arrange the display of these freshly baked foods.

Administrative, Clerical, and Technical Occupations. Administrators in large baking firms and proprietors of small firms coordinate all baking activities from the purchase of raw materials to the production and delivery of baked products. In large baking firms, activities are divided into separate departments or functions and supervised by plant managers, comptrollers, sales managers, and other executives. Other administrative employees may specialize in such fields as accounting, purchasing, advertising, and personnel and industrial relations. Business offices of bakeries employ many types of clerical workers, including bookkeepers, cashiers, clerks, business machine operators, stenographers, typists, and switchboard operators. A large proportion of these office workers are women. Some large baking companies have laboratories which employ chemists, home economists, and their assistants to test ingredients and to prepare formulas and recipes for bread and other baked items. (Detailed discussions of the duties, training, and employment outlook for technical, administrative, and office personnel appear elsewhere in this Handbook. See index for page numbers.)

Training, Other Qualifications, and Advancement

Training requirements for the various occupations in the baking industry range from a few days of on-the-job training to several years of training and experience. For example, some bakery workers, such as slicing machine operators, can be trained on the job in a few days. Skilled workers, such as all-round bakers and baking specialists, require at least 3 or 4 years of training. Professional personnel and some administrative workers must have a college degree or its equivalent in their particular specialty.

Most inexperienced production workers in the baking industry are hired as helpers. They may be assigned such tasks as washing and greasing pans, carrying ingredients to mixing machines, pushing troughs of dough to the proofing room, and otherwise assisting bakers in the shop. By working alongside skilled bakers, helpers are able to pick up baking skills over a period of several years.

Some bakeries train their bakers through formal apprenticeship programs. Apprentices generally are selected from among the helpers in the plant. Employers usually require that apprentice applicants be between 18 and 26 years of age, have a high school or vocational school education, and show an interest in baking. Apprenticeship programs last 3 or 4 years. They include on-the-job training in all baking operations and classroom instruction in related subjects.

Some workers acquire baking skills by taking courses in vocational school or by learning the trade in the Armed Forces. Such training may not qualify a young man as a skilled baker, but it may help him to become an apprentice and perhaps shorten his apprenticeship period.

Bakers may be promoted to such jobs as foreman, production manager, and eventually plant superintendent. Some bakers who have developed special skill in fancy cakemaking or pie-making may find jobs in hotel or restaurant bakeries. All-round bakers with some business ability sometimes open their own bakeshops.

Good health is important for a young man or woman planning to enter one of the baking jobs. Most States require a health certificate for anyone handling food. Such certificates indicate that workers are free from communicable diseases. Good health is also necessary because of irregular working hours and the extremes in temperatures found in bakeries.

Maintenance workers, such as machinists, electricians, and auto mechanics, who have already acquired their skills, are sometimes hired directly by baking firms. Some bakeries have
apprentice training programs to meet the needs of their maintenance shops. Other plants hire new workers as helpers to skilled maintenance employees; they gain experience and know-how while working with skilled mechanics.

For jobs as driver-salesmen or truckdrivers, baking firms generally hire inexperienced young men with a high school education. Often, inexperienced workers may start out as stock clerks, packers, or checkers and be promoted to one of the driving jobs as vacancies occur. Some young men take summer and part-time jobs as driver-helper to gain experience. Applicants for these jobs must be able to get a commercial driving permit (chauffeur's license). Large baking companies often give tests to their applicants to determine whether they are safe drivers. A pleasant appearance and the ability to get along well with people are preferred qualifications for the new worker who wants to sell as well as drive. New driver-salesmen may be given classroom instruction in sales, display, and delivery procedures. Most training, however, is given on the job by route supervisors. Driver-salesmen may be promoted to jobs as route supervisor and sales manager.

Jobs at the administrative level are usually filled by upgrading personnel already employed in the firm. Some owners and production managers of bakeries have risen from the ranks of baking craftsmen. Others have started their careers in sales departments. In recent years, large baking firms have required that their new administrative workers have a college degree in one of the administrative fields such as marketing, accounting, labor relations, personnel, or advertising. Several colleges offer courses in baking science and management; one college offers a 4-year course in this field.

Young women who have completed a commercial course in high school, junior college, or a business school usually are preferred for secretarial, stenographic, and other office jobs.

Employment Outlook

Young people will have many thousands of opportunities to get jobs in the baking industry during the 1960's. Some of these openings will result from the anticipated expansion in the industry, but most of them will arise from replacement needs. Retirements and deaths alone may provide about 4,000 to 5,000 jobs each year. Many other opportunities will arise as workers leave the industry for other jobs or open their own bakeshops.

A continued expansion in the demand for the products of the baking industry is expected in the 1960's mainly because population will increase. Also, because of the anticipated rise in income, people will be able to buy more baked foods, including the "bake-and-serve" type. Since the early part of this century, there has been a trend toward buying bread and cake at stores rather than baking these products at home. This trend is the result of more women working outside the home as well as the shift from farm to city living. Today, 95 percent of all bread consumed is bought from stores.

Although the total demand for factory-baked foods is expected to rise, it will continue to increase at a slower rate than population. During the past several decades, people have been eating less bread; as a result, consumption per person has dropped considerably. Probably, the main reason for this drop in bread consumption is the increasing weight consciousness of the American consumer. The trend toward the use of prepared flour mixes for baking cakes and pastries at home has also reduced the demand for factory-baked foods.

Total employment in the baking industry is expected to grow slowly during the 1960 decade as the demand for baked foods increases. Employment in some occupational groups in the industry will grow, whereas in others it will decline. For example, as families move into suburbs farther away from cities, salesmen's territories will expand and more driver-salesmen will be needed to cover them. Some increases may occur among clerical workers as a result of additional recordkeeping requirements. As plants become more mechanized, the number of maintenance workers will probably expand to keep the machinery and equipment in operating order. The anticipated increases in these occupations will more than off-
set the expected decline in the number of bakery production workers. It is expected that employment in some baking production jobs will continue to decline as a result of the installation of mechanized processing and materials handling equipment. For example, there has been a sharp drop in the employment of laborers and helpers because machines now do many of the strenuous tasks formerly done by these workers.

Other technological changes may also affect employment in this industry. Bakers and baking specialists have been able to produce more baked foods per worker not only because of the use of mechanized equipment but also because of changes in methods of processing these foods. For example, the method of fermenting a yeast broth rather than a dough mixture has cut processing time from several hours to a matter of minutes. In addition, the process of freezing baked foods for storage until ready for sale permits bakeries to prepare a week's requirements at one time rather than small batches daily. This results in a more efficient use of workers and machinery because fewer man-hours are spent on cleaning vats and kettles between each batch of dough.

Earnings and Working Conditions

Earnings of production workers in the baking industry averaged $89.06 a week, or $2.21 an hour, in 1960. This average was about the same as that for all manufacturing employees. Size of city and geographic location affect earnings of bakery workers. In general, the larger the city, the higher the wage rate. Wage rates also tend to be higher in the Far West and the Northeast than in the South or Southwest. Because of these geographic variations, the highest and the lowest hourly wage rates vary widely. For example, according to a private survey of nearly 100 union-management contracts covering employees in wholesale bakeries in 1961, hourly wage rates for bench hands ranged from $1.66 to $3.18, and those for mixers ranged from $1.58 to $3.27. However, minimum hourly rates in the major baking occupations were concentrated in the following ranges:

<table>
<thead>
<tr>
<th>OCCUPATIONS IN THE BAKING INDUSTRY</th>
<th>Minimum hourly rates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baking foremen and all-round bakers</td>
<td>$2.25-$2.75</td>
</tr>
<tr>
<td>Baking specialists:</td>
<td></td>
</tr>
<tr>
<td>Mixers</td>
<td>2.10- 2.60</td>
</tr>
<tr>
<td>Dividermen</td>
<td>1.95- 2.45</td>
</tr>
<tr>
<td>Molders</td>
<td>1.95- 2.40</td>
</tr>
<tr>
<td>Benchmen</td>
<td>2.05- 2.50</td>
</tr>
<tr>
<td>Ovenmen</td>
<td>2.00- 2.60</td>
</tr>
<tr>
<td>Icers and decorators</td>
<td>1.80- 2.15</td>
</tr>
<tr>
<td>Wrapping machine operators</td>
<td>1.70- 2.10</td>
</tr>
<tr>
<td>Maintenance workers:</td>
<td></td>
</tr>
<tr>
<td>Automobile mechanics</td>
<td>2.15- 2.60</td>
</tr>
<tr>
<td>All maintenance trades</td>
<td>2.30- 2.55</td>
</tr>
<tr>
<td>Helpers</td>
<td>1.95- 2.35</td>
</tr>
</tbody>
</table>

Some plant employees work night shifts and weekends because baking is done around the clock in many plants. Workers receive from 5 to 20 cents an hour extra pay for night work. Most plant workers are on a 40-hour workweek, although some work 44 or 48 hours regularly. Time and a half is paid for work over 40 hours a week.

Driver-salesmen are usually paid a guaranteed minimum salary plus a percentage of their dollar sales. According to a 1961 survey of baking firms in 13 Eastern States, driver-salesmen for both wholesale and home-service bakeries had minimum weekly salaries of from $50 to $98. By selling more baked products to their customers and by increasing the number of customers on their routes, driver-salesmen can increase their earnings considerably. Companies usually pay for uniforms.

Truckdrivers for baking plants are paid by the hour for the time worked. Hourly rates and hours worked vary from city to city. In mid-1960, the minimum wage rates and hours per week, provided by union-management contracts in 10 selected cities, were as follows:

<table>
<thead>
<tr>
<th>City</th>
<th>Minimum wage rates</th>
<th>Hours per week</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atlanta, Ga.</td>
<td>$2.22</td>
<td>45</td>
</tr>
<tr>
<td>Birmingham, Ala.</td>
<td>1.96</td>
<td>48</td>
</tr>
<tr>
<td>Cleveland, Ohio</td>
<td>2.63</td>
<td>40</td>
</tr>
<tr>
<td>Dallas, Tex.</td>
<td>2.12</td>
<td>45</td>
</tr>
<tr>
<td>Detroit, Mich.</td>
<td>2.60</td>
<td>45</td>
</tr>
<tr>
<td>Houston, Tex.</td>
<td>2.17</td>
<td>45</td>
</tr>
<tr>
<td>Little Rock, Ark.</td>
<td>1.96</td>
<td>48</td>
</tr>
<tr>
<td>New York, N.Y. (cake deliveries)</td>
<td>2.50</td>
<td>40</td>
</tr>
<tr>
<td>Oklahoma City, Okla.</td>
<td>1.96</td>
<td>48</td>
</tr>
<tr>
<td>Pittsburgh, Pa.</td>
<td>1.95</td>
<td>44</td>
</tr>
</tbody>
</table>

Home-service driver-salesmen and truckdrivers work mostly out of doors. Wholesale driver-
salesmen spend much of their time arranging bakery foods on grocers’ display shelves. Many jobs in baking plants involve some strenuous physical work, despite the considerable mechanization of baking processes. Work near ovens may be unpleasantly hot.

Paid vacations for employees are almost universal in industrial baking firms. Vacation periods range from 1 to 4 weeks, according to length of service. The number of paid holidays ranges from 6 to 11 days, depending on locality. Most baking firms have adopted some type of insurance or pension arrangement for their employees. Some provide life insurance plans; others have health insurance programs or retirement pension plans. A large number of employees are covered by joint union-industry health and welfare plans and pension systems which are paid for entirely by employer contributions.

Most plant workers and drivers belong to a labor union. Bakers, baking specialists, and other plant workers have been organized by the American Bakery and Confectionery Workers’ International Union or the Bakery and Confectionery Workers’ International Union of America (Ind.). Driver-salesmen and transport drivers are generally members of the International Brotherhood of Teamsters, Chauffeurs, Warehousemen and Helpers of America. Some maintenance workers are members of craft unions such as the International Association of Machinists and the International Union of Operating Engineers.

Where To Go for More Information

Information on local job openings in the baking industry may be obtained directly from bakeries in the community.

High school students—or adults interested in evening courses—may obtain information on courses relating to baking by writing to the Director of Vocational Education or to the Superintendent of Schools in their local community, or to the State Director of Vocational Education in the Department of Education in the State capital.

General information on opportunities in the baking industry and on requirements for entering accredited schools which offer courses or degrees in baking science and technology may be obtained by writing to:

American Bakers Association,
20 North Wacker Dr., Chicago 6, Ill.
More than 680,000 people worked in late 1960 in the Nation’s banks, which provide many kinds of financial services to businessmen and other individuals, and to organizations. Nearly all businessmen and great numbers of other people maintain accounts with banks in order to earn interest on their money, insure its safekeeping, and to pay bills more conveniently. Many also obtain loans from banks, rent safe-deposit boxes, or rely on banks for such help as the administration of estates and trusts, analysis and handling of securities, and foreign banking operations. The complicated financial transactions of our present-day business world could not be carried on without banking services.

