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INDUSTRIAL ACCIDENTS AND HYGIENE SERIES

SURVEY OF
HYGIENIC CONDITIONS IN
THE PRINTING TRADES

By S. KJAER
Of the United States Bureau of Labor Statistics



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PREFACE

In 1922 the International Joint Conference Council of the Printing Industry planned an investigation of the hygiene of the printing trades. The general supervision and control of the investigation was placed by the Joint Council in the hands of Dr. Frederick L. Hoffman.

The Bureau of Labor Statistics was, from the start, called into these conferences and subsequently agreed to do a definitely outlined part of the work involved in the general survey. Under the agreement the Bureau of Labor Statistics was to conduct a branch of the work involving the employment of at least one field investigator. Mr. Swen Kjaer was assigned to this field work. The schedules and questionnaires had of course been jointly agreed upon by Doctor Hoffman and the Bureau of Labor Statistics. Special Agent Kjaer began his field work in October, 1922, completing it early in 1924. The present bulletin is the beginning of the publication of the results of the joint survey of the hygiene of the printing trades made by the International Joint Conference Council of the Printing Industry and the Bureau of Labor Statistics in cooperation. It represents that specific part of the work which the Bureau of Labor Statistics agreed to do and will be followed by bulletins covering other phases of the investigation.

ETHELBERT STEWART,
Commissioner of Labor Statistics.

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SURVEY OF HYGIENIC CONDITIONS IN THE PRINTING TRADES

INTRODUCTION

The printing industry, like all industries in general, has experienced constant improvement in working conditions and in the application of new ideas.

The Bureau of Labor Statistics published a study of hygiene in the printing trades in 1917¹ but, as data regarding recent changes were scant and information concerning prevailing health conditions in the industry was more or less conflicting, another and more extensive survey has been made by the Bureau of Labor Statistics, through its special agent, Mr. S. Kjaer.

The survey consisted of a personal inspection of representative printing trade plants, located in 21 cities of the United States: Atlanta, Baltimore, Boston, Charleston (S. C.), Chicago, Cincinnati, Cleveland, Denver, Detroit, Indianapolis, Kansas City, Louisville, Milwaukee, Nashville, New Orleans, New York, Philadelphia, Pittsburgh, Richmond, St. Louis, and Washington.

Approximately 1,000 plants were visited in all and detailed reports were made of surveys in 536 establishments, some including additional inspections during night hours. The plants surveyed in detail were, in the majority of cases, the larger establishments in each city, as conditions in such naturally affected the greatest number of workers. The other plants were looked over and compared in a general way only, because the former ones embodied all the important features. The shops in each city were selected carefully, after consultations with associations of both employers and workers, so as to include not only each of the various branches of the trade but also the different localities of the city and the varied conditions in the plants.

The most important features of the reports have been summarized so the general condition can be readily ascertained (pp. 228, 229). To prevent identification of any of the plants the figures have not been given by cities.

Splendid cooperation in the survey has been rendered by both the employers and employees, individually, through their organizations in the localities visited, and through their national associations, as well as by the State or city authorities where interviewed.

¹ U. S. Bureau of Labor Statistics Bul. No. 209: Hygiene of the printing trades.

Special appreciation of courtesies and assistance, or offers of the same, is due Mr. John P. Meade, director of industrial safety, department of labor and industries, Commonwealth of Massachusetts; Messrs. Chas. F. Glueck and E. E. A. Fisher, John Hancock Mutual Life Insurance Co.; Hon. George H. Carter, Public Printer, and official staff, notably Dr. Daniel P. Bush, medical and sanitary officer; Dr. E. C. Levy, director public welfare department, city of Richmond, Va.; Mr. H. N. Kellogg, chairman standing committee, American Newspaper Publishers' Association; Mr. J. W. Hays, secretary-treasurer International Typographical Union; Mr. Chas. A. Sumner, secretary-treasurer International Stereotypers and Electrotypers' Union; Mr. Matthew Woll, president International Photo-Engravers' Union; Mr. F. H. Bird, director industrial division, United Typothetæ of America; Mr. H. M. Ellis, executive secretary Milwaukee Typothetæ; Mr. F. A. Silcox, secretary Printers' League section, New York Employing Printers' Association (Inc.); Dr. Leland E. Cofer, director, and Dr. C. T. Graham-Rogers, medical inspector, division of industrial hygiene, department of labor, State of New York; and Dr. Louis J. Harris, director department of health, city of New York.

SUMMARY

Employment in the printing trades has been considered as very dangerous to the health of the workers, and the conditions under which the work at one time was conducted unquestionably made it so. It has, however, been changed greatly through application of modern factory ideas and the adoption of hygienic improvement.

The industry is one of considerable importance, since the product is used in all industrial, business, and everyday life, ranking among the necessities of the present age. The various branches of the work are performed in over 35,000 establishments by more than 600,000 workers, including proprietors, managers, superintendents, and clerks.

Approximately two-thirds of the total number engaged in the industry were actively employed in the trades, grouped in six subdivisions—composition, photo-engraving, stereotyping, electrotyping, presswork, and binding—each of which is again divided into several skilled trades, totaling more than 50. These trades are highly specialized in the larger shops, and each carries its own individual hazards for the workers in addition to the general hazards accompanying indoor occupations. A few minor occupations that do not exactly belong in either of the six main groups are included, because they are closely allied with these and the work is performed in printing-trade establishments, though customarily by specialists. These occupations are type founding, ink grinding, roller making, and various plate-making operations which are performed by hand. In small shops it is not uncommon to find workers who are engaged in more than one operation, and in the very small shops one operator may successively perform all of the various duties required to turn out the product, with consequent exposure to the peculiar hazards of each of them.

Practically all the hazards created by the various operations can be eliminated by sensible precautions, and there is really no necessity

for any more danger to the health of the workers in the printing trades than would be encountered through employment in office work or any other indoor occupation. Observation proved that it could be accomplished, partly through the efforts of the employers to create and maintain wholesome and hygienic quarters for the performance of the work and partly through cooperation of the employees in enforcing health measures. Unfortunately these conditions did not prevail in all of the establishments surveyed, sometimes through the fault of the employers, at other times of the workers, or through disregard from both sides.

Some of the conditions affect all of the trades. One of these, which constitutes one of the main requisites for desirable working conditions, is a suitable building. Most of the processes require considerable light and ventilation, which to a great extent are determined by the constructive arrangement of walls and pillars. This has been influenced mainly by the period when the building was erected. Some splendid examples of modern buildings were seen, both single story and multistory, and also a number of old structures, which were entirely unsuited for the purpose. Construction essentials limit the extent of remodeling, and an old-style building can not be changed to conform with modern factory ideas. Employers realize that well-constructed buildings, adapted to the work, mean increased production and, consequently, the industry presents continual improvement in housing facilities year by year, especially for establishments large enough to have buildings of their own. About two-fifths of the establishments inspected had been erected for housing the plants, while about three-fifths were domiciled in adapted structures. Those who are compelled to rent quarters are naturally handicapped in the majority of cases, though the difficulty has been reduced to a certain extent in several cities by erection of special, large buildings for the housing of printing trade firms, constructed to meet the peculiar requirements and capable of housing a number of them.

The location of the quarters in the building is of considerable importance, as the natural facilities for light and air usually decrease in a multistory building in accordance with descent, especially in congested districts of cities, where streets are often narrow and where surrounding tall buildings obstruct light and air. At one time the majority of printing-trade plants were, at least partly, located in basements on account of the heavy machinery used and the vibration created by this. The adoption of scientific production methods, the increased stability of buildings, and a realization of the undesirable hygienic conditions for the workers in basement locations have reduced this practice to a great extent. Only comparatively few, usually small plants, were noticed that were located entirely in basements, but in a number of the larger establishments, due in part to lack of space, one or more of the working operations were often performed in the basement. The tendency at present is for elimination of such locations, with consequent improvement in hygiene, since basements are not suitable for industrial purposes, especially when fumes are produced.

Separation of processes was found customary in the larger establishments and in many of the smaller ones on account of fumes or

gases generated by the operations, special temperatures required, dust, noise, or other conditions. In some of the single-story structures the different processes were often seen grouped in departments arranged in consecutive working order around the building and without wall separation, except for a few special operations. This method seemed preferable to dividing the interior into a number of small spaces and, with adequate provision for proper local ventilation, provided better distribution of light and air.

Environment of the building affects conditions inside of it to a great extent. Modern convenience of transportation facilities, increased use of the telephone for transaction of business, and the gradual change in business ideas have helped to create better hygienic conditions by developing the tendency toward moving printing trades establishments away from the congested sections of the cities to the outlying districts, where plenty of daylight and air can be obtained.

The proportion of working space to employees is also of considerable importance in connection with hygiene. Overcrowding reduces the air supply, retards the light, and affects sanitary conditions through impossibility of cleaning quarters properly. It is, however, a constantly recurring factor, due to increase in the volume of business, and necessitates expansion of housing facilities from time to time. Nearly one-third of the plants inspected were crowded, but some of these were preparing to move to larger and better quarters.

The system of power transmission for machinery also has a bearing on the condition of the workroom and the health of the workers. The individual motor drive system has to a great extent eliminated collective drives, with hangers, shafting, and overhead belts, which obstructed and retarded diffusing of light and accumulated or scattered dirt and oil. It allows a flexibility in layout, which permits placing equipment in the most advantageous manner for better lighting, eliminating considerable eyestrain. Over three-fourths of the establishments surveyed were equipped with individual motor drive exclusively. Nearly one-eighth of the plants had individual drives on the majority of the machines and in about one-third of the rest the two systems were evenly divided. The change to individual drives has also reduced the liability to accidents through individual controls, safety attachments, and automatic devices for the protection of operators. The accident hazard has been further reduced through better provisions for guarding dangerous machinery and more than half of the plants inspected were found to have taken all possible precautions, while only one-ninth were judged badly neglected as far as safety guards on dangerous machinery was concerned.

In recent years considerable attention has been given to provide adequate daylight for printing trade establishments, partly by locating the building in the open to admit light from all four sides, partly by providing the maximum number of large windows and skylights so the daylight can penetrate to all parts of the plant, and partly by arranging the equipment so that it will not obstruct the light. Some good examples were seen, especially several modern single-story buildings provided with saw-tooth roofs, where there was abundant daylight for all working purposes and where artificial light was unnecessary in the daytime, even on dark, rainy days. The skylights

in saw-tooth roofs seemed especially preferable, as they give free access to the north light, do not admit any sun glare, and do not need shading, with accompanying loss of light.

The majority of modern establishments have been planned so the workers are placed sideways to the windows, in order to prevent the additional eyestrain from facing these. In some plants the workers were found facing the windows, sometimes due to lack of space and sometimes to the idea that this arrangement was necessary for the work. It is being generally recognized that the condition of walls, ceilings, and columns plays a very important part in the diffusion of light. A building may be provided with the maximum number of windows and the best type of skylights but may lose the benefits from these if the interior surfaces absorb the light in place of reflecting it. This condition affects the artificial light as well as the daylight. Tests have shown that the highest power of reflection is reached by the use of white surfaces. Considerable light is required for the printing processes, which even then involve eyestrain, but apart from that it has been proved that pleasant surroundings increase the contentment of the workers—a prominent factor in the health question.

While daylight is naturally to be preferred, it is necessary to perform a great deal of the work at night by artificial light, especially on newspapers. Nearly one-third of the establishments inspected were engaged regularly in night work, ranging from a small part up to the entire output. In the large modern plants the lighting systems had been installed with a view to correct intensity, absence of glare, and good distribution to all parts of the work, but a number of the establishments surveyed were equipped with ordinary incandescent bulbs, sometimes provided with transparent glass shades or without shades at all. In other places the quantity of light was insufficient or the light was rendered feeble and inadequate through accumulations of smoke and dust on the bulbs. More attention could be paid to this feature. Improved types of lights and fixtures are being developed continually, and the locations for placing the lighting units in a plant to suit individual requirements can be determined scientifically. The installation of a proper lighting system is a humanitarian act to guard the eyesight of the workers, but it is also an economic measure, as inadequate illumination means lowering of speed and accuracy among the workers, together with increase in accidents.

A few of the establishments were still depending on the old, practically obsolete gas lamps, while others were provided with auxiliary gas lamps for emergency purposes. Several used mercury vapor lamps, at least partially and usually in the composing rooms. These, it was claimed, produced ideal illumination, giving a softer and cleaner light.

One bad feature was noticed in some newspaper composing rooms where part of the space was occupied by line-casting machines and part by hand composition and imposition. The two last-named operations require intensive light over a large surface, while the line-casting machine operators prefer strong individual illumination concentrated on the small spot on each machine occupied by the copy. Where overhead illumination was provided above the line-casting

machines it was usually turned off, creating a large dark space in the room. This would not affect the operators on the machines, but would create eyestrain for those who worked in the well-illuminated part of the room, whose eyes would encounter this dark space from time to time.

One of the most vital problems in the hygienic conditions of the industry is ventilation. Fresh and pure air is necessary in any industrial establishment. It is estimated that about 2,400 cubic feet of fresh air are required per hour for a person sitting still, 3,200 feet when doing light work, and 6,000 feet when doing hard work. In the printing trades the air is polluted not only by the breath of the workers but also by dust, fumes, and gases developed in the processes, especially where the machines are not provided with special ventilating devices for removing these. A poorly ventilated room affects the health of the workers and, in addition, affects the pocketbook of the employer through decreased efficiency.

The majority of printing-trade plants depend upon natural ventilation for the building, principally by opening the windows. This is not always satisfactory, because they seldom distribute the air evenly and the workers located close by them often complain of cold and draught. Besides, they are usually kept tightly closed during cold weather. The air inside a building is affected by various factors, such as temperature, humidity, movement of the air, and cubic contents in proportion to the number of workers. A comfortable air condition can not be determined by temperature alone, because humidity and movement of the air change the relative effect. It is commonly accepted that a desirable temperature varies from 60° to 65° F., with about 50 per cent relative humidity, for work which requires considerable exertion, to approximately 70°, with similar humidity, for people sitting still. Excessive humidity or stagnant air causes discomfort and affects the vitality of the workers.

Humidity and stagnation of the air can not be controlled by natural means, and the ideal condition for a workroom is one which can be regulated as desired at all times regardless of outside influences. This can be accomplished successfully only by mechanical ventilating devices, which supply washed and cleansed air, heated or cooled, charged with moisture or with excess moisture removed, distribute it evenly, and also exhaust the impure air from the building. Several of the large establishments were provided with such equipment, either for the entire building or part of it. Others were provided only with plenum devices that forced fresh air into the building, and still others only with exhaust systems which removed the impure air.

Considerable fumes, gases, and dust are developed in some of the printing-trade processes. Practically all of these can be removed by mechanical exhaust directly from their source, preventing contamination of the surrounding air spaces. In addition to eliminating these dangerous factors, the exhaust devices on equipment also act as exhaust for the rooms and assist in the circulation of air. Several places were visited in which exhaust had not been applied to the equipment, the fumes, gases, or dust being removed by exhaust fans in the windows or walls, and the workers being exposed to the fumes or dust in the travel from point of origin to point of exhaust. In

other places hoods had been placed over the equipment, but as no exhaust fans had been placed in the ducts the fumes and gases were not absorbed through the pipes and the surrounding air was constantly polluted by them.