Banks and Their Workers

Though several types of banks are found in most cities today, commercial banks, which offer the most varied services, lead in numbers and employment. About 23,000 insured commercial banks (including branch offices) were operating at the end of 1959. They employed more than half a million workers, about half of whom were women. Mutual savings banks are another type of bank offering some of the services of commercial banks. These banks handle savings deposit accounts, and may also furnish safe-deposit facilities and administer trusts.

There are workers in many other financial institutions with the same occupational skills as in banks. Among these institutions are loan associations of various kinds, most of which invest customers’ funds in first-mortgage loans made on real estate; personal finance companies, which specialize in making short-term loans to individuals; and investment banking organizations which underwrite, buy, and sell corporation stocks and bonds and State and local government bonds. Some Government or quasi-Government agencies also have positions of the same kinds as are found in banks; among these are the housing and farm financing agencies, the Export-Import Bank, the Federal Deposit Insurance Corporation, and the Federal Reserve System. Federal Reserve Banks, operating as bankers’ banks in 12 districts, had about 19,000 full-time employees in 1959. The Federal and State agencies concerned with the supervision of banks employed about 3,000 persons as bank examiners.

Banking involves an enormous amount of paperwork and approximately two-thirds of all bank employees are clerical workers. Many of these workers handle checks, withdrawals, and deposits; keep records of transactions; and take care of correspondence, telephone calls, and other office duties. The Nation’s commercial banks handle about 14 billion checks a year. The clerks who sort, record, file, mail, and otherwise process these checks make up one of the largest groups of bank clerks. Some of them operate equipment designed especially for banks, such as proof machines which are used to sort checks; others operate adding, calculating, and other kinds of office machines which are used in many types of offices. Two other large groups of clerical employees do bookkeeping or are secretaries, stenographers, and typists. Their skills are, of course, much the same as those required for similar work in other industries. Tellers are a large group unique to banking. Other bank workers in the clerical category include credit analysts, loan examiners, telephone operators, and messengers.

Bank officers—presidents, vice presidents, treasurers, comptrollers, and cashiers—are directly responsible for the management of banks. About one-sixth of all bank employees are officers. In addition, various professional specialists, such as accountants, lawyers, statisticians, economists, and engineers are em-
ployed to advise, conduct research, and prepare reports.

This chapter gives information about several of the principal occupations unique to banking—Bank Clerks and Related Workers, Tellers, and Bank Officers. Other occupations mentioned previously, which are found in many other business enterprises, are described elsewhere in this Handbook. (See index for page numbers.)

Where Employed

Most cities and towns in the United States have one or more banks. However, approximately one-third of the employees of insured commercial banks are in New York, California, Pennsylvania, and Illinois, the States with the largest population. The more than 500 mutual savings banks and their workers are located chiefly in the Northeastern States. There are far more bank employees in New York City, the financial capital of the Nation, than in any other city.

Banking employment is concentrated to a considerable extent in a relatively limited number of very large banks. In late 1959, half of all workers in insured commercial banks were employed by the 267 largest banks of this kind, and only one-tenth by the 8,000 smallest banks. The 267 largest institutions, which represented only about 2 percent of all insured commercial banks, averaged well over 1,000 employees each; and the 8,000 smallest, which accounted for about two-thirds of all banks of this kind, averaged only 8 employees each.

Employment Outlook

Bank employment is expected to grow rapidly during the 1960's. In addition to the new jobs thus created, an even greater number of openings will arise as employees, many of them women, leave their jobs to take care of their families, to retire, or for other reasons. Altogether, banks may well have more than 100,000 jobs to fill each year during the next decade. These openings will be chiefly in large city banks, which account for the bulk of bank employment. However, many opportunities are likely to arise also in smaller communities, particularly in branch banks. The number of branch banks has been increasing for many years, and will probably continue to do so, as more people move to the suburbs of large cities, and new business centers are established to serve these communities.

Most of the openings in banks during the next 10 years will be in clerical occupations. In addition, young college graduates should find an increasing number of opportunities to begin in trainee jobs which may eventually lead to officer positions. There will also be some openings for professional and specialized personnel, including lawyers, accountants, programmers, and personnel workers.

The anticipated rise in bank employment will continue a trend which has been observed for many years, and the reasons for it will be much the same as in the past. Population growth and the accompanying rise in production, sales, and national income will unquestionably lead to a growth in banking business and employment. More jobs will also be created as banks further expand their services to customers and seek new business. The “auto bank” branches and “drive-up” banking facilities built during recent years for the convenience of customers with parking problems, and the economy checking accounts introduced for people with moderate incomes are both bringing new business to many banking firms. Other services introduced by banks include accepting payments for utility bills, handling charge accounts for retail stores, and doing bookkeeping for business firms. More employees may be needed also as banks expand their services in such fields as the investment of employee pension funds and financing of housing developments.

As their business increases, banks will use more and more new and improved office machines—electronic equipment to sort and process checks, for example. Equipment of this kind is expected to save considerable worktime, particularly in large city banks, and may well reduce the number of clerks needed to handle a given volume of work. In the banking industry as a whole, however, mechanization is unlikely to eliminate the need for more workers.
Bank employees can anticipate steadier employment than workers in many other fields, because they are less likely to be affected by layoffs during periods when the general level of business activity is low. Even when a bank is sold or merged with another bank, it usually continues to do business, and there is little likelihood that workers will lose their jobs. Whenever bank officials find it necessary to curtail employment, they usually do so by not replacing employees who retire or quit their jobs for other reasons; although this serves to reduce the number of openings for new employees, it also avoids the necessity of laying off experienced personnel.

**Earnings and Working Conditions**

Information on the earnings of nonsupervisory clerical employees is available from a 1960 survey covering banks in 27 metropolitan areas throughout the country. Women employed as routine file clerks—one of the jobs often filled by beginners—averaged from $45.50 to $62 a week in the different cities surveyed. The city averages for transit clerks, who also do routine work, were roughly the same as for file clerks in most of these cities, or else slightly higher; and for proof machine operators and bookkeepers doing routine work, average earnings were a little higher still. In most cities, the highest paid of all the nonsupervisory office workers included in the survey were secretaries, whose average earnings ranged from $69 to $91 a week. For experienced men tabulating machine operators, the averages were almost as high—$65 to $89 a week. In most cities, the average earnings of men employed as transit clerks and proof machine operators were from $1 to $5 or more a week higher than the earnings of women in comparable positions.

Among tellers, many of whom are on specialized jobs, salary differences were even greater than among office employees. In many cases, men were paid salaries somewhat higher than the salaries of women in comparable jobs. Average salaries ranged all the way from $49.50 a week for women with less than 5 years' experience, who were employed as commercial and savings tellers in one city surveyed, to $106 for experienced men employed in another as note tellers—generally the highest paid of all specialized teller jobs.

Salary levels for all of these nonsupervisory clerical workers varied considerably in different sections of the country. In the cities surveyed, salaries were generally highest in New York City and Chicago, and in the Los Angeles–Long Beach and San Francisco–Oakland areas, and lowest in Providence, St. Louis, and in the South (except for Houston and Washington, D.C.)

Recent college graduates hired as executive trainees in large city banks usually started at $4,000 to $5,500 a year in 1960, according to the limited information available. Most executive trainees, after they have gained experience and assumed the responsibilities of bank officers, can expect considerable salary advancement. A junior executive in a large city bank, earning about $10,000 a year, may, after some years' experience and promotion to a more responsible position, earn more than twice that figure. For senior bank officers, salaries may be still higher. Salaries for officers as well as other employees are generally lower in small town banks than in big city banks.

Most bank employees work a 40-hour week, according to the 1960 survey previously mentioned. Many banks, particularly in the northeastern part of the country, have a scheduled 37½-hour week and a few, principally around the New York City area, a 35-hour week. In some banks, however, daily hours may be irregular. Tellers and other employees may have to work late hours at least once a week, and accounting department employees may work overtime during peak periods which occur at the end of each month.

The number of paid holidays for bank employees in the cities surveyed ranged all the way from 5 a year in two cities to 12 or more in several others. In the South and North Central parts of the country, it was fairly common for banks to pay their employees for 5 or 6 holidays a year, in the West for 7 or 8, and in the Northeast (as well as in some large cities elsewhere) for 11 or 12.

Usually, bank employees are given a 2-week paid vacation after 1 year's service. Many
banks allow a 3-week vacation after 10 or 15 years' service, and a 4-week one after 25 years. Group life insurance and hospitalization and surgical benefit plans are available to many employees. Retirement plans, frequently financed jointly by employer and employee contributions, are also common in banking.

Work in banks is generally carried on in clean, well-lighted, and often air-conditioned office space. Most clerical work in banks requires no strenuous physical exertion, and a number of jobs can be performed by moving about in a limited work area. This affords some job opportunities for people with certain physical handicaps.

**Where To Go for More Information**

Information on jobs in banking may be obtained from your local bank and your State bankers' association. General information on banking occupations and on training opportunities offered by the banking industry is available from:

American Bankers Association,
12 East 36th St., New York 16, N.Y.

For additional information on salaries of clerical workers in banking, see:

Wage Structure: Banking Industry, Mid-1960,
(BLS Report 179). Bureau of Labor Statistics,
U.S. Department of Labor, Washington 25, D.C.

### Bank Clerks and Related Workers

**Nature of Work**

Many thousands of employees in banks are bookkeepers, office machine operators, messengers, or clerks who are assigned to specialized functions. The exact duties they perform vary with the size of the bank and the nature of its business. In a small bank, a clerk may work in a combination job as both messenger and clerk, for example, or as proof machine and bookkeeping machine operator; still other clerks may file materials, operate the switchboard, give routine information to the public, operate duplicating or other office machines, and help with sorting and listing of checks and other items. In large banks, clerks are usually assigned to specific jobs such as those discussed below.

Bookkeeping clerks may cancel and file checks, sort and list various items, and alphabetize material for experienced bookkeepers. **Transit clerks** (D.O.T. 1–01.43; 1–06.21, .22, and .24; 1–25.03) sort checks and drafts on other banks according to routine instructions, list sorted items on cash letters, and mail checks and cash letters for collection purposes. **Mortgage clerks** (D.O.T. 1–37.34) may type legal papers affecting title to real estate, record the transaction, and maintain a record card file.

Some of the office machines commonly used in banks are adding machines, proof machines, and bookkeeping machines. Most check sorting is done by **proof machine operators** (D.O.T. 1–25.68). The proof machines which they operate have keys for sorting checks and for adding and recording amounts involved, in a single operation. Proof machine operators may also help prepare monthly statements of customers' accounts for mailing.

Bookkeeping machine operators maintain records of customers' accounts. The proof department forwards deposit slips and paid checks to
the bookkeeping machine operator who arranges them in proper order. Then, using the bookkeeping machine, the operator adds deposits and subtracts withdrawals on statement cards kept for each customers' account. The bookkeeping machine operator may also cancel and file checks, furnish information about balances in customers' accounts and prepare customers' statements for mailing. In many banks, the title of bookkeeper is assigned to these workers and, in some cases, to bookkeeping clerks as well. Very few hand bookkeepers are employed in banks today.

*Bank messengers* (D.O.T. 1–06.27) are responsible for the safe delivery of banking items such as checks, drafts, and letters. They make trips to other banks, branches of the same bank, business firms, and often government agencies in the local area. Messengers in many banks are older men who, although still active, can do only light work. Inside messengers or pages, who may be men or women, run errands within the bank and may also do simple clerical tasks.

Other bank clerks do work similar to that performed by people in the same occupations in all industries. (Information about some of these occupations is given in the chapter on Clerical and Related Occupations in this Handbook. See index for page references to statements on Bookkeeping Workers, Office Machine Operators, and Electronic Computer Operating Personnel.)

**Training, Other Qualifications, and Advancement**

High school graduation is adequate preparation for most clerical entry jobs in banks. For the majority of jobs, business education courses such as bookkeeping, shorthand, typing, and business arithmetic are considered desirable. In addition, since bookkeeping, adding, and calculating machines are widely used in banks, courses in machine operation are helpful. Before an applicant is hired, he is usually given a personal interview by at least one bank official and may be given an intelligence test and a clerical aptitude test—the latter to determine his speed and accuracy.