Each process has its own problems of ventilation for equipment to eliminate the hazards. Composing rooms are subject to fumes and gases from the metal pots on line or type casting machines and from the fuel on them; from the ingot furnaces, if located in the same room; and also from dust generated in the process. Photo-engraving departments are exposed to fumes and gases developed by the chemicals and by the fuel on heating equipment, to dust from the chemicals or the materials used, and to heat from the various equipment. Stereotyping rooms are also affected by fumes and gases from molten metal and from the fuel used, as well as by the dust created in the process; also by the great amount of heat generated by the large quantity of metal heated to a high temperature, and by considerable humidity. Electrotyping rooms are subject to similar conditions, with fumes from molten wax and with dust from the graphite. Pressrooms are exposed mainly to fumes from the ink and to gases liberated where gas-fuel burners are used. A number of pressrooms were found with an excessively high temperature, claimed to be necessary for the work, though in others the workers seemed to get along well without it. In rotogravure pressrooms the ink is an important factor, as this consists mainly of naphtha or xylol, and requires special exhaust devices to remove the fumes. The same thing holds good with rooms containing varnishing machines on which wood alcohol is ordinarily used as a solvent for the varnish, but which are seldom provided with any ventilation device. Some fumes are created by tensions on rotary presses and by roller washes. The dust problem in pressrooms is not considered serious other than in the operation of bronzing. The ordinary bronzing machine used is provided with vacuum attachment, but in any establishment where bronzing is done dust is noticeable flying through the air and scattered all over. It is doubtful if any method can be applied which would completely eliminate the dust hazard in this operation, and under present conditions such machines should be separated from the rest of the plant. Binding rooms are subject to fumes from the equipment used, such as paraffin machines and spraying tables and ovens for artificial-leather covers. Where gas-heated equipment is used the rooms are also subject to gases liberated by such equipment. Dust created in the process is usually paper dust. The problems of type founding are very similar to those of the composing room, with a metal-smelting room additional. Ink grinding in the printing trade plants does not present any unusual features, though it produces both fumes and dust and presumably needs only proper ventilation of rooms.

Some of the work is of a dirty nature, but even the dirtiest of it was performed in some plants which were clean throughout and provided pleasant quarters for the workers, showing that there is no reason for allowing a workroom to become filled with dirt. The worker spends approximately one-third of his or her life in the workroom, after first engaged in the trade, and the environment has a marked influence on both mental and physical development. Dark

and dirty workrooms foster a depressing feeling which affects the health, contentment, and efficiency. It seemed regrettable that vacuum cleaning was not used more generally, because it embodies the correct principle by eliminating dust and dirt instead of scattering it, the natural result of sweeping. In some establishments the floors were badly broken, preventing thorough cleaning, and in others the workrooms were so crowded with equipment, product, or material, that they were extremely difficult to clean. The large establishments were, as a rule, kept very clean and the very small ones likewise. The medium sized plants presented the most insanitary appearance, probably on account of insufficient janitor service.

Other sanitary features have also a certain relation to the health of the workers. Dirty windows retard the daylight and cause eye-strain. Cleanliness of toilet rooms was, as a general thing, greatly dependent on the personal habits of the workers. For every two toilet rooms that were sanitary one was found where the workers exhibited carelessness in littering the floor with pieces of paper, matches, cigarette stubs, and even expectorations.

Dressing rooms and individual lockers were provided in a number of establishments, though they were at times found located in undesirable places that were subjected to fumes from various processes in the plants.

One of the most important of the sanitary features, washing facilities, was badly neglected in many instances. Cold water will not remove accumulations of lead, ink, and grease, and it is consequently important to provide hot water for that purpose. It was nevertheless found that a number of the establishments were supplied with hot water during the winter months only, and others not at all. Some of the large establishments had installed splendid looking arrangements but, unfortunately, these were not always appreciated by the workers. The danger from contact with lead is too often ignored and a very careless attitude is often exhibited by workers, perhaps unconsciously. A number of cases were noted where the workers only rinsed their hands slightly, and sometimes neglected even this, before sitting down, usually in the workrooms, to eat their lunches. In spite of the observations to the contrary they would continually insist, when asked about it, that they always washed carefully. Liquid or bar soap was furnished by some establishments, and some provided towels, paper or cotton, for the employees. Others required the workers to supply their own. Roller towels were still present in a few establishments, in spite of the well-known danger of using them. Shower baths were found mostly in the larger newspaper plants and electrotyping establishments. The nature of the work in part of the latter trade, especially where the dry molding process is used, makes a bath at the end of a working day a necessity, and all such establishments should be equipped with showers. This is also very desirable in other trades, where either dust or excessive heat is encountered.

Another feature which showed considerable opportunity for improvement is the provision for lunch rooms. The relative importance of good food and health is universally known. There is, of course, no necessity for maintaining restaurant service in plants that are located in a business district, where they are surrounded by eating places, but provisions should be made for a separate room where

those who bring their lunches can eat them and at the same time enjoy a change of environment during the period. It may seem unimportant, but experiments have proved that such a variation is a factor in health conditions and will increase efficiency during working hours. Eating in the workrooms should never be allowed, but it was found to be a common practice, even in places with signs on the walls forbidding it. Some of the large establishments were provided with excellent restaurants, where appetizing and nourishing food was served at a low cost to employees.

The large modern establishments were usually provided with filtering and cooling systems for drinking water piped to bubbling fountains in the various rooms. The majority of the other plants were supplied with tank coolers filled with hydrant water, and often with the ice placed directly in the water, an arrangement which is far from commendable. In many places the cooling tanks were not used during the winter months, and drinking water was obtained direct from the hydrants, and in some others tanks were not provided even in summer. Pure and cool drinking water is very essential for all workers, especially where these perform physical labor, and a sufficient supply should be furnished at all times.

The importance of health supervision is generally recognized in modern factory life, and most of the large establishments were equipped with excellent emergency hospitals, some with physicians and others with nurses in attendance. Emergency treatments for minor illnesses during working hours often prevent development into severe sicknesses, and prompt attention to slight wounds often averts serious, disabling infections. The majority of the plants were provided with first-aid kits and many also with female rest rooms. Several plants were located adjoining or close to hospitals, eliminating the necessity for individual emergency rooms. Some plants called physicians in the neighborhood in case of emergency, while others sent the patients direct to physicians selected by the insurance companies. In addition to emergency treatments, the medical staffs render valuable service by instructing the workers in the fundamentals of public health, personal hygiene, and preventive medicine. These are all great factors in the reduction of illness, and healthy employees mean reduction of absenteeism and labor turnover, as well as increase in production. A few establishments were noticed that had included dental clinics in the medical departments. Some establishments conducted monthly examinations of workers that were subjected to fumes from lead. Others required physical examination of applicants for positions, and this was also required by several of the trade-unions before admitting applicants to membership, so as to assure their physical fitness for the trade.

Several of the larger plants provided special features for the amusement and recreation of the employees, or other items in adopted welfare programs. Some of these may seem insignificant, but any movement in that direction exerts a beneficial influence by directing the outside life of the workers into healthy lines.

The number of trade workers in the establishments surveyed, as furnished by the managers, was 81,314, or about 20 per cent of the total number of workers in the trade. More than one-fifth were females. About one-sixtieth of the workers were 60 years old or over, ranging up as high as 91 years of age, and records were ob-

tained of nearly half of these, giving birthplace, age, number of years in the trade or occupation, present condition of health, past cases of sickness, and condition of eyesight. The records indicate a good condition of health among these workers, and most of them had been employed a number of years under conditions which were far more detrimental to the health than those of the present time.