Young men and women without previous experience may be hired for many of the jobs already mentioned, such as file clerk, bookkeeping clerk, and transit clerk. They may also be hired and trained by the bank to operate proof, bookkeeping, and other office machines designed especially for use in banks. Whereas formerly most beginners were hired as inside messengers, now only a limited number of bank employees start out in such work.

An employee in a routine clerical job may eventually be promoted to a minor supervisory position, next to teller or credit analyst, and then to a senior supervisory position. A limited number of opportunities for advancement to bank officer also exist for outstanding employees, although an increasing number of banks give preference to persons with college training in selecting officers. Additional education obtained while employed, particularly the completion of courses offered by the American Institute of Banking, may be helpful in advancement. Since most banks follow a “promotion-from-within” policy, length of service is also an important factor in advancement.

**Employment Outlook**

Thousands of openings for bank clerks and related workers can be expected each year through the mid-1960's. Most of them will probably result from high turnover rates—common in many clerical occupations where the majority of workers are women. Other jobs will arise as new banks and branch banks are opened, particularly in suburban areas of large cities, and as long-established banks expand their services.

Over the long run, the number of clerical workers will probably continue to rise, with the continued expansion in banking business. However, the increased use of automatic office equipment is likely to cause some changes in the kinds of clerical job openings that occur in banks. As more mechanical equipment is introduced, there will be relatively fewer routine and repetitive jobs for clerical workers such as check sorters, file clerks, and some kinds of office machine operators. The jobs thus eliminated are unlikely to be numerous enough to result in any reduction in total clerical employ-
ment; in the past, it has been apparent that, as machines have taken over work handled by clerical employees, many banks—particularly the largest ones—have been quick to reassign their clerks to jobs as operators of their newly acquired mechanical equipment or to other duties related to the many new functions and services they have introduced for their customers. They will undoubtedly continue to do so for some years to come. For bank clerks and related workers as a group, employment will continue to rise, although somewhat less rapidly than in the past.

(See introductory section of this chapter for more information on Employment Outlook, Where Employed, Earnings and Working Conditions, and Where To Go for More Information.)

Tellers

(D.O.T. 1-06.02 through .04)

Nature of Work

Every bank—no matter how small—has at least one teller to receive and pay out money and record these transactions. The great majority of people in this occupation are the paying and receiving tellers with whom most people deal when they transact business at banks. A paying and receiving teller begins work on a typical day by obtaining his cash box from the vault. If he thinks he will need more money in the course of the day's work, he orders more cash. During the hours the bank is open to the public, a teller is mainly occupied with cashing customers' checks and handling deposits and withdrawals. Before he cashes a check, he must verify the signature and identity of the person to whom he makes payment, and be certain that the bank account against which the check is drawn is adequate to cover the payment. In handling a deposit, the teller checks the accuracy of the deposit slip and makes an entry in a passbook or on a deposit receipt. Sometimes tellers use machines to make change and total deposits.

After public banking hours, a paying and receiving teller "proves" his cash. He usually counts the cash on hand, lists the currency-received tickets on a settlement sheet and makes any adjustments necessary to balance his day's accounts, and takes the settlement sheet to the proof department. He may also perform other incidental tasks such as sorting checks and deposit slips, filing new account cards, and removing closed account cards from files. A paying and receiving teller may supervise one or more clerks assigned to assist him.

Other kinds of tellers, employed mostly in large banks, are usually identified by the special kinds of financial transactions which they handle or the department to which they are assigned. Some, for example, deal only with Christmas club accounts, or deposits and withdrawals from regular savings accounts. Trust tellers specialize in receiving and issuing receipts for payments on promissory notes, while the work of discount tellers involves issuance and collection of customers' notes. Among the

Tellers receive deposits and cash checks for customers.
most responsible tellers jobs is that of the note
teller, who computes interest on notes and
handles collateral and payments on loans.

An estimated 75,000 tellers were employed in
banks of all types in 1960. Probably at least
half of them were women.

Training, Other Qualifications, and Advancement

In filling teller positions, banks generally
follow a "promotion-from-within" policy. Em­
ployees with experience in bookkeeping or other
clerical bank work—positions which usually re­
quire at least a high school education—are the
ones most often promoted to teller jobs. Both
seniority and ability, as demonstrated on the
job, are considered in selecting employees for
such advancement.

A new teller usually learns his duties by
working under the supervision of an experi­
enced one. However, some banks conduct for­
mal training programs for these employees.

Much of the teller's work involves contact
with the public, and it is therefore important
that these workers be neat in appearance, and
tactful and courteous in manner. Many custom­
ers judge a bank's services principally by
the impressions they receive in their dealings
with tellers. Accuracy, quickness, and a good
memory are all important in this job. Also,
since they handle large sums of money, tellers
must be able to meet the standards established
by bonding companies.

A teller who performs ably for several years
is in line for promotion to head teller or to some
other supervisory position, except in banks too
small to have such positions. Experienced tel­
lers may eventually qualify for promotion to
bank officer positions, particularly if they have
had college training or are high school gradu­
ates who have taken the specialized courses of­
fered by the banking industry.

Employment Outlook

The number of tellers in the Nation's banks
is expected to increase during the 1960's with
rising volume of banking transactions. In­
creased use of mechanical equipment, such as
change-dispensing and adding machines, can
be expected to take over some routine work now
done by many tellers, but mechanization is
likely to have less effect on employment in this
occupation than in many other types of cler­i­
cal positions.

Many additional employment opportunities
will arise as workers retire or leave their jobs
for other reasons. Among the thousands of
women tellers, many are likely to stop working
after a few years because of family responsi­
bilities which require them to remain at home.

(See introductory section of this chapter for
further information on Employment Outlook,
Where Employed, Earnings and Working Con­
ditions, and Where To Go for More Informa­
tion.)

Bank Officers

(D.O.T. 0-85.10; 0-97.01 through .05, .14; 0-98.01 through .06, .08, .11 through .13)

Nature of Work

Practically every bank has at least three
kinds of officers—a president, who exercises
general direction over all operations, one or
more vice-presidents, who either act as general
bank managers or have charge of particular
departments; and a comptroller or cashier who
(unlike cashiers in stores and other businesses)
is an executive officer generally responsible
for bank funds. Small banks are sometimes man­
aged almost entirely by such officers. Large
banks may also have treasurers and other
senior officers, as well as several assistant offi­
cers, in departments such as trust, credit, in­
vestments, and real estate.

A bank officer makes decisions within the
framework of policy as set by the board of
directors. His job requires a broad knowledge
of business activities, which he must relate to
the operations of the particular department
involved. For example, the loan officer must
exercise his best judgment in approving loans,
bearing in mind general business conditions
and the local community situation. He must
evaluate carefully the reports of credit analysts (who may be executive trainees) on the individual or business firm applying for a loan, and balance the favorable and unfavorable elements in reaching a decision. Similarly, the trust officer must have a thorough understanding of a particular trust agreement, in order to manage a fund or estate properly. Moreover, only the wise investment of trust funds will make it possible to carry out trust agreements, which may involve provision for sending a young person to college or paying pensions to employees. Besides supervising financial services, bank officers are frequently called upon to advise individuals and businessmen and to participate in community projects.

Banking institutions of all kinds employed about 115,000 officers in late 1960. Women, most of whom were assistant cashiers, represented about one-tenth of the total.

Training, Other Qualifications, and Advancement

In recent years, banks have shown a marked preference for college graduates in selecting persons to be trained for officer positions. Many of them send representatives to college campuses to recruit members of the graduating class for this training. However, outstanding individuals with experience in banking, even though not college graduates, are sometimes considered for executive trainee jobs also.

Specialized college education is seldom required for executive trainee positions. A business administration curriculum with a major in banking is considered excellent preparation; other helpful majors are accounting, finance, or statistics. A liberal arts curriculum with some courses in the fields mentioned and in economics, political science, and commercial law, is usually considered good preparation. Courses in English composition are also desirable.

In-service training aimed at developing future bank officers is given in most banks. Programs are generally designed to give a trainee the “feel” of banking and to help bank officers determine the position for which the employee is best suited in the long run. Most large city banks have well-organized training programs, ranging from 6 months to 2 years in length. Trainees may work as credit or investment analysts, or be rotated among various jobs in several bank departments. In smaller banks, trainees may be assigned to teller positions. In other programs, trainees study, observe, and write reports on the operations of the departments to which they are assigned. Though many small banks cannot operate formal officer-trainee programs, they usually have some plan designed to help promising employees gain enough understanding of various banking operations to qualify for later advancement.

Advancement to officer positions may come slowly in small town banks, which are often operated largely as family enterprises and in which little turnover occurs. In large city banks with special training programs, initial promotions may come more quickly. However, many years of service are usually required to obtain the thorough knowledge of bank operations, bank customers, and the community needed to qualify for senior officer positions.

Although experience, ability, and leadership qualities receive great emphasis when promotions are made, advancement may also be accelerated by special study. Courses in every phase of banking are offered by the American Institute of Banking, a long-established, industry-sponsored school. The courses are usually offered locally and most banks pay the tuition fees for employees who have successfully completed their courses. More advanced
training is offered in programs sponsored jointly by universities and bankers' associations; one of the better known is the Stonier Graduate School of Banking conducted each summer at Rutgers University, by the American Bankers Association.

**Employment Outlook**

The number of bank officers in the country is expected to increase fairly rapidly during the 1960’s. Some new positions will be created by the expected expansion of banking activities. Others will probably develop because of the increasing use of electronic computers which makes possible more extensive analysis and planning of banking operations. In addition to these new positions, about 5,000 openings can be expected each year, according to an industry estimate, because of the need to replace officers who retire or leave their jobs for other reasons.

Most of the officer positions which become available will continue to be filled by promoting people who have already acquired experience in banking operations. Competition for such promotion is likely to remain keen, particularly in the largest banks. College graduates who meet the standards for executive trainees should find good opportunities for entry positions, however.

(See introductory section of this chapter for more information on Employment Outlook, Where Employed, Earnings and Working Conditions, and Where To Go for More Information.)
Electricity has been a vital force in America's tremendous technological development over the past 75 years. It not only provides power for the production of the Nation's goods and services, but also heats, cools, and lights homes, offices, factories, and farms. More than 58 million customers are served today by our electric utility systems.

Many different types of workers are needed to provide and maintain electric utility services. These include power plant operators, linemen, meter readers, electricians, engineers, research scientists, technicians, and workers in office occupations. In many communities, the local utility system offers men and women opportunities for interesting and steady jobs.

Nature and Location of the Industry

The electric light and power industry is made up of approximately 3,800 private and government (Federal, State, and municipal) utility systems. These systems include powerplants in which electric energy is made (generated), substations where the voltage (measure of electric power) is increased or decreased as needed, and a vast network of transmission and distribution lines.

The delivery of electricity to the user at the instant he needs it is the distinctive feature of the operation of electric power systems. Electricity is a form of energy which cannot be efficiently stored but must be used at the same moment it is produced. A customer can begin to use electric power or increase his use at any time by merely flicking a switch. For this reason, a utility system must have sufficient capacity to meet peak consumer needs at any time during the day or night.

Some utilities generate, transmit, and distribute only electrical energy; others produce both electricity and gas. This chapter is concerned with employment opportunities only in those jobs relating to the making and sending of electric light and power in both types of utilities.

In 1960, private and government utility systems employed approximately 460,000 workers to provide electric light and power. Privately owned systems which generate and distribute electricity only, employed about 260,000 of these workers. Private systems which produce both gas and electricity employed about 115,000 workers in connection with electric services. Federal, State, and municipal government systems employed the remainder—an estimated 85,000 workers. A few large manufacturing industries which produce electric power for their own use also employed some electric light and power workers.

Electric utility service now reaches into almost every locality. Electric utility jobs are found in small towns and in rural areas as well as in urban communities throughout the Nation. Most of them, however, are in the more heavily populated areas, especially where there are many industries. Cities have a larger share of electric utility jobs, not only because they have more customers, including large industrial users, but also because the headquarters of most of the large systems are in the cities. The extension of electric service into rural areas in recent years has brought more jobs into the smaller towns. Hydroelectric power projects have created some electric utility jobs in relatively isolated areas.

Electric Light and Power Processes and Activities

The production and distribution of large quantities of electric power involves many processes and activities. To carry on these proc-
esses, workers are needed in many different jobs. In 1960, about 12 percent of the workers were employed in jobs in generating plants. About 21 percent were in jobs related to the transmission and distribution of power to customers. Because of the need to keep the great amount of equipment and the plants in good working order, about 18 percent of the workers were employed in maintenance, repair, and other jobs. About 10 percent were in customer servicing jobs. More than 30 percent were employed in administrative and clerical jobs and about 9 percent were in engineering and technical jobs.