The chief occupational diseases of the printing industry are tuberculosis and lead poisoning. The various trades have always ranked high among the special industries subject to tuberculosis, partly as a result of dust or carbon monoxide created by the processes, partly from poor ventilation with stagnant air or abnormal temperatures, and partly from lack of personal cleanliness or regular habits among the workers. The information obtained from the various establishments regarding number of cases occurring during the past five years did not seem reliable, because the number of attacks per 1,000 employees stated for the personnel was only approximately one-third of the known death rate from the disease among all occupations, and these were simply attacks, not deaths. Information that 9 out of 11 deaths among cylinder-press feeders in one of the cities during the previous two years were caused by tuberculosis prompted an investigation. This resulted in showing that the death rate from tuberculosis was higher among cylinder feeders than among any of the other trades. The only difference noticed in this city in the hazards affecting the feeders and the hazards affecting the pressmen, whose tuberculosis rate was relatively low, was the exposure by the former to fumes and gases from open-flame gas burners on the presses. The resulting irritation of the respiratory organs and the lowered power of bodily resistance seemed to present the most logical reason for the abnormally high tubercular rate. Unhygienic habits, a prominent factor in the disease, has been largely eliminated through health campaigns by trade organizations and various health or labor departments. Mortality statistics for the country at large show a constant annual decrease of deaths from tuberculosis, and this is no doubt also the case among the printing-trade workers.

The dangers of lead poisoning are known but there is considerable difference in opinion regarding how it is acquired—by breathing of fumes, by inhaling of dust, or through contact. It may possibly be contracted by all three methods but it has been proved conclusively that it can be acquired through contact and, while fumes or dust can be eliminated, it is difficult to avoid contact. This does not mean that the contact itself produces lead poisoning, but that the oxide of lead dust, formed by the action of the air on the surface of lead products, is deposited on the fingers through contact and conveyed into the mouth. As there is a known danger in this, and lead can not be removed from the hands by cold water, hot water should always be provided for washing in all places where contact with lead takes place. Promiscuous eating in workrooms should not be allowed. Most States have laws prohibiting this practice but these are often ignored by the employers, as well as by the workers. Hand washing is often performed in a haphazard manner, and sometimes not at all, before eating lunch, which is consumed directly in the workroom. It would be an excellent plan if compulsory washing could be introduced and enforced among those who handle lead

products, similar to the practice in vogue in the painting department of the Pullman-car shops, in Pullman, Ill., where lead poisoning was reduced from 77 cases in 1911 to none in 1912. Each worker is provided with soap, towel, and a nailbrush and all are compelled to wash thoroughly under supervision of the foremen. Tests, conducted by the department of labor for the State of New York, have shown that more than superficial washing is required to remove lead. Inhalation of lead dust is, of course, equally dangerous but it is a comparatively simple matter to prevent contamination of the air by dust through proper ventilating devices. In composing rooms the nondistribution of type has practically disposed of one source, the collection of dust in the type cases, and the vacuum cleaning method effectually eliminates the rest, so far as the type cases are concerned. The main origin of detrimental dust noticed during the survey in composing rooms was cleaning the plungers in the metal pots of casting machines, and liberation of the dust in this operation was found easily preventable. The lead dust created in other processes was mainly too coarse to float through the air, and all of it could be removed by suitable devices. The third possible source of lead poisoning, fumes from the molten metal, can also be disposed of by proper local ventilating devices, as was evident in many of the establishments inspected, and such precautions should not be neglected unless it is proved conclusively that lead poisoning is not derived from inhaling the fumes.

Observations during the survey indicated that there is a more dangerous factor than fumes from molten lead and that the symptoms from this might erroneously be responsible for a diagnosis of lead poisoning. This factor is illuminating gas, which liberates various gases whenever the combustion is not complete, and complete combustion is a condition seldom encountered. One of the gases liberated is carbon monoxide gas, well known as very poisonous, not alone through exposure to large quantities but also through continued exposure to small portions, which develops a chronic poisoning. Illuminating gas is used extensively for heating various equipment in the different processes, though it is gradually being replaced by electrical heating devices. It seemed significant that in the establishments where gas fuel was used, such as on metal pots for line-casting machines, and no suitable provisions existed for removal of the fumes, there were frequent complaints of ill health among the workers. In establishments of similar character, but provided with good local exhausts so that the air of the room was not contaminated by gas fumes, there were no such complaints. This showed only the advisability of using proper local exhaust; but a decided contrast was found in establishments where electrically heated devices were employed on the same kind of equipment and no exhaust was provided to eliminate the metal fumes. In spite of this there were no complaints of illness, such as in the places where gas fuel was used. This would indicate that the carbon monoxide, and not the fumes from the metal, was really the disturbing factor. The symptoms commonly described—headache, dizziness, mental dullness, lassitude, nervousness, insomnia, and digestive disturbances—are all claimed to be indicative of lead poisoning, but the fact that they

seem prevalent where illuminating gas is employed for fuel and are comparatively absent where electrically heated devices are used points strongly to carbon monoxide poisoning and the relative insignificance of fumes from the molten metal.

Reliable information on the prevalence of lead poisoning is difficult to obtain. The employers are apt to minimize the dangers and to point to their old employees who never have suffered from lead poisoning, while the workers are often unwilling to make any statements or undergo examinations, for fear that they might be afflicted and possibly lose their jobs if it became known. Only a few actually known cases of lead poisoning were heard of during the survey as existing in the previous five years, 14 in all. These were all of the violent type and there might have been a number of others, such as claimed by Dr. Louis J. Harris, director of the health department, city of New York, who stated that he had examined about 1,000 compositors and had found one-fifth of these affected with lead poisoning. Conclusions can not be drawn regarding this examination until the report has been issued, showing what the contentions are based upon. A trace of lead may be discovered in the contents of a glass of water, but that does not prove the fluid dangerous to the system.

Fatalities from carbon-monoxide poisoning were not encountered in the printing-trade establishments, and only four cases or alleged attacks of it were reported. The complete account of occupational hazards furnished by the employers was, in fact, very insignificant, consisting additionally of only nine cases of chromium poisoning and two cases of eczema. There is always considerable danger from poisoning by some of the chemicals employed in the various processes, especially in photo-engraving or from fumes developed in the operations. Chromium poisoning, one of the most common afflictions, appears as gangrenous ulcers that are very painful and seem extremely difficult to heal. It is claimed that no permanent cure has been found and, though apparently cured, it may manifest itself after a number of years, and even appear in children that are born later on. This, as well as other poisoning due to contact, could properly be avoided by the use of rubber gloves, such as were found supplied in a number of establishments but often disregarded by the workers on account of being too clumsy, or through the belief that former immunity would prevent any hazard. Danger from contact with any of the other poisons or irritants used can be avoided in similar manner by the use of rubber gloves and by thorough cleanliness on the part of the workers, both of the person and of the working clothes. The latter is also very important where fumes exist, together with sufficient ventilation, preferably localized to the source, such as for the fumes of nitric acid in photo-engraving establishments. The hazard from this is very much underrated by the workers, who get careless through continual use of the material without any apparent detriment. Acrolein fumes from ingot-metal furnaces and stereotype or electrotype metal kettles are also easily eliminated by proper exhaust, such as existed in the larger establishments. In the smaller ones it was often found neglected, causing considerable annoyance from the pungent suffocating smoke.

The dust problem can also be solved in a successful manner by exhaust, except bronze dust used in the bronzing operation. In

spite of the statements by employers that bronze does not affect the workers, observation confirmed the opinion that bronzing operations should be separated from the rest of the establishment to prevent the dust from scattering all over. Dust from dragons blood, used in the photo-engraving process, which may in the past have proved considerable of a factor in congestion of the lungs, can be controlled by proper devices. The graphite dust used in electrotyping, which has been reduced considerably through adoption of the wet process, is claimed to be noninjurious. It would, however, also have a tendency to cause congestion of the lungs when inhaled in large quantities, and all possible precautions should be taken to prevent all excessive dust from scattering through the air.

Many of the operations in the printing industry involve considerable nervous or mental strain, from maintained use of intelligence and observation, from constant attention upon one skilled task, or from divided attention in operating several machines. Others also require considerable muscular strain, sometimes with a demand for speed included. These conditions develop fatigue, a slight attack of which can easily be cured by proper rest. Accumulated results of excessive fatigue may, however, result in sickness and affect the vitality. Night work and excessive or continuous noises are also important factors in fatigue, vibration of the factory buildings likewise, as well as posture and the consistency of the floors. More attention is continually being paid by employers to this question and more effort is being made to protect the workers against fatigue, as better health means increased production.