The following brief description of how an electric utility system operates provides a clearer picture of the nature and organization of the jobs in this industry. Chart 28 shows how electric energy is generated, and how it travels from the generating station through the transmission and distribution systems to the individual users.

Powerplant Operations. The first step in providing electric power for consumers is the production of electricity in powerplants by generators. Most electric power is generated by means of steam power or water power. Some small generators are operated by internal combustion engines—the Diesel engine is the most common type used. Today, electricity is produced primarily in steam-powered generating plants which use coal, gas, or oil to produce the steam power. It is also produced in hydroelectric
powerplants which use water power to generate electricity. Atomic energy is also used as a fuel to produce steam power, but accounts for only a very small proportion of the total electric power generated in the United States today.

After electricity is generated, but before it flows through the powerlines leading away from the generating station, it passes through a "switchyard" where the voltage is increased.

Basic equipment used in power generating plants includes boilers; turbines; generators, auxiliary equipment such as condensers (which change the steam back to water), fans, blowers, compressors, water pumps, and coal handling equipment; and switchboards.

Jobs which are basic to the operation of a powerplant include those of boiler operator, turbine operator, and auxiliary equipment operator. These operators watch over, check, and take readings on the operation of this equipment. Another basic powerplant job is that of switchboard operator. From a switchboard in the control room of the plant, he controls the flow of the electric current from the generators to the powerlines. Watch engineers supervise powerplant operations and employees.

Transmission and Distribution Operations. After electricity leaves the powerplant, it passes onto transmission lines which link the generating plant to the distribution network serving the individual customers. Transmission lines may carry electricity from a distant powerplant to the city where it is to be used, or they may carry the electricity from a power station in a city to distribution substations in the various neighborhoods or in outlying areas. Transmission lines also tie together the generating stations of a single utility system or the power facilities of separate systems. In this way, power can be interchanged to meet varying demands.

Electric power is sent from the generating plants through a transformer in a step-up substation in which the voltage is raised in order to send electricity over transmission lines without excessive loss of power. Transmission lines may be carried on tall steel towers or wooden poles across the countryside or they may be buried in underground cables in cities. The transmission system ends at a step-down substation where transformers reduce the voltage to a point at which the power can be passed on to the distribution lines which carry it to the consumers.

Large factories, apartment houses, hotels, and office buildings may receive their electric current by direct wire from substations. Schools, stores, farms, and homes get their current from distribution lines leading away from the substations. However, the current, even though its voltage has been reduced at the substation, is still too high to use for lights and appliances. Therefore, the voltage is further reduced by small transformers mounted at points where secondary lines branch off to individual customers. Distribution lines are usually strung from cross arms mounted on wooden poles, but in heavily populated sections of cities, they may be carried in underground cables.

The most important jobs in the transmission and distribution operations are those of the men who control the flow of electricity—the load dispatchers and the substation operators—and the men who construct and maintain the powerlines—the linemen, cable splicers, troublemen, and their helpers.

Customer Service. As the electric power enters the wiring system of a customer's building, the amount of electricity is measured by a meter installed by the local utility company, so that the customer can be charged for the power he has used. Workers in customer service jobs include meter readers, metermen, and district representatives.

The duties and training of, and employment outlook for, workers engaged in powerplant, transmission, and distribution operations, and in customer services are discussed separately later in this chapter.

Maintenance and Other Activities. A considerable number of workers are engaged in maintaining and repairing the equipment used by the electric utilities. The duties of these skilled craftsmen are similar to those of maintenance workers in other industries. Among the more important skilled workers are electricians, instrument repairmen, maintenance mechanics,
machinists, plumbers, and boilermakers. Some of the other workers employed are guards, watchmen, and janitors.

**Engineering and Scientific Activities.** Many interesting job opportunities are available for engineers and technical workers in electric utilities. Engineers plan generating plant additions and installations of new transmission and distribution equipment, and supervise their construction and installation. They develop improved operating methods and test the efficiency of the many types of electrical equipment. They may also plan entire utility systems. In such work, engineers deal with problems such as the selection of plant sites, type of fuel, and type of plant. Engineers also help industrial and commercial customers make the best use of electric power for equipment and lighting. They stimulate greater use of electricity by demonstrating the advantages of electrical equipment and suggesting places where electricity can be more effectively used. About 8 percent of the total industry employment is made up of engineering, scientific, and technical personnel such as engineers, chemists, draftsmen, and engineering aids.

**Administrative and Clerical Activities.** Because of the enormous amount of recordkeeping necessary to run the business operations, electric utilities employ a greater proportion of administrative and clerical personnel than many other industries. Nearly a third of the industry's work force is employed in clerical and administrative jobs. Many of the workers in these jobs are women. Large numbers of stenographers, typists, bookkeepers, office machine operators, file clerks, accounting and auditing clerks, and cashiers are employed. These workers keep records of the services rendered by the company, make up bills for customers, and prepare a variety of statements and statistical reports. An increasing amount of this work is now being performed by the electronic data-processing equipment recently introduced in this industry. This has generally resulted in more clerical work being done with the same or fewer employees. The use of this equipment is creating some new jobs such as programmer and console operator. Administrative employees include specialized workers such as accountants, personnel officers, purchasing agents, lawyers, and salesmen.

(Detailed discussions of professional, technical, mechanical, and other occupations found in the electric light and power industry as well as in many other industries are given elsewhere in this Handbook, in the sections covering the individual occupations. See index for page numbers.)

**Employment Outlook**

Several thousand job opportunities for new workers in electric utilities will occur each year during the 1960's. Overall employment in the industry is expected to increase only slightly above the approximate 460,000 employed in 1960. Job opportunities will arise mainly because of the need to replace workers who retire, die, or leave the industry for other employment.

The electric light and power industry has grown rapidly since its beginning in 1882, but its greatest growth has been since World War II. The capacity of electric generators and the production of power tripled between 1947 and 1960. Future needs for electricity can best be understood by considering the needs of the principal groups of customers.

In 1960, industrial customers such as chemical plants, metal processing plants which produce aluminum and steel, and automobile plants purchased nearly half of all electric power sold by utility systems. These plants are expected to increase their use of electricity during the 1960's because of its many new uses in industrial processes and the favorable outlook for industrial growth.

Residential customers purchased more than a fourth of the electric power produced by utility systems in 1960. The rapid growth in population, increase in new family units, introduction of new electric appliances, and wider use of all electric appliances will create an increased need for electric power by this group of customers during the 1960's.

Commercial customers such as stores, office buildings, hotels, and theaters used more than 17 percent of the electric power produced in
1960 for light, heat, air conditioning, and electric display signs. The expected construction of new stores and office buildings and the modernization of present buildings during the 1960's will increase the use of electric power by commercial customers.

Local, State, and Federal agencies, farms, and electrified railroads, consumed the remainder of the electric energy produced in 1960. Many of these customers are expected to increase their use of electric power during the 1960's.

Employment in the electric light and power industry has generally grown at a much slower rate than the increase in capacity and production. There are several reasons for this difference. The most important has been the use of large, mechanized equipment in generating plants and transmission and distribution departments. Since operators are needed chiefly to check gages and to control instruments, improvements in equipment have made possible great increases in the industry's capacity and production with only a small increase in the number of workers.

Continuing developments of larger, more mechanized, and automated equipment will affect the number of new workers needed in generating plants. The introduction of new equipment for the transmission and distribution of power, requiring less maintenance and line work; more efficient billing and recordkeeping systems; and the increasing use of electronic data processing equipment will result in only a small increase in employment despite the expected doubling of capacity and production during the 1960's, owing to the increased use of electricity.

However, there will be some differences in the rates of growth among the various occupational groups employed by the electric utilities. For example, employment of maintenance craftsmen will increase at a faster rate than most other occupational groups because of the need to maintain the growing amount of complex machinery and equipment. On the other hand, employment of substation operators will decline. Since completely automatic equipment is being installed in all but the largest substations, the number of substation operators will be reduced considerably. (The employment outlook for some of the important electric utility occupations is discussed at the end of this chapter.)

Earnings and Working Conditions

Earnings in the electric utility industry are generally higher than in other public utility industries and in many manufacturing industries. In January 1961, nonsupervisory employees of electric light and power utilities averaged $2.76 an hour or $112.61 a week.

Most nonsupervisory electric utility workers in the production, transmission, and distribution departments are union members. The bargaining representative for most of these workers is either the International Brotherhood of Electrical Workers or the Utility Workers Union of America, both affiliated with the American Federation of Labor–Congress of Industrial Organizations (AFL–CIO). Some utility workers are represented by independent, unaffiliated unions.

Because electric utility companies give continuous service to their customers, supplying electricity is a 24-hour, 7-day-a-week activity. Therefore, some employers must work schedules which include evenings, nights, and weekends. Most union contracts with electric utilities provide a higher rate of pay for evening and night work than the basic day rate. In 1960, workers on the second shift received from 6 to 12 cents an hour more than the basic day rate, and those on the third shift, from 9 to 15 cents an hour more.

Overtime work is sometimes required in this industry, especially during emergencies such as floods, hurricanes, or storms. During an "emergency callout," which is a short-notice request to report to work during nonscheduled hours, the worker is generally guaranteed a minimum of 3 or 4 hours' pay at 1 1/2 times his basic hourly rate, and travel time to and from the job is counted as worktime.

In addition to these provisions which affect the workers' pay, other benefits are provided by electric companies. Annual vacations are granted to workers according to length of service. Usually, contracts provide for a 1-week vacation for 6 months to 1 year of service, 2
weeks for 1 to 10 years, 3 weeks for 10 to 25 years, and 4 weeks for more than 25 years. The number of paid holidays ranges from 5 to 12 days a year, depending on locality. Nearly all companies have benefit plans for their employees. A typical program provides life, hospitalization, and surgical insurance and paid sick leave. Retirement pension plans supplement Federal social security payments, and are generally paid for by the employer.

The number of injuries per million man-hours worked is much lower in this industry than in most manufacturing industries. Workers in some occupations in this industry are more subject to accidents than others. Accidents occur most frequently among the line and cable splicing crews. Because of the dangers of electrocution and other hazards, electric companies and unions have made intensive efforts to enforce safe working practices. Utility companies have set up safety rules for employees to follow. Strict adherence to safety standards is required.

As a result, the accident rate has been declining in recent years. In 1958, there were 5.5 disabling injuries per million man-hours worked among the employees of electric utility systems, compared with an average of 10.9 in all manufacturing industries.

Where To Go for More Information

More information about jobs in the electric light and power industry may be obtained from local electric utility companies or from the local offices of unions which have electric utility workers among their membership. If no local offices of the unions are listed in the telephone directory, write to the national headquarters of the following unions and ask them to refer your letter to their nearest branch:

International Brotherhood of Electrical Workers,
1200 15th St. NW., Washington 5, D.C.

Utility Workers Union of America,
1413 K St. NW., Washington 5, D.C.

Powerplant Occupations

Nature of Work

Powerplant operators are the key workers in a powerplant. They are responsible for watching, checking, controlling, and keeping records of the operation of various kinds of equipment. They must see that the equipment is functioning efficiently and detect instantly any trouble which may arise. There are four basic classes of powerplant operators—boiler, turbine, auxiliary equipment, and switchboard operators. Other powerplant workers include maintenance and repair men, coal handlers, and cleaners. Supervision of powerplant operations is handled by a chief engineer and by his assistants, the watch engineers.

Boiler operators (D.O.T. 5-72.930) regulate the fuel, air, and water supply used in the boilers, and maintain proper steam pressure needed to turn the turbines, on the basis of information shown by control valves, meters, and other instruments mounted on panelboards. One man may operate one or more boilers. In some powerplants, coal is fed to the boilers by mechanical coal stokers. In more modern plants, pulverized coal, oil, or gas is piped into the boilers. Boiler operators, of course, are employed only where steam, produced in boilers, is used to generate electricity. None are needed in hydroelectric plants because in such plants waterpower instead of steam is used to generate electricity.

Turbine operators (D.O.T. 5-51.120) operate the turbines and generators. (In small plants, they may also operate auxiliary equipment or a switchboard.) Modern steam turbines and generators operate at extremely high speeds, pressures, and temperatures; therefore, close attention must be given the pressure gages, thermometers, and other instruments which show the operations of the turbogenerator unit. Turbine operators record the information shown by these instruments, check the oil pressure at bearings, the speed of the turbines, and the circulation and amount of cooling water in the condensers which change the steam back into water. They are also responsible for starting and shutting down the turbines and generators as directed by the switchboard operator in the
control room. Other workers, such as helpers, and junior operators assist the turbine operators.

*Auxiliary equipment operators* (D.O.T. 5-51.115) operate pumps, fans, and blowers, condensers, evaporators, water conditioners, compressors, and coal pulverizers. They check and record the reading of instruments which show how the equipment is functioning. Since auxiliary equipment may go out of order occasionally, the operators must be able to detect trouble quickly, make accurate judgments, and sometimes make repairs. This equipment, which is used only in steam operating plants, is essential to the powerplant operations since it is directly connected with the operation of the boilers and the turbines. As powerplants become larger, auxiliary equipment increases in complexity and size and more of it is required to operate the plants.

In some of the smaller plants, there are no separate auxiliary equipment operators. The turbine operators handle this work along with their other duties. In large plants, however, auxiliary equipment operators often outnumber turbine operators.

*Switchboard operators* (D.O.T. 5-51.130) control the flow of electric power in the generating station from generators to outgoing powerlines. They usually work in a control room which is equipped with switchboards and instrument panels. Switches control the movement of electricity through the generating station circuits and onto the transmission lines.

Instruments mounted on panelboards show the power demands on the station at any instant, the powerload on each line leaving the station, the amount of current being produced by each generator, and the voltage. The operators use switches to distribute the power demands among the generators in the station, to combine the current from two or more generators, and to regulate the flow of the electricity onto various powerlines to meet the demands of the users served by each line. When power requirements on the station change, they order generators started or stopped and at the proper time connect them to the power circuits in the station or disconnect them. In doing this work, they follow telephone orders from the load dispatcher who directs the flow of current throughout the system.

The switchboard operators and their assistants also check their instruments frequently to see that electricity is moving through and out of the powerplant properly and that correct voltage is being maintained. Among their other duties, switchboard operators keep records of all switching operations and of load conditions on generators, lines, and transformers. They obtain this information by making regular meter readings.

Plants with high generating capacity generally have more varied and complex equipment than smaller plants. Disturbances in the system may have far-reaching effects, and cause interruptions in service over a large area. Therefore, these operators check their lines and test their equipment more frequently than operators in smaller plants, and thus must have a greater degree of skill.

In some new powerplants, the duties of the switchboard operator are combined with those of boiler operator, turbine operator, and auxiliary equipment operator. In such cases, he is called a control room operator. Generally, these powerplants have controls for all departments centralized in the control room. From this cen-
entral control room, through closed television circuits, the control room operator, with several assistants, watches all powerplant controls and directs repairmen to make repairs on boilers, turbines, and other equipment when the instruments show that such equipment is not operating properly.

Watch engineers (D.O.T. 5–95.320) are the principal supervisory workers in a powerplant. They supervise the employees responsible for the operation and maintenance of boilers, turbines, generators, auxiliary equipment, switchboards, transformers, and other machinery and equipment. Watch engineers are supervised by a chief engineer or a plant superintendent who is in charge of the entire plant. In small plants, the watch engineer may be the top supervisory employee.

Training, Other Qualifications, and Advancement

New powerplant workers generally begin at the bottom of the ladder—usually on cleanup jobs. Such work gives beginners an opportunity to become familiar with the equipment and the operations of a powerplant. They advance to the more responsible job of helper as job openings occur. Formal apprenticeships in these jobs are rare.

It takes from 1 to 3 years to become a fully qualified auxiliary equipment operator and from 4 to 8 years to become a boiler operator, turbine operator, or switchboard operator. A person learning to be a boiler operator generally spends from 2 to 6 months as a laborer before being promoted to the job of helper. Depending on openings and the worker’s aptitude, the helper may advance to junior boiler operator and eventually to boiler operator, or transfer to the maintenance department and work his way up to boiler repairman. Most large cities require that boiler operators be licensed.

In many plants, turbine operators are selected from among the auxiliary equipment operators. The line of advancement in other companies is from laborer to turbine helper. The helper then may advance either to junior turbine operator and eventually to turbine operator, or he may transfer to turbine repairman, depending on job openings and his aptitude. Where a system has a number of generating plants of different size, operators first get experience in the smaller stations and then are promoted to jobs in the larger stations as vacancies occur. Most large cities require that turbine operators be licensed.

Switchboard operators work first as helpers, then as junior operators, and finally as senior operators. They also may advance from jobs in small stations to those in larger stations where operating conditions are much more complex. Some utility companies promote substation operators to switchboard operating jobs. The duties of both classes of operators have much in common. In the larger plants, switchboard operators can advance to the job of chief switchboard operator.

Watch engineers are selected from among experienced powerplant operators. At least 5 to 10 years of experience as a first-class operator are usually required to qualify for a watch engineer’s job.

Employment Outlook

There will be a moderate number of opportunities for new workers to obtain employment as powerplant operators during the 1960’s. Several hundred job openings will occur each year because of the need to replace operators who retire, die, or leave the industry for other fields of work. The total number of jobs for powerplant operators is not expected to increase, and may even decrease somewhat, although the capacity and production of electric utility systems is expected to double during this decade.

The use of larger and more efficient equipment has made possible great increases in capacity and production without corresponding increases in the number of workers. For example, one operator can control a large modern turbo-generator unit which produces 200,000 kilowatts as well as he can control a unit that produces half that amount. Also, the growing use of new equipment which has many automatic operating features reduces the number of operators needed. For example, in some generating plants, all operating processes are con-
controlled from a central control room. In this room, electronically operated instruments report and make a permanent record of the operations of boilers, turbines, and auxiliary equipment. Television screens even make it possible to watch the boiler fires from the control rooms. Thus, in plants with highly automatic equipment, one control room operator and his assistants do the work of boiler operator, turbine operator, auxiliary equipment operator, and switchboard operator.

The introduction of atomic energy as a fuel to replace coal, gas, and oil will not greatly affect the number or skill requirements of powerplant employees. Generally, about the same number and types of operators will be required to run an atomic-powered steam-generating plant as are required to operate steam-generating plants using more common fuels.

**Earnings and Working Conditions**

The earnings of powerplant workers depend on the type of job they have, the part of the country in which they work, and many other factors. The following tabulation shows estimated average hourly earnings for selected powerplant occupations in the United States in 1960:

<table>
<thead>
<tr>
<th>Occupation</th>
<th>Average hourly earnings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Auxiliary equipment operator</td>
<td>$2.51</td>
</tr>
<tr>
<td>Boiler operator</td>
<td>2.80</td>
</tr>
<tr>
<td>Control room operator</td>
<td>3.16</td>
</tr>
<tr>
<td>Switchboard operator</td>
<td>2.94</td>
</tr>
<tr>
<td>Turbine operator</td>
<td>2.86</td>
</tr>
<tr>
<td>Watch engineer</td>
<td>3.48</td>
</tr>
</tbody>
</table>

A powerplant is typically well lighted and ventilated and its interior is clean and orderly. Even steam plants are generally clean, since coal is handled by mechanical equipment separated from principal work areas. The turbine room is airy and clean, but there is usually considerable noise from the whirling turbines.

Switchboard operators in the control room often sit at the panel boards, but boiler and turbine operators are almost constantly on their feet. The work of powerplant operators is generally not strenuous, particularly in the newer powerplants. Since generating stations operate 24 hours a day, 7 days a week, powerplant employees sometimes must work nights and weekends, since they work on a schedule of three 8-hour shifts.

**Transmission and Distribution Occupations**

**Nature of Work**

More than a fifth of the workers employed by electric light and power systems are in transmission and distribution jobs. These workers are primarily employed in getting electric power to the users. The principal workers in transmission and distribution jobs are those who control the flow of electricity—load dispatchers and substation operators—and the men who construct and maintain powerlines—linemen, cable splicers, troubleshooters, groundmen, and helpers. Linemen make up the largest single occupation in the industry.

*Load dispatchers* (D.O.T. 5-51.520) (sometimes called system operators or power dispatchers) are the key operating workers of the transmission and distribution departments. They control the flow of electricity. The load dispatcher's room is the nerve center of the entire utility system. From this location, the dispatcher controls the plant equipment used to generate electricity and directs its flow throughout the system. He telephones his instructions to the switchboard operators at the generating plants and the substations. His instructions tell operators how power is to be routed and when additional boilers and generators are to be started or shut down in line with the total power needs of the systems.

The load dispatcher must anticipate demands for electric power so the system will be prepared to meet them. Power demands on utility systems may change from hour to hour. A sudden afternoon rainstorm can cause a million lights to be switched on in a matter of minutes, but boilers often must be heated for 2 hours before they are ready to produce sufficient steam for generating. Therefore, the load
dispatcher must keep in touch with weather reports from hour to hour. He must also be able to direct the handling of any emergency situation, such as a transformer or transmission line failure, and to route current around the affected area. Load dispatchers are also in charge of the interconnections with other systems, and they direct the transfer of current between systems as the need arises.

The load dispatcher's source of information for the entire transmission system centers in the pilot board. This pilot board which dominates the load dispatcher's room, is a complete map of the utility transmission system. It enables the dispatcher to determine at a glance the conditions that exist at any point in the system. Meters on the board show the output of individual power stations, the total amount of power being produced, and the amount of current flowing through the principal transmission lines. Red and green lights may show the positions of switches which control generating equipment and transmission circuits as well as high voltage connections with substations and large industrial customers. The board may also have several recording instruments which make a graphic record of operations for future analysis and study.

Substation operators (D.O.T. 5–51.210) are generally in charge of a substation and are responsible for its operation. Under orders from the load dispatcher, they direct the flow of current out of the station by means of a switchboard. Incoming energy from the powerplant is switched to the outgoing lines on which it is needed. Depending upon the type of substation, electrical voltage may be either raised or lowered. The flow of electricity from the incoming to the outgoing lines is controlled by the circuit breakers. The substation operators connect or break the flow of current by pushing or pulling the switches which control the circuit breakers. Ammeters, voltmeters, and other types of instruments located on the switchboard register the amount of electric power flowing through each line. In some substations, where alternating current is changed to direct current to meet the needs of special users, the operator controls converters which perform the change simultaneously.

In addition to switching duties, the substation operators check the operation of all equipment to make sure that it is in good working order. They supervise the activities of the other substation employees on the same shift, assign tasks, and direct their work. However, in small substations the substation operator may be the only employee.

Linemen (D.O.T. 5–53.420) construct and maintain the network of powerlines which carry electricity from the generating plants to the consumers. However, construction of transmission lines—the erection of the steel towers and the stringing of the lines between them—is generally contracted out to companies specializing in this work. Groundmen (D.O.T. 9–54.10) dig postholes and assist the linemen and apprentices to erect the wooden poles which carry the distribution lines. The linemen bolt crossarms to the poles or towers, and nail or clamp insulators in place on the crossarms. With the assistance of the groundmen, they raise the wires and cables and install them on the poles or towers by attaching them to the insulators. In addition, linemen attach a wide variety of equipment to the poles and towers, such as lightning arrestors, transformers, and switches.

Although the installation of new lines and equipment is important, much of the linemen's
work consists of repairs and routine maintenance. When wires, cables, or poles break, it means an emergency call for a line crew. Linemen splice or replace broken wires and cables and replace broken insulators or other damaged equipment.

In some power companies, linemen specialize in particular types of work. Those in one crew may work only on new construction and others may do only repair work. In some instances, linemen specialize on high voltage lines using special “hot line” tools to avoid interruptions in the flow of current.

Troubemen (D.O.T. 5–53.422) are linemen with several years of experience who are assigned to special crews which handle emergency calls for service. They move from one special job to another, as ordered by a central service office which receives reports of line trouble. Often troubemen receive their orders by direct radio communication with the central service office.

These workers must have a thorough knowledge of the company’s transmission and distribution network. They first locate and report the source of trouble and then attempt to restore service by making the necessary repairs. Depending on the nature and extent of the trouble, a troubleman may restore service in the case of minor failure, or he may simply disconnect and remove damaged equipment. He must be familiar with all the circuits and switching points so that he can safely disconnect live circuits in case of line breakdowns.

Cable splicers (D.O.T. 5–53.950) install and repair underground lines, performing about the same service as the linemen do on the overhead lines. When cables are installed, the cable splicers pull the cable through the conduit in which the cable is carried. The splicers then join the cables at connecting points in the transmission and distribution systems. At each connection or break in the cable, they wrap insulation around the wiring. They splice the wires leading away from each junction of the main cable, insulate the splices, and connect the insulated splices to the cable sheathing by means of a lead joint. Most of the actual physical work in the placing of new cables is done by the cable laying crew.

Cable splicers spend most of their time in repairing and maintaining the cables and changing the layout of the cable systems. Splicers must know the arrangement of the wiring systems, where the lines are connected, and where they lead to and come from. They test pairs of wires for electrical continuity and to make sure that the insulation is in good condition. They connect the ends of the wires to numbered terminals, making certain that they have the same identifying number at the remote panel box in an underground vault as they have in the control office.