Accidents are closely interwoven with and often due to the condition of a building, especially to insufficient lighting facilities or insanitary conditions, while many are directly due to fatigue. The carelessness of other workers or the speed required by the plant or desired by the individual worker is sometimes responsible. Accidents which are caused through the fault of the employer, of fellow workmen, or of the operator in person can all be prevented. Some accidents, due to chance, will always exist, but these can not be charged against the trade. While there is some machinery employed that is dangerous unless handled properly and with presence of mind, and although a number of accidents have occurred in the past, the printing trade processes can not be judged as extremely hazardous in this respect. Where care is taken to see that all machinery is in proper working order, and where the workers are not permitted to take chances for the sake of excessive speed, the question of accidents is comparatively nil. Safety committees in the larger shops have been doing valuable work in this connection by recommendations to the employers and by educational campaigns among the workers. Information requested regarding major accidents in the establishments during the previous five years gave a total of 139 cases, or 1 for each 585 employees. Over half of the accidents consisted of loss of arms, hands, or fingers, occurring principally in pressrooms. Some of the processes involve considerable fire risk, mostly through the carelessness of the workers, a risk which could be greatly reduced by observance of the posted rules against smoking in the workrooms. These rules were often completely ignored by both employers and workers.

Splendid efforts were found in many establishments to provide for the health and comfort of the employees, but there is still need of intensive educational campaigns among both employers and workers. The employers should be educated as to proper housing and arrangement of the plants and as to the possible menace of crowding, bad lighting, poor ventilation, and faulty sanitary conditions, together with the dangers from material or machinery employed. More attention to these features would result in a corresponding increase in efficiency and production. The workers should be instructed as to the common dangers of industrial life, as to the special ones in their occupations, and as to the menace of ignoring ordinary precautions to guard against certain easily preventable hazards. Cooperation by both parties is very essential and is bound to secure results.

DESCRIPTION OF OPERATIONS

Printing has been defined as the art or trade of making and issuing matter for reading, including all that is done from the reception of manuscripts to the issuing of printed matter, consequently the industry presents a rather complex situation as well as one of considerable importance in the manufacturing field.

The number of establishments engaged in the industry was compiled from the Biennial Census of Manufactures for the United States from the group of paper and printing, with paper and wood pulp and cardboard manufacturing plants left out, but with governmental printing establishments added. The total was 24,607 establishments for the year 1921, a number exceeded only by the number of establishments in two other general groups of industries, food and kindred products and textiles and their products. Considered from the basis of average wage earners employed, it ranks seventh in line, with 372,403, while from value of products (\$2,498,480,175) it is also the seventh. The actual number of establishments in existence is, however, considerably larger, as the census was limited to establishments reporting annual production over \$5,000. Reports from over 10,000 establishments, with annual production of more than \$500 but less than \$5,000, were consequently not considered. The production for these establishments amounted to over \$28,000,000. In addition to these there are also a number of still smaller plants, with a production of less than \$500 per year each. The number of workers engaged in the industry is actually considerably higher than shown in the census figures, and will easily go over 400,000 for average wage earners, with about 200,000 additional in other capacities, including superintendents, managers, and clerks.

Grouping of industries is, of course, always more or less arbitrary, and while it was attempted during the inspection of plants to follow the classification established by the Bureau of the Census, so as to cover all the various divisions, it was found more advantageous to compile the information with regard to the different vocations or trades engaged in the work.

At one time "the printer" performed all the work himself—set the type, read the proof, ran the press, and bound the printed sheet into a finished volume—but with the growth in size of printing-trade

establishments and the introduction of modern machinery the different processes have been separated and specialized until to-day the printed product represents the work of more than 50 skilled trades, grouped in six subdivisions of the industry.

The six principal departments—composition, photo-engraving, stereotyping, electrotyping, presswork, and binding—are sharply defined in the larger plants while they are more or less interwoven in the smaller ones, according to size of the establishment, equipment used, and character of product. Each of these main groups is again divided into several skilled trades, totaling more than 50, which are highly specialized.

All six departments are rarely found in any single establishment. Among the plants surveyed in detail, 264 were book and job printing establishments. The operations in the average book and job printing plant consist of composition, presswork, and binding, but a number of these were combination plants, requiring additional processes for the products. One combination plant may differ widely from another, as it is often found advantageous to specialize in some particular line and arrange buildings or equipment to suit requirements. Most of the work done in 45 plants was printing of periodicals, which differs only slightly in operations from book and job printing; 64 establishments printed newspapers. A newspaper plant usually includes composition, photo-engraving, stereotyping, and presswork. Some specialty plants were surveyed which performed only one branch of work, such as 18 trade composition plants, 46 photo-engraving shops, 3 job stereotyping and 14 electrotyping establishments, 27 bookbinderies, 2 type foundries, 2 brass die engraving establishments, 2 ink factories, and 1 roller factory. The last three were included because they were units of certain printing plants, though located separately. Ink grinding was found included among the operations performed in 25 of the previously listed plants and roller making in 3 of them. In 12 additional electrotyping establishments composition or photo-engraving or stereotyping was also performed.

Some establishments produce special articles only, usually by individual processes which, nevertheless, belong rightfully to one or more of the six vocational groups of the industry. Thirty-six of those reported on fall within this class, and consist of 9 doing principally label printing, 6 doing rotogravure printing, 6 doing steel-die and copperplate printing, 4 doing music printing, 4 using the lithographic printing method only, 1 printing on tin foil, 3 manufacturing envelopes, 1 paper patterns, 1 paper bags, and 1 playing cards.

COMPOSITION

Analysis of the character of work performed in these various plants shows that hand composition was used in 400 of them and machine composition was found additional in 273 of these. Up to about 40 years ago all the type was set by hand. At the present time there are only a few establishments which use this method exclusively, except the very small ones.

TYPESETTING

Hand composition consists in picking up one by one the type characters, which are short pieces of metal of a fixed height with a reversed letter standing out in relief at one end, from their places in the type cases and placing them in lines on a small tray with three sides, one side of which is adjustable, called a composing stick. Similar pieces with blank ends and less than type-high, called spaces or quads, are inserted between the words to separate them and to regulate the length of the line, an operation called justifying. Leads or slugs are the strips of type metal less than type-high and varying in thickness which are placed between the lines of type as they are set up. When a stick becomes full the type is removed from it and placed on a larger metal tray with three fixed sides, called a galley, where the job is gradually built up by successive stickfuls. Operations following this are practically similar for both hand and machine composition.

MACHINE COMPOSITION

In the last 20 years hand composition has been largely replaced by machine composition in either line or single type form. The type used in newspaper and periodical printing establishments is practically all produced on machines located in the plants. A number of book and job printing plants are also equipped with machines. In addition there is a considerable number of trade composition establishments, which furnish machine composition to other shops.

There are several makes of line-casting machines. The linotype, which is in common use, casts lines of type characters on type-high metal strips or slugs. A standard measure, 0.918 of an inch, has been adopted for the height of all type and is called type-high. The linotype is provided with a keyboard, somewhat similar to that of a typewriter, which controls the dropping and assembling of the matrices or molds for the letters. These are made in different sizes and styles and are placed in a portable magazine on the top of the machine. As the operator presses the keys the corresponding brass matrices are released from the magazine and drop into an assembler, with the words separated by spaces. When sufficient matrices have been assembled to form a line of the desired length the operator pulls a lever, which starts the automatic action of the machine, moving the matrices and space bands to a position in front of openings from the metal pot and justifying the line by adjusting the wedge-shaped space bands. The plunger in the metal pot forces molten metal against the characters, which are countersunk in the sides of the matrices, forming a solid type-high bar with the line of type on one edge. The mold is moved clear of matrices and pot and the slug is trimmed and ejected in front of the operator. The matrices are lifted to a position abreast the top of the reservoirs in the magazine and are distributed automatically to the proper containers, while the space bands, which were left behind, are returned to their original positions. As all of these actions are performed automatically the operator is meanwhile setting another line. In establishments that have a large number of machines the work of the operators is confined to manipulating the keyboards and adjusting the

machines. Special machinists keep the machines in running order and do the necessary repairing. In smaller shops, which have only a few machines, one of the operators usually performs the duties of a machinist-operator.