Training, Other Qualifications, and Advancement

Load dispatchers are selected from among the experienced switchboard operators and operators of the larger substations. Usually, 7 to 10 years of experience as a senior switchboard or substation operator is required for promotion to load dispatcher. To qualify for this job, an applicant must demonstrate his knowledge of the entire utility system.

Substation operators generally begin as assistant or junior operators. It usually takes 3 to 7 years of on-the-job training to advance to the job of operator in a large substation. Workers begin in small substations and are promoted to larger stations as they become more experienced.

Skilled linemen (journeymen) usually qualify for such jobs after about 4 years of on-the-job training. In some companies, this training consists of a formal apprenticeship program. Under formal apprenticeship, there is a written agreement, usually worked out with a labor union, which covers the content of the training and the length of time the apprentice works in each stage of the training. The apprenticeship program combines on-the-job training with classroom instructions. Such instruction includes courses in blueprint reading, elementary electrical theory, electrical codes, and methods of transmitting electrical currents. At the beginning of 1960, 745 linemen were receiving training under formal apprenticeship programs.

The apprentice usually begins his training as a groundman; he assists the lineman by
helping to set poles in place and by passing tools and equipment up to him. After a training period of approximately 6 months, the apprentice begins to do simple linework on lines with low voltage. While on this work, he is under the immediate supervision of a journeyman lineman or the line foreman. After about a year, he is assigned more difficult work, but is still under close supervision. During the last part of his apprenticeship, the trainee does about the same kind of work as the journeyman lineman, but with more supervision. When he begins to work independently, he is first assigned less difficult routine tasks. After he acquires several years of experience and demonstrates a thorough knowledge of the company’s transmission and distribution systems, he may advance from lineman to troubleman.

The training of linemen under the informal method is generally similar to the apprenticeship program; it usually takes about the same length of time, but it does not involve classroom instruction. The worker begins as a groundman and progresses through increasingly difficult stages of linework before becoming a skilled lineman.

Candidates for linework should be strong and in good physical condition since climbing poles and lifting lines and equipment is strenuous work. They must also have steady nerves and good balance to work at the tops of the poles and to avoid the hazards of live wires and falls.

Most cable splicers get their training on the job, usually taking about 4 years to become fully qualified. Workers begin as helpers and are then promoted to assistant or junior splicers. In these jobs, they are gradually assigned more difficult tasks as their knowledge of the work increases.

At the beginning of 1960, there were about 290 cable splicers receiving training under formal apprenticeship programs.

**Employment Outlook**

A continued slow increase in the employment of transmission and distribution workers is expected during the 1960’s. Even though the total number of these workers is expected to increase only slightly during the 1960’s, there will be job opportunities for new workers. The need to replace workers who retire, die or transfer to other fields of work should provide a few thousand job opportunities each year.

There will be differences in the rate of employment growth among the various transmission and distribution occupations. Because of the need to construct and maintain the growing number of transmission and distribution lines which are anticipated in the 1960’s, the number of linemen and troublemen are expected to increase more rapidly than the other occupations. However, even for linemen, the increase will be moderate. Little increase in the number of cable-splicers is expected because most large cities are already equipped with underground line installations and little expansion of underground construction is anticipated because of its high cost compared with overhead wire installations. The need for substation operators will be substantially reduced because of the introduction of improved and more automatic equipment, and the growing number of completely automatic substations.

**Earnings and Working Conditions**

The earnings of transmission and distribution workers depend on the type of job they have and the part of the country in which they work. The following tabulation shows the average hourly earnings in the United States for major transmission and distribution occupations in 1960:

<table>
<thead>
<tr>
<th>Occupation</th>
<th>Average hourly earnings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Groundman</td>
<td>$2.06</td>
</tr>
<tr>
<td>Lineman</td>
<td>3.00</td>
</tr>
<tr>
<td>Load dispatcher</td>
<td>3.54</td>
</tr>
<tr>
<td>Substation operator</td>
<td>2.90</td>
</tr>
<tr>
<td>Troubleman</td>
<td>3.05</td>
</tr>
</tbody>
</table>

No recent earnings data are available for cable splicers; however, their earnings are generally about the same as those for linemen.

Load dispatchers and substation operators generally work indoors in pleasant surroundings. Linemen, troublemen, and groundmen work outdoors in all kinds of weather. Cable
splicers do most of their work in manholes beneath city streets—often in cramped quarters. Safety standards developed over the years by utility companies, with the cooperation of unions, have greatly reduced the accident hazards of these jobs.

Customer Service Occupations

Nature of Work

Workers in customer service jobs include those who install, test, and repair meters and those who read the meters. Also in this group are company agents in rural areas and appliance servicemen working in company-operated shops which repair electrical equipment owned by customers.

*Metermen* (D.O.T. 5–83.456) (or meter repairmen) are the most skilled workers in this group. They install, test maintain, and repair meters on customers’ premises, particularly those of large industrial and commercial establishments. Some metermen can handle all types of meters, including the more complicated ones used in industrial plants and in other places where large quantities of electric power are used. Others specialize in repairing the simpler kinds, like those used to record consumption of electricity in homes. Often, some of the large systems have meter specialists, such as *meter installers* (D.O.T. 5–83.450, .451) and *meter testers* (D.O.T. 5–83.452). Meter installers install and remove meters. Meter testers specialize in testing not only the small meters on homeowners’ property, but also the more complicated ones used in relay testing and control operations of the utility systems.

*Meter readers* (D.O.T. 1-49.94) go to customers’ premises—homes, stores, and factories—to read the figures on the meters which register the amount of electric current used. They record the amount of current used in a specific period so that each customer can be charged for the amount he used. Meter readers also watch for, and report, any tampering with meters.

*District representatives* usually serve as company agents in outlying districts, in localities where the utility company does not have an office and where the small number of customers does not justify the use of more specialized workers. Their work includes reading meters, collecting overdue bills, connecting and disconnecting meters, and making minor repairs on them. They receive complaints about service and reports of line trouble and send them to a central office for handling.

*Appliance servicemen* (D.O.T. 5–83.041) are employed by some electric utility companies to install, repair, and service electrical appliances either in the company’s shop or on the customers’ premises. In a large city where many appliance servicemen are employed, they may specialize in servicing only one type of appliance; however, the companies generally require that the servicemen know how to fix many types of appliances. (A detailed discussion of the duties, training, and employment opportunities in Appliance Servicemen Jobs appears elsewhere in this Handbook. See index for page numbers.)
Training, Other Qualifications, and Advancement

Metermen begin their jobs as helpers in the meter testing and meter repair departments. Young men entering this field should have a basic knowledge of electricity. About 4 years of on-the-job training is required to become a fully qualified meterman. Some companies have formal apprenticeship programs for this occupation in which the worker advances along well-defined lines of progression.

Utility companies usually employ inexperienced men to work as meter readers. They generally learn the job by accompanying the experienced meter reader on his rounds until they have learned the job well enough to go out on their rounds alone. This job can be learned in a relatively short time.

The duties of district representatives can be learned on the job in a relatively short time. An important qualification for men in these jobs is the ability to deal tactfully with the public in handling service complaints and collecting overdue bills.

Employment Outlook

Slowly rising employment is expected in this field of work in the 1960's. Because many new customers—homes, offices, factories, hotels, and stores—will be served by utility systems; a large number of meters will be needed. However this will require only a slight increase in the number of meter readers because of the trend toward reading meters every other month. Furthermore, since the new meters now being installed are better constructed and require less maintenance, there will be only a limited growth in the number of metermen needed. The need to replace workers who retire, die, or transfer to other fields of work will provide a small number of job openings for new workers each year.

Earnings and Working Conditions

The earnings of customer service workers vary according to the type of job and the part of the country in which they work. The following tabulation shows the average hourly earnings in the United States for major customer service jobs in 1960:

<table>
<thead>
<tr>
<th>Job</th>
<th>Average hourly earnings</th>
</tr>
</thead>
<tbody>
<tr>
<td>District representative</td>
<td>$2.87</td>
</tr>
<tr>
<td>Meterman</td>
<td>2.98</td>
</tr>
<tr>
<td>Appliance serviceman</td>
<td>2.73</td>
</tr>
</tbody>
</table>

Little information is available on wages of meter readers, but an examination of a few union-employer contracts indicates that their hourly rates averaged from $2.14 to $2.39 in 1960.

The job of the meter reader is not physically hard, but involves considerable walking and some stair climbing. Metermen and appliance servicemen work indoors under typical repair shop conditions except when repairing or installing meters or appliances on customers' premises.
ELECTRONICS MANUFACTURING OCCUPATIONS

Job opportunities in electronics manufacturing are expected to continue to expand rapidly over the 1960–70 decade. Electronic products, such as radar, television, radio, and computers, are being used increasingly in the Nation's defense—for example, in missiles and satellites—and in factories, offices, homes, schools, and hospitals. Opportunities will be particularly good for scientists, engineers, and technicians, as well as for skilled craftsmen. Women will find many opportunities in this field, mainly in production jobs, such as assembler, and in clerical jobs.

Nature of Electronics Manufacturing

Before World War II, the principal electronic products were radios, broadcasting equipment, other receiving and transmitting equipment, and electron tubes. With the rapid development of new electronic products during and after the war, the broader term “electronics manufacturing” or “electronics industry” came into general use.

Approximately 550,000 workers were employed in 1960 in plants which principally produced electronic end products, such as radios, radio and television equipment, radar and other detection apparatus, phonographs, and radio tubes. Many thousands of other electronics workers were employed in industries which principally produced nonelectronic equipment but also made electronic devices. For example, plants manufacturing computing and accounting machines also produced electronic computers.

The heart of every electronic product is an electronic circuit or system which includes electron (vacuum or gas filled) tubes, semiconductors, or photo-sensitive devices. These tubes and other electronic devices discharge, control, or direct the flow of small, active particles of negative electricity (electrons) through the circuit. Because of their unique functions, electronic devices are finding many applications. For example, they are used in computers which can perform hundreds of thousands of calculations per second; in control systems which guide missiles traveling at supersonic speed; and in equipment which can transmit, over hundreds of miles, clear pictures of events as they happen.

Electronic products may be grouped into five major categories: (1) military equipment, (2) consumer products, (3) industrial and commercial equipment, (4) electron tubes and semiconductor devices, and (5) other electronic components. Military products include electronic guidance systems for aircraft and missiles, radar and other detection devices, automatic communications and computing systems, navigational equipment, and fire controls (including rocket launching and guidance equipment and air-to-air target-seeking and detonating equipment). Consumer products include television sets, radios, phonographs, high fidelity and stereophonic equipment, tape recorders, automatic garage door openers, and hearing aids. Some important commercial and industrial electronic products are commercial radio and television broadcasting equipment, commercial and private aircraft communications and navigational apparatus, electronic computers, and industrial testing, measuring, and production control equipment. Electron tubes include receiving tubes, power tubes, television picture tubes, and special purpose tubes, such as those used in ultra-high frequency equipment; semiconductors include transistors, diodes, and rectifiers. Other electronic components include capacitors, resistors, transformers, relays, connectors, and switches.

Military equipment accounted for almost one-half of the nearly $6 billion total electronic equipment output in 1959, excluding research, development, test, and evaluation expendi-
Military equipment represents almost one-half of the total electronics output...

In plants which produce several types of end products or components, each type is generally made in a separate department.

Subassemblies such as tuners and record changers are often made by firms specializing in these products. Special types of subassemblies, such as those in military and industrial equipment, are usually made in the plants assembling these products.

A large proportion of workers in plants manufacturing end products are engaged in assembly operations. Inspecting and testing of subassemblies and end products are also important activities. Some of these plants have fabricating and processing departments in which workers do machining, sheet-metal work, and cleaning and coating of metals.

In assembling television sets and other end products, components and major subassemblies (such as tuners and speakers) are attached mainly by hand onto a chassis or printed circuit board or panel. Assembled units are then placed into metal, plastic, or wooden cabinets. In large quantity production, a moving conveyor is used to move the chassis from one work station to another. Where production lots are smaller, workers push the product along the work table. Much of the assembly of military and industrial equipment is done by hand.

In electronic equipment manufacturing plants, semiautomatic and automatic machinery is being used more and more to perform certain assembly operations. For example, in the manufacture of printed circuit boards, punch presses are used to make holes in thin sheets of plastic (one side of which is coated with a thin layer of copper) so that components can be attached. Many of these presses operate automatically. Electrical circuits are etched on the boards by machines, replacing wires. Machines also position components into the proper holes in the circuit boards. Mechanical devices bend the wires or metal “ears” on the bottom of the components, thus locking them into place on the board. The wire leads on the components are soldered to the etched circuits in one continuous operation (called “dip” or “wave” soldering).

Parts used in end products are usually brought to the assembly line by hand truck.
since most electronic parts are not bulky. They may be loose in boxes, fed from hoppers (rece­ptacles for parts), or held in special containers or jigs. During the movement of the product down the assembly line, it passes frequent visual inspection and electrical testing stations where workers locate faulty parts or connections. Electronic tubes are the last components added to the unit prior to placement into a cabinet.

Some electronic products, particularly scientific and research devices and some military equipment, are made in small lots. These products are assembled entirely by hand by assem­blers who frequently work under the direction of an electronics technician. This work is often performed in engineering laboratories.

In component manufacturing plants, parts are assembled primarily by hand. Most types of transistors, as well as other semiconductors which have very tiny parts, are usually assembled by women using tweezers and other small handtools. Also, special purpose tubes, as well as experimental components, generally are assembled by hand. Machinery is used to put to­gether certain types of components, particularly standardized items made in large quanti­ties, such as many types of resistors, capac­itors, connectors, and related components. Some automatic equipment has been introduced in recent years.

Electronic components, subassemblies, and end products are thoroughly inspected and tested many times so that the product being manufactured meets specifications. Inspecting and testing begin with visual inspection of raw materials or components as they enter the plant and continue through all stages of manu­facture.

Electronics Manufacturing Occupations

A wide variety of occupations, requiring a broad range of training and skills, are found in plants manufacturing electronic products. Approximately three out of five workers in elec­tronics manufacturing are in plant jobs (pro­duction, maintenance, transportation, and serv­ice); the rest are in white-collar jobs (engine­ering, scientific, and other technical jobs, and administrative, clerical, and sales jobs). App­roximately one-half of all the white-collar workers are engaged in research and develop­ment work. The proportions of plant and office workers differ from one establishment to another, depending on the products being manu­factured. For example, the proportion of plant workers in establishments producing consumer products, such as television sets, is generally higher than in plants manufacturing military and industrial products, since more assembly, fabrication, and processing workers are needed.

About half of the workers employed in electronic manufacturing plants are women and, in some plants, particularly those producing semiconductors, women account for more than 60 percent of the total employment. Most wom­en are employed as semiskilled production workers, chiefly as assemblers and as office workers. However, some opportunities exist for women in nearly all types of jobs.

Professional and Technical Occupations. A large proportion of electronics workers are in engineering, scientific, and other technical jobs. Engineers and scientists alone made up about 15 percent of all electronics workers in 1960, according to an estimate by the Electronics Industries Association. Generally, they account for a much larger proportion of employment in plants making military and industrial-commercial electronic products than in those producing consumer products. Also, a higher proportion of scientists and engineers are employed in es­tablishments engaged entirely in research and development work, and in manufacturing plants which have such activities.

The largest group of engineers are electrical or electronics engineers who are generally em­ployed in research and development, although considerable numbers are also engaged in pro­duction, sales, and liaison work. Many elec­tronics engineers work as design engineers; others work as test methods and quality con­trol engineers in production operations. Elec­tronics engineers also work outside the plants as field engineers, sales engineers, and engi­neering liaison men.

Substantial numbers of mechanical engineers and industrial engineers are also employed in
electronics manufacturing plants. Mechanical engineers work as design engineers in product development and in tool and equipment design. They work also as plant engineers—chiefly concerned with the maintenance, design, and operation of plant equipment. Most industrial engineers work as production engineers or as efficiency, methods, or time-study engineers. Other engineers employed in electronics manufacturing are chemical engineers and ceramic engineers.

Physicists make up the largest group of scientists. Many of them work on the development of microwave tubes and the design and fabrication of micro-miniaturized components and circuits (developing lighter weight, increasingly smaller electronic devices which consume less power). Devices have already been developed so small that they are measured in terms of layers of molecules. A large proportion of the scientists are chemists and metallurgists, who are employed mainly in research work and in materials testing. Mathematicians and statisticians work with engineers and scientists on complex mathematical and statistical problems, especially in the field of military equipment and computer design. Statisticians are also employed in the field of quality control. Industrial designers work on the design of electronic equipment.

Many thousands of technicians and draftsmen are employed by electronics manufacturing firms, mainly to assist engineers and scientists. Draftsmen are usually employed in engineering departments to prepare drawings from sketches or specifications furnished by engineers. Manufacturers of military equipment generally employ a higher proportion of draftsmen than manufacturers of other types of electronic products.

Electronics technicians comprise a large group among technicians. Many are engaged in research and development work, assisting engineers in the design and construction of experimental models. They are also employed by manufacturers to work on electronic equipment in customers’ establishments. Other electronics technicians work in certain highly technical inspecting, testing, and assembly jobs in the engineering laboratories of firms manufacturing electronic products.

Engineering aids are another important group of technicians. They assist engineers by making calculations, sketches, and drawings, and by conducting performance tests on components and systems. Laboratory technicians assist physicists, chemists, and engineers by performing standard and, frequently, routine laboratory analyses. Some laboratory technicians set up apparatus and conduct experiments. Mathematical assistants help to solve mathematical problems, following procedures that have been outlined by mathematicians. They also operate test equipment used in the development of electronic computers.

Technical writers work closely with engineers, particularly in plants making military and industrial products and in establishments doing research and development work only. They prepare training and technical manuals describing the operation and maintenance of electronic equipment. They also prepare catalogs, product literature, and project reports and proposals. Technical writers often have technical school or college training in science or engineering; others are usually college graduates with a flair for writing who acquire a knowledge of electronics on the job. Specifications writers compile lists of required measurements and materials. Technical artists or illustrators draw pictures of electronic equipment.

Administrative, Clerical, and Related Occupations. A large number of the white-collar workers in electronics manufacturing plants are in administrative or other office jobs. Administrative workers include purchasing agents, sales executives, personnel workers, and advertising personnel. Clerks, secretaries, stenographers, typists, and business machine operators are among the thousands of other office workers employed by electronics manufacturing firms. More than half of the office workers are women.

Plant Occupations. About three-fifths of the employees in electronics manufacturing are plant workers. They work in assembly, machining, fabricating, processing, inspecting and
testing, maintenance, and other types of plant operations. The proportion of workers in each of these operations differs among electronics plants, depending largely on whether end products or components are produced, and the type of end product or component that is manufactured. For example, the proportion of assemblers is higher in plants making consumer end products than in plants producing military equipment. It is also higher in plants producing semiconductors and receiving tubes than in plants making other electronic components, such as connectors and relays. The proportion of machining, fabricating, and processing workers is usually higher among manufacturers of components than of end products.

**Assembly occupations** (D.O.T. 6-98.010 through 350; 7-00.007 through .970). Assemblers make up the largest group of plant workers. Both electronic end product and component manufacturing firms employ assemblers with many different skills. However, most assemblers are semiskilled workers.

Most end products are assembled mainly by hand. Assembly line workers put together end products with small handtools, soldering irons, and light welding devices. They use diagrams, models, and color coded parts and wires to help them in their work. Both dip soldering processes and hand soldering may be used. In the assembly of certain subassemblies for end products, such as printed circuit boards, automatic machines are often used to position components on the boards. Here the assemblers work as machine operators or loaders.

Precision assemblers put together components and subassemblies into end products in which moving parts and mechanisms must operate within clearances measured in thousandths of an inch. Some of these assembly workers do repair work, experimental and developmental work, and model assembly work. Most precision assemblers are employed in the manufacture of military and industrial electronic equipment.

Electronics technicians may do some types of assembling in engineering laboratories of plants manufacturing end products. They work chiefly on the assembly of small quantities of complex, often experimental, equipment, particularly where some knowledge of electronics theory is required to understand the operation of the equipment. Some electronics technicians put together subassemblies into complex systems such as those in guided missiles.

Assemblers employed by component manufacturers range from machine operators, frequently called machine loaders, to electronics technicians who hand assemble experimental components. Most components are assembled by machines, since their assembly involves many separate but simple and repetitive operations. Even some types of miniaturized transistors and other components, made with parts small enough to pass through the eye of a needle, are now assembled on highly complex machines. Some of these machines are automatically controlled.

Many hand assemblers are needed to put together certain components, such as receiving tubes, special purpose tubes, and many types of transistors, diodes, capacitors, and resistors. Assemblers usually perform a single operation on the component as it moves down the assembly line, but some may completely assemble a particular type of component. Tiny components
ELECTRONICS MANUFACTURING OCCUPATIONS

Assemblers putting together transistors under a microscope in dust-free room.

are often hand-assembled under magnifying glasses or powerful microscopes.

Hand assemblers are also employed in electronics research laboratories and in the research and development departments of component manufacturers. These workers—frequently called electronics technicians—generally do difficult assembly work on small quantities of components for experimental purposes. They may also work on the development of new ways to assemble large quantities of such components by machine. These assemblers usually must know enough electronics theory to understand how the components operate.

Most assemblers are women. They are employed mainly as machine operators or tenders and as hand assemblers of components made in large quantities. Men are chiefly employed in experimental assembly work, in model assembly, and in assembly jobs requiring relatively heavy work. Men are also employed in assembly departments as “trouble shooters.” These workers analyze end products and subassemblies which have failed routine performance tests, to pinpoint the exact cause of faulty operation. Men assemblers employed in plants which manufacture military and industrial electronic systems connect units into major electronic systems.

Machining occupations. Metal machining jobs account for a significant number of plant jobs in electronics manufacturing plants. Machine tool operators and machinists operate power-driven machine tools to produce metal parts for electronic products. Toolmakers construct and repair jigs and fixtures used in the fabrication and assembly of parts. Diemakers specialize in making metal forms (dies) used in punch and power presses to shape metal parts.

Fabricating occupations. Many different fabricating occupations are found in electronics manufacturing, but the number of workers in each of these jobs is not large. Among the fabricating workers are sheet-metal workers who make frames, chassis, and cabinets. Glass blowers and glass lathe operators (D.O.T. 7-00.085) are used chiefly in electronic tube experimentation and development work; in the manufacture of special purpose tubes, which are made in small numbers; and in rebuilding television picture tubes. Other fabricating workers include punch press operators, blanking machine operators (D.O.T. 8–98.01), and shear operators.

Some fabricating jobs involve the molding, firing, and glazing of ceramics which are used as insulating materials in many components. Workers may also mold plastic components. In tube manufacturing, special fabricating workers are employed. For example, grid lathe operators (D.O.T. 6–98.251) make grids (devices in electronic tubes which control the flow of electrons) by winding fine wire around two heavy parallel wires. Other fabricating workers include spot welders, coil winders (D.O.T. 6–98.250 and 6–99.013 through .016), and crystal grinders and finishers (D.O.T. 6–98.080, .084, and .085).

Processing occupations. Many workers in electronics manufacturing occupations are engaged in processing activities, chiefly in plants producing electronic components. Electroplaters and tinner (D.O.T. 6–74.120) coat many parts with metal. Anodizers (D.O.T. 4–74.910) treat parts in electrolytic and chemical baths to prevent corrosion. Silk screen operators
print patterns on circuit boards and on parts of electronic components. Etching equipment operators do chemical etching of copper on the printed circuit boards.

Some processing workers impregnate or coat coils and other electronic components with waxes, oils, or other materials. Such operations are important in tube manufacturing.

Another group of processing workers operates furnaces, ovens, and kilns, which are used chiefly to harden ceramics, to bake on coatings, and to eliminate contamination by gases and foreign materials. Operators of infrared ovens, and hydrogen furnace firers (D.O.T. 6–98.280) rid tubes of foreign deposits. In tube manufacturing, exhaust operators (D.O.T. 7–00.018) and sealers (D.O.T. 7–00.025 and .054) operate gas flame machines which seal the mount (the part of an electronic tube consisting of a Bakelite base and stem) in the tube, clear the tube of impurities, exhaust the gas, and seal the tube.

Testing and inspection. Testing and inspection in electronics manufacturing begin when raw materials enter the plants, and continue throughout the fabricating operations. Finished components and end products undergo thorough testing and inspection before they are shipped.

In component plants, testers are employed in various types of jobs—for example, coil tester, transformer tester, and magnetic component tester. Many others are simply called component testers.

Inspectors of raw materials and components make up a major group of inspectors. Some of these workers have job titles which indicate the work they do, such as incoming materials inspector, plating inspector, and machine parts inspector.

In end product manufacturing plants, components and subassemblies are generally tested individually. Final assemblies are also tested separately; frequently they are operated for a period of time before they are packaged and shipped. Among the occupations involving testing in the manufacture of radios and television sets are trouble shooter or analyzer, final tester, prealine tester, tuner tester, and operational tester.