Other makes of line-casting machines are the intertype and the linograph, both of which vary slightly in mechanism from the linotype; also the typograph, for which the matrices are assembled by hand, justified to correct measure, and placed in the machine, where the line is cast automatically.

A different style, the monotype, which both casts and sets individual type, consists of two independent and separate machines, a keyboard and a type caster. The keyboard is similar to that of the linotype, but instead of releasing a matrix each depression of a key operates a valve for compressed air, which in turn operates punches that perforate a paper ribbon at the top of the machine. The ribbon advances automatically to receive the perforations and winds on a spool. This spool is transferred to the casting machine where the position of the perforations across the ribbon determines the letters to be cast, just as the perforations in a roll of music for a mechanical piano control the notes which the piano will play. As the ribbon passes through the machine it operates, by the aid of compressed air, the matrices in the type case, placing them in proper position over the mouth of the metal pump, and the type is cast, one at a time, in reverse order as originally manipulated on the keyboard. The individual type is trimmed and ejected by a carrier to a galley, repeating line by line as the job is automatically built up on the galley. The separation of the two operations has naturally developed two distinct individual occupations, the keyboard operator and the caster operator.

Another machine used for casting individual type is the Thompson type caster, which casts single type or characters repeatedly from an inserted mold. The monotype caster can also be used in this manner to produce movable type for use in hand setting. Some of the monotype casters are arranged to produce leads and slugs in continuous length strips, with a fixed mold. Additional makes of slug casters are also used, such as the Mergenthaler, similar to the casting part of the linotype, and the Elrod, which casts leads, rules, borders, etc., and cuts them automatically to required lengths.

HAND COMPOSITION

Even though the type is set by machines there is considerable hand composition required. On newspapers and in periodical printing plants the display advertising, or at least part of it, is set by hand. In-book and job shops the title pages of books, letterheads, and other jobs requiring special type or arrangement are also set by hand.

After the type has been composed, whether by hand or by machine, and placed together on a galley it is taken to a proofing press. The galley is laid on the bed of the press, the face of the type is inked with a hand roller, a piece of paper is placed over it, and pressure is applied, which transfers the ink to the paper, making an impression of the type form, or proof, for the purpose of inspecting the job and discovering possible errors. The form is

cleaned with gasoline or other type wash to remove the ink. The proof is compared carefully with the original manuscript and marked for corrections, which are then made. The men who proof the type, make corrections, insert headings, and make the type up into galleys are known as bankmen. While proof reading and copy holding are special, practically clerical, vocations, they are usually performed by former compositors on account of their knowledge of the trade.

When the corrections have been made the type is taken to the imposing table, where it is placed on a smooth iron or stone surface, made up into forms or pages, and the illustrations, folios, or other missing items inserted by the maker-up. It is then placed inside a steel frame, known as a chase, evened down with a block of wood, called a planer, and a mallet, locked firmly in the chase with blocks and wedges and sent to the electrotyping department, stereotyping department, or pressroom as required. The men performing these operations are known as stone hands.

After the forms have been used they are returned to the composing room, where they are unlocked. Whatever the nature of the form, hand or machine set type, photo-engravings, electrotypes, or stereotypes, there are the chase and spacing out material to be placed back in proper places. Hand-set foundry type is usually cleaned by a type wash and is redistributed, one at a time, to their proper compartments in the type cases. Machine-set type, as a rule, is taken out and sent in bulk to be melted and recast into ingots for the casting machines. The ingot furnace, where this is done, is sometimes located in the composing room and occasionally is taken care of by a compositor or an apprentice, but in the larger newspaper plants it is usually placed in the stereotyping room, and a number of plants have special metal rooms for the purpose.

Plates for illustrations, or other material that may be used again, are removed from the forms, separated, cleaned, classified, and stored. Several plants have cut rooms for photo-engravings, electrotypes, etc., often in charge of a compositor, who takes care of the plates, trims them as required, or makes small corrections. Some plants store entire type forms or pages for future use.

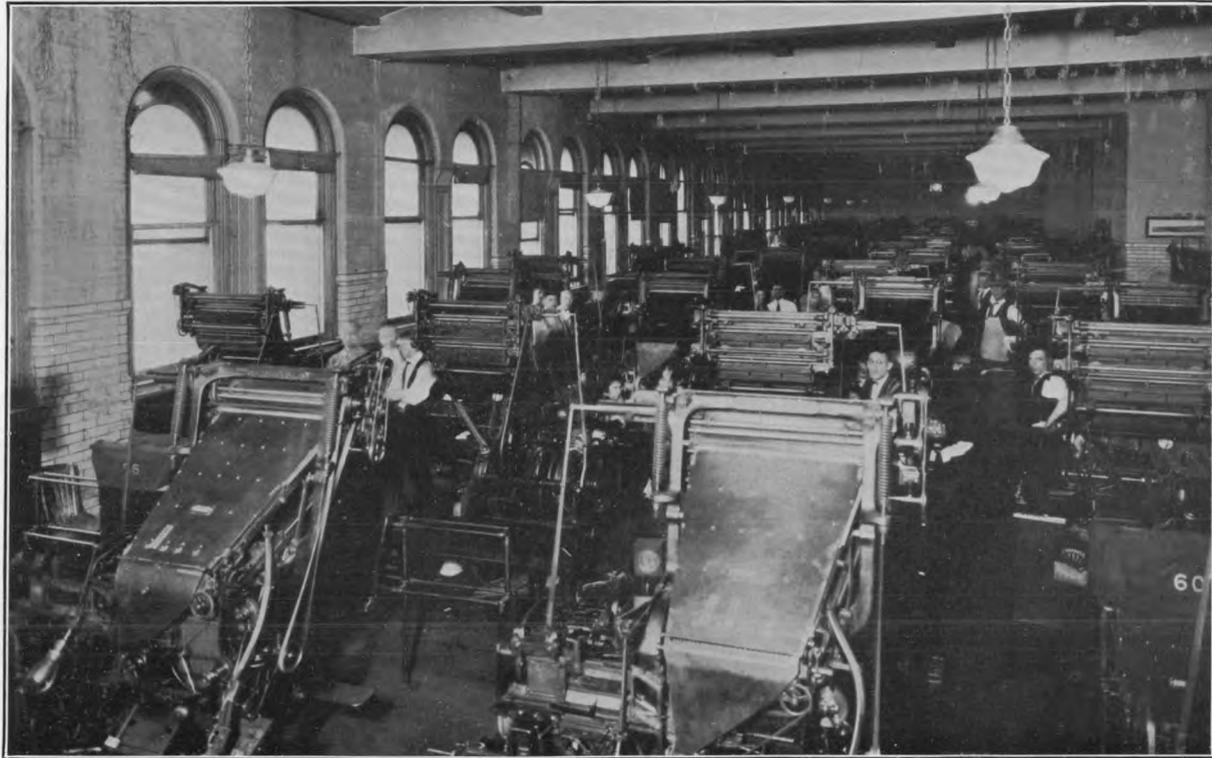
While the various special occupations in the composing room are strictly separated in the larger establishments, they are more or less merged together in the smaller plants, and in the very small shops one man may be performing all of the operations. For that reason, and because the actual hazards naturally divide the compositors into two distinct groups, all except machine operators have been classed as hand compositors in this survey.