Electronic assembly inspectors (D.O.T. 4–98.101) examine assembled electronic units to make certain that they conform to blueprints and specifications, and check wire routing, electrical connections, and quality of units. Mechanical and precision inspectors check mechanical assemblies and precision parts. Final inspectors provide the last visual inspection of the plant's products.

Testers use voltmeters, oscilloscopes, and other test meters to make certain that electronic components, subassemblies, and end products conform with specifications. Automatic testing devices are also used.

Some testing jobs require technically trained workers who have had several years of experience in electronic testing. In research and development activities, electronics technicians test circuits and systems as part of their overall responsibility. In skilled production testing jobs, missile testers and other systems testers test, adjust, and align complicated systems. Missile component testers and certain other component testers perform similar work on electronic units.

Maintenance occupations. Many maintenance workers with different types of training are employed in electronics manufacturing plants to take care of machinery and equipment. Skilled electricians are responsible for

Inspector, using magnifying glass, checks negative used in printing electrical circuits on circuit boards.
ELECTRONICS MANUFACTURING OCCUPATIONS

Tester checking and adjusting test pattern on TV picture tube.

The proper operation of electrical equipment. Machine and equipment repairmen perform mechanical repairs. Hydraulic mechanics specialize in maintaining hydraulic equipment. Maintenance machinists and welders build and repair equipment, jigs, and fixtures. Air-conditioning and refrigeration mechanics are employed in some electronics plants, particularly in component plants and those engaged in research and development work, which are air conditioned and have special refrigerated and dust-free rooms. Painters, plumbers, pipefitters, carpenters, sheet-metal workers, and other building maintenance craftsmen are also employed in electronics plants.

Other plant occupations. Parts changer and repairman are other important occupations in electronics plants. These workers repair assembled electronic products which have been tagged by trouble shooters, inspectors, analyzers, and testers for replacement of parts or for other repairs. Women are frequently employed as parts changers.

Many workers are employed in materials movement and handling. These include operators of plant trucks and tractors; forklift operators who stack crates and load and unload trucks and boxcars; and truckdrivers who handle transportation outside of the plant. Other occupations include boiler operator and stationary engineer.

(Detailed discussions of professional, technical, mechanical, and other occupations found in electronics manufacturing plants as well as in many other industries are given elsewhere in this Handbook, in sections covering the individual occupations. See index for page numbers.)

Training, Other Qualifications, and Advancement

Electronics manufacturing plants employ many engineers, scientists, and technicians, because of the technical nature of plant production operations and the great emphasis on research and development work. Beginning engineering jobs are usually filled by recent graduates of engineering colleges (some with advanced degrees). A small number of workers without college degrees have been upgraded to professional engineering classifications from such occupations as engineering assistant and electronics technician. Workers who have become engineers in this way usually have taken advanced electronics courses in night school or under other training programs. To keep up with new developments in their fields and to help them qualify for promotion, professional and technical personnel obtain additional training, read technical publications, and attend lectures and technical demonstrations.

Almost all mathematicians, physicists, and other scientists employed in electronics manufacturing plants have college degrees and many have advanced degrees. Job prospects are usually better for scientists with at least a master's degree than for those with only a bachelor's degree.

Technicians generally need some specialized training to qualify for their jobs. Most electronics technicians have attended either a public, private, or Armed Forces technical school. Two years of training in a technical school and 5 or 6 years of experience are often the requirements for the more highly technical jobs. Some electronics technicians obtain their training through apprenticeships. Some testers and experimental assemblers have been upgraded to the job of electronics technician after they have developed required skills on the job and
acquired the necessary knowledge in basic electronics theory, mathematics, drafting, and reading of schematic diagrams, by attending company-operated evening classes, or taking night school, junior college, technical school, correspondence, or other courses. Some technicians who do final testing that requires the operation of radio transmitting equipment must hold licenses from the Federal Communications Commission as first- or second-class commercial radiotelephone operators.

Chemical and physics laboratory technicians, engineering and scientific aids, and mathematical assistants frequently have had 1 or more years of college training in a scientific or engineering field, but have not completed the course requirements for a degree; in other cases, these workers have been upgraded from jobs as lower grade assistants in engineering laboratories or as high-grade testers in production departments. In hiring lower grade assistants, electronics firms give preference to high school graduates who have completed high school courses in mathematics, physics, and chemistry.

Draftsmen usually have entered their trade by taking a course in drafting at a trade or technical school; a few have completed a 3- or 4-year apprenticeship. Some have qualified for their jobs under an informal arrangement with their employers which provided for a combination of on-the-job training and part-time schooling. Because many draftsmen must understand the basic principles of electronic circuits to do their work, they should study basic electronics theory and circuits and the reading of electronic schematic diagrams.

Technical writers must have a flair for writing and are usually required to have some technical training. Electronics firms prefer to hire those who have had some technical institute or college training in science or engineering. Some have college engineering degrees. Many have college degrees in English or journalism and have received their technical training on the job and by attending company-operated evening classes. Technical illustrators have usually attended special schools of art or design.

Many tool and die makers, machinists, electricians, pipfitters, carpenters, and other craftsmen in electronics manufacturing have learned their trades by completing a 4- or 5-year apprenticeship. Some have entered these trades through upgrading from helpers’ jobs. Some have taken courses at vocational schools which have helped them learn their trades.

Employers look for job applicants with an avocation in electronics for production as well as some office jobs. Employees with hobbies or other interests involving electronics, such as assembling radios, repairing radio and television sets, and “ham” radio operation tend to show considerable interest in their jobs. Such employees are often given preference in promotion. Because of the nature of their work, assemblers, testers, inspectors, and electronics technicians need good vision, including good color vision; patience; manual dexterity; and good eye-hand coordination. Electronics technicians and other technical workers must be able to understand technical publications.

Formal training in electronics is not necessary for workers entering many of the plant jobs, but employers frequently require applicants to have completed high school. Sometimes, job applicants must pass aptitude tests and demonstrate skill for particular types of jobs. On-the-job training, usually for a short period, is generally provided for workers who have had no previous experience.

Requirements for filling administrative and other office jobs are similar to those in other industries. Certain beginning jobs in administrative activities in electronics manufacturing are generally open only to college graduates with degrees in business administration, accounting, or engineering. More and more employers are requiring college training for administrative jobs in advertising, personnel, accounting, and sales. For clerical jobs, employers usually prefer applicants who are high school graduates with special training in stenography, typing, bookkeeping, and the operation of office machines. Women hold many of these jobs.
Employment Outlook

Many thousands of job opportunities will be available for new workers in electronics manufacturing plants each year over the 1960-70 decade. Electronics employment is expected to grow much more rapidly than manufacturing employment as a whole, but it probably will not increase as rapidly as it did over the 1950-60 decade. Because of the large number of workers in electronics manufacturing, thousands of job openings will also become available each year as a result of the need to replace workers who transfer to jobs in other industries, or who retire or die. Since women make up a high proportion of electronics employment, many people will be hired to replace the large number of women workers who leave their jobs to marry or, if they are already married, to raise families.

One of the main reasons why employment in electronics manufacturing will expand will be rising expenditures for military electronic equipment. Particularly large increases in expenditures are expected for electronic equipment in guided missiles and supporting equipment, and in detection and communications systems. Also, the Nation's expanding space program will require larger quantities of electronic equipment.

Substantial growth in electronics production for industrial use is also expected because the trend toward modernization and automation of production processes will stimulate spending for new plants and equipment. An increasing proportion of these expenditures will be for the newer types of electronic equipment, such as computers and automatically controlled machine tools. Also, the demand for industry's older and more developed industrial products, such as broadcasting equipment, radio communications equipment, test instruments, and navigational equipment, will continue to expand. For example, the use of two-way radio communications equipment by police and fire departments, public utilities, taxicab and trucking companies, pipeline firms, and others is expected to spread rapidly. Production of electronic equipment for the medical field will also expand greatly.

More home television sets, radios, phonographs, and stereophonic and high fidelity equipment will be purchased as population and the standard of living continue rising over the 1960-70 decade. These products will remain the principal electronic consumer items. In addition, other electronic consumer products which are already on the market or being developed (e.g., electronic ovens, garage door openers, dishwashers, lighting equipment, and air conditioners) may become standard household equipment in the years ahead.

Rising expenditures for research and development in the electronics field will stimulate employment in electronics manufacturing. Also, research and development will result in new military, industrial, and consumer products and in new types of components, all of which will provide more employment in electronics manufacturing.

The increase in employment probably will not be as great as the expansion in output because technological improvements in production methods are expected to increase output per worker. Also, increasing mechanization of operations formerly done by hand (such as many of those in assembly, processing, or materials movement) could reduce labor requirements. However, fabrication of many electronic products will be difficult to adapt to highly automatic manufacturing processes, where such products are made in small quantities and require frequent design changes.

The rates of employment growth will differ among the occupational groups and individual occupations in electronics manufacturing. Engineering, scientific, and other technical jobs will show the greatest rise over the next decade, because of the growing volume of research and development in electronics manufacturing and the increasing application of scientific and engineering principles to production operations. Employment of electronics engineers and electronics technicians will rise more quickly than that of most other technical workers. However, there will also be many job opportunities for other types of engineers, and for physicists, chemists, mathematicians, and their technical assistants. Engineers, as well as people with backgrounds in marketing, will
also have many opportunities to work in the fields of sales and product application (finding new uses and markets for electronic products).

Among those in plant jobs, semiskilled workers, particularly hand assemblers, will increase the fastest. However, the number of semiskilled workers is expected to rise more slowly than over the 1950–60 decade, because of increasing mechanization of manufacturing operations in electronics plants. Although the number of skilled workers probably will rise slowly, employment opportunities will be favorable for the highly skilled workers needed to maintain and repair the growing amounts of complex machinery used to manufacture electronic products. The number of unskilled workers is expected to drop, because of the growing mechanization.

**Earnings and Working Conditions**

Production workers in plants manufacturing radios, phonographs, television sets, radar and related detection equipment earned an average of $89.78 per week or $2.25 an hour in January 1961. Those employed in plants making electronic tubes averaged $85.39 per week or $2.14 an hour. In the same month, production workers in all manufacturing industries had average weekly earnings of $90.25 or average hourly earnings of $2.32.

Hourly earnings of workers in many occupations in the manufacture of electronic equipment vary considerably because of differences in the types of work performed and in the levels of skill and training required. Earnings also differ among plants depending upon their geographical location and the type of product manufactured. The following data collected from a number of union-management agreements illustrate the approximate range of hourly wage rates of workers in selected occupational groups and individual occupations in plants manufacturing electronic equipment in 1960:

<table>
<thead>
<tr>
<th>Occupation</th>
<th>Rate Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Machinists</td>
<td>$1.90–$2.90</td>
</tr>
<tr>
<td>Troubleshooters</td>
<td>2.00–2.60</td>
</tr>
<tr>
<td>Assembling occupations</td>
<td>1.50–2.45</td>
</tr>
<tr>
<td>Inspecting occupations</td>
<td>1.65–2.70</td>
</tr>
<tr>
<td>Testing occupations</td>
<td>1.50–2.55</td>
</tr>
</tbody>
</table>

Trainees and apprentices may have rates below these ranges; other workers, such as highly qualified craftsmen, as well as troubleshooters, testers, and inspectors, may receive higher rates.

Electronics workers generally receive premium pay for overtime work and for work on Sundays and holidays. Virtually all plants pay a differential for evening and night shift work.

Many workers in electronics manufacturing plants receive 2 or 3 weeks’ vacation with pay, depending on their length of service, and from 6 to 8 paid holidays a year. The benefits are more liberal for some workers, less liberal for others. Almost all electronics workers are covered by health and life insurance plans.

Working conditions in electronics manufacturing compare favorably with those in other industries. Plants are usually well lighted and relatively clean and quiet. Plants, or plant departments, where sterile conditions or air temperature control is necessary for the manufacture of some types of electronic equipment, are air conditioned. The work in most electronics occupations is not strenuous. However, many assembly line operations are repetitious. Some plants provide music during working hours. Cafeterias, recreational facilities, and social programs are provided for employees by some electronics manufacturing firms.

The frequency of injuries in electronics manufacturing, for each million man-hours worked, is far below the average in manufacturing as a whole, and injuries are usually less severe.

Many of the workers in electronics manufacturing are employed in unionized plants and are covered by collective bargaining agreements. The principal unions involved are the International Union of Electrical, Radio and Machine Workers; International Brotherhood of Electrical Workers; International Association of Machinists; and the United Electrical, Radio and Machine Workers of America (Ind.).