TYPE FOUNDING

The individual type for hand composition can be produced on some of the type-casting machines, but a considerable portion is manufactured in type foundries, which are entirely separate establishments for such purpose. Two of these were inspected in detail, both large plants, which contained some additional working processes, such as designing of type, cutting of dies and matrices, or molds for casting the types, or manufacturing brass rules and some printers' furniture.



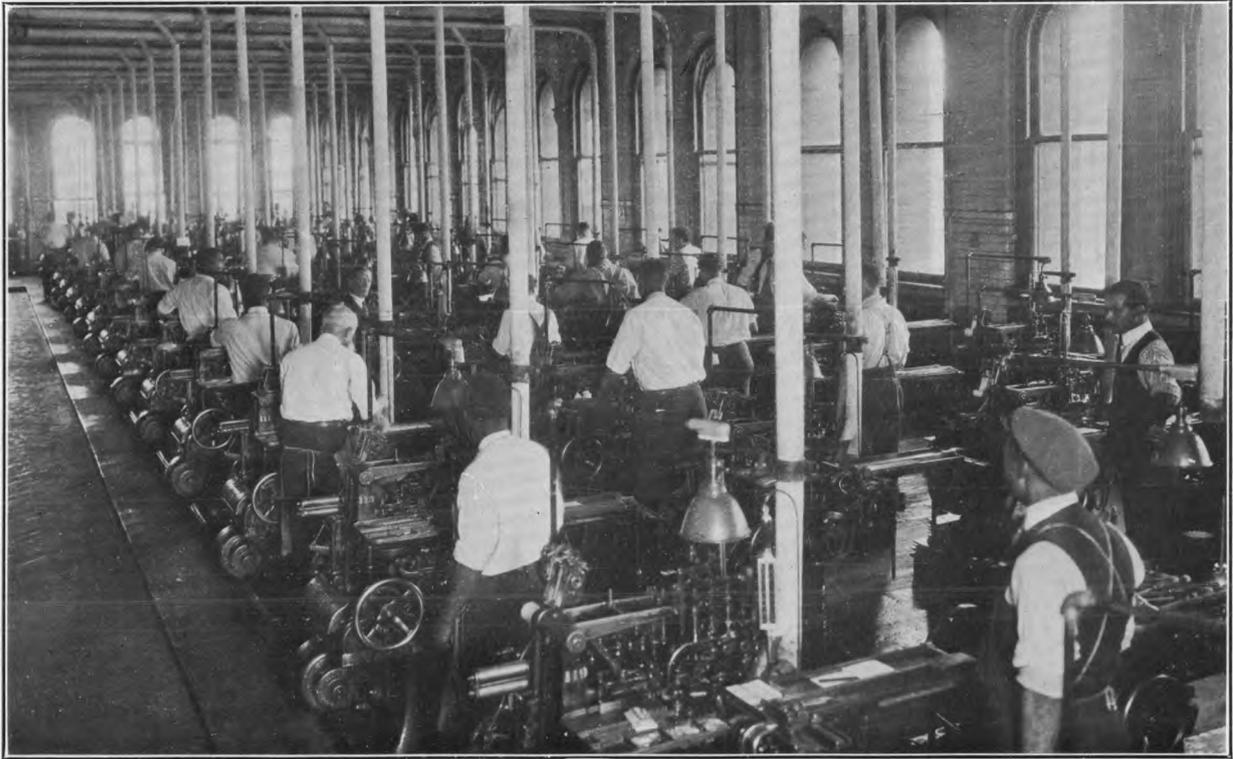
HAND COMPOSITION



MACHINE COMPOSITION—LINE-CASTING MACHINES



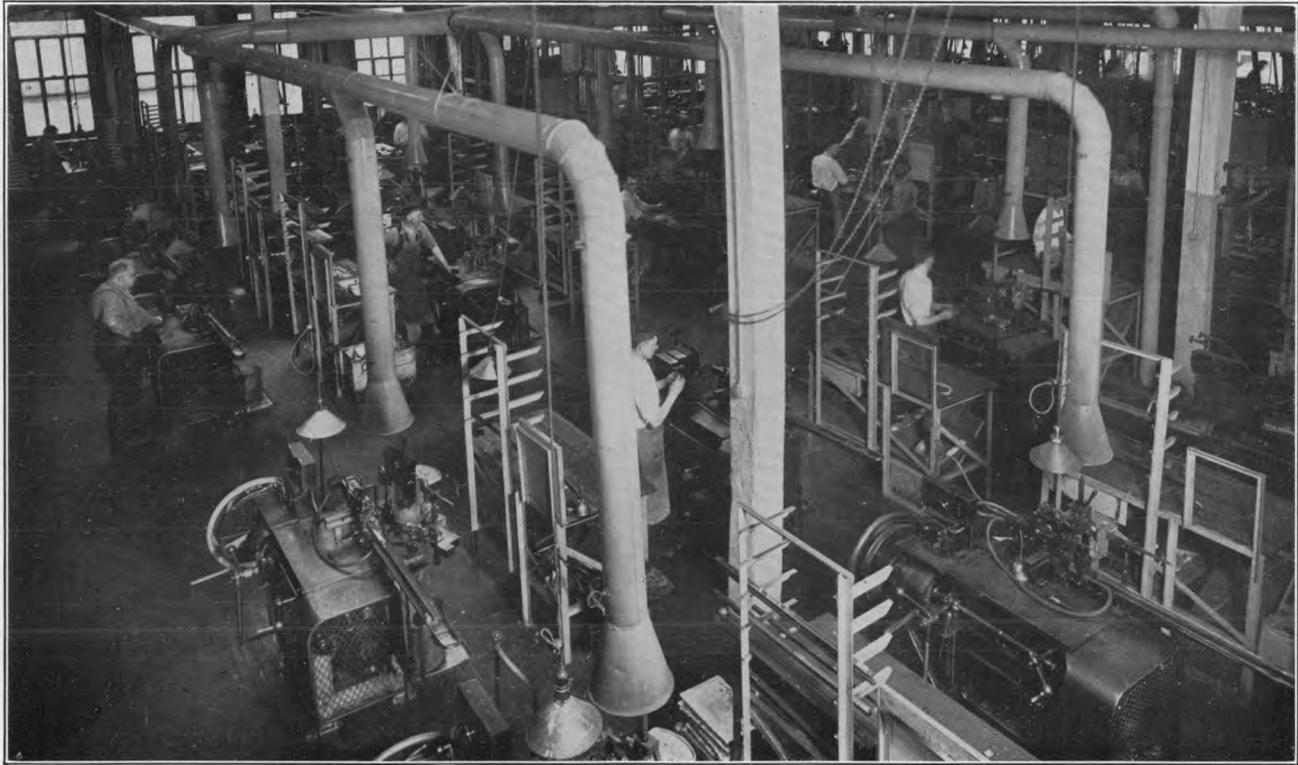
MACHINE COMPOSITION—MONOTYPE KEYBOARDS



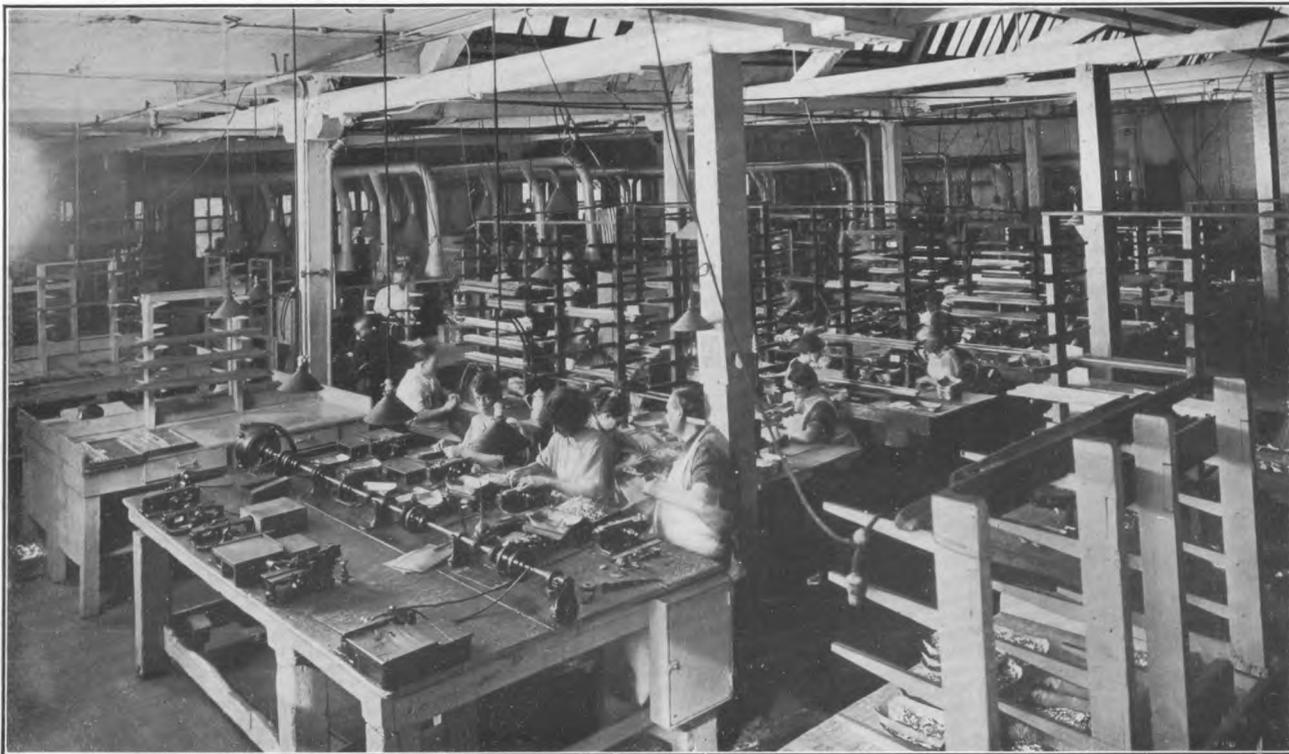
MACHINE COMPOSITION—MONOTYPE CASTING MACHINES



TYPE FOUNDRY—METAL MIXING DEPARTMENT



TYPE FOUNDRY—TYPE-CASTING MACHINES



TYPE FOUNDING—TYPE-DRESSING DEPARTMENT



TYPE FOUNDRY—DIVIDING ROOM

A counterpunch or engraved master type with the nonprinting part of the letter in high relief is first engraved from the design by the aid of special engraving machines. This is impressed into the end of a short bar of soft steel, which is afterwards hardened and known as a punch. The punch is, in turn, forced into a narrow flat bar of cold-rolled copper, making a reverse or sunken imprint of the letter, which is called a strike, drive, or unjustified matrix, and after finishing becomes a matrix, that is placed in a mold where the type is cast. Each character requires a separate matrix. These are fitted carefully to the mold, inspected, and corrected with aid of gauges, saws, trimmers, grinders, and hand casters.

The photo-engraving and electrotyping processes are also used in the production of matrices. An enlarged negative is made from the original design, which is drawn on paper, and a print is made from it. The engraver makes a tracing from the print and outlines the photograph on a piece of metal, called the templet, which is used as a guide in a pantograph engraving machine. A block of composition metal is engraved in this, with the design in required size, and metal around the outlines is cut away, leaving these in high relief. The engraved block is placed in an oblong hole in a thin slab of copper or nickel, which is suspended in an electrotype bath until the deposit has filled the hole in the slab around the block. The slab is turned over to the matrix fitter, who finishes it into a matrix and fits it to the mold.

The mold, which is attached to the type-casting machine, consists of two pieces with a seat for the matrix in the upper end, an opening for inflow of metal in the lower end, and a hollow between, into which the metal flows. At each revolution of a crank, operated by hand or by power, the plunger of the pump in the metal pot forces enough molten metal through an opening to fill the mold and the matrix. The halves of the mold separate, the matrix is drawn back from the face of the type, which is ejected, and the mold closes again automatically. The mold is kept cool by blasts of cold air or by cold water. Two varieties of type casters are used. The type is cast with a wedge-shaped strip, called a jet, adhering to the lower end. In one of the type-casting machines, the Barth caster, this jet is detached by automatic breakers, a groove is plowed automatically in the lower end, and the feather edges are smoothed off before the type is ejected.

The type cast in an older style of machine, the Bruce caster, is in a comparatively rough state and requires considerable hand finishing. The jet is broken off by hand and the sides of the type are rubbed on a file or stone, by hand, to remove the burs or sharp edges on the corners. The types are set up in a long row and fastened, face down, in a grooved channel where the roughness at the bottom end, caused by breaking off the jet, is plowed out with a hand plane by the dresser, leaving two feet at exact type height with a shallow groove between.

Special sizes of type are cut down further in kerning machines. After smoothing is completed all type is examined individually through a magnifying glass, imperfect specimens rejected, and the remainder packed in paper for shipment. Brass rules and brass type are finished by hand in similar manner or by special machines. Lead

rules and slugs are cast in continuous strips, passed automatically over long conveyors and wound on reels, later cut up in desired lengths and trimmed. Both plants were equipped with large machine shops for repair work, for the manufacture of tools or special machines used in the plant, and for production of other supplies for printing establishments, such as chases, metal furniture, etc. Very large kettles are used for mixing the metal, which is poured through spouts into pans for later use in the casting machines.

The vocations are quite sharply defined. Since the two establishments employed about 700 workers in all, several of these were employed in each particular operation, resulting in specializing it.

PLATE MAKING

PHOTO-ENGRAVING

The greater number of reproductions of pictures is made by the photo-engraving process, and partial or complete plants of that class were found in 142 of the establishments surveyed in detail. Only 46 of these were exclusive photo-engraving establishments, the others using it entirely or partly in combination with other processes for their products.

Relief photo-engraving.—Photo-engraving, as usually understood, consists in reproducing, by the aid of photography, a subject on a relief block or plate for printing, in which the parts to be printed are raised above the surrounding surface, but in the modern sense it includes also reproductions used in photolithography and roto-gravure printing. The subject to be reproduced may be a line drawing, a photograph, a painting, or the object itself. Some plants, especially newspapers, employ special field photographers to obtain views of interest for publication. Some photo-engraving establishments have large staffs of artists, who draw designs and prepare the photographs or other material for reproduction by shading or retouching with air brushes or by hand.

The subject is turned over to the photographer, who operates the camera to reproduce it on a glass plate, previously coated with a sensitizing solution. If the subject is a design containing only black lines or dots, such as a pen drawing, it is photographed direct on the sensitized glass, but in case it is a photograph, painting, or the object itself it is necessary to first insert a screen between the lens of the camera and the glass plate. The screen consists of glass covered with fine black lines, at an angle to each other, which can not be penetrated by the light, resulting in breaking up the solid tones of the subject into small black dots. After the photographer has developed the image on the glass plate the negative is turned over to the stripper, who removes the film, reverses it, and places it on another glass plate, which may contain additional films, then prints the image on sensitized zinc or copper.

The metal plate is inked and washed, leaving the ink covering the printed parts which represent the lines or dots in the picture. These, together with other parts that are not to be etched, are further covered with an acid-resisting powder or solution by the etcher, strengthened by application of heat, and placed in an acid bath, where the unprotected parts of the plate are etched away while the

protected design remains in relief at the original height. Most establishments use special etching machines, which throw a fine spray of acid against the face of the plate, but some of the plants still use large trays with rocking motion, which moves the acid gently over the face of the plate, laid on the bottom. Zinc is ordinarily used for line etchings where the subject is photographed direct on the glass plate, while copper is the usual metal for half tones which are photographed through a screen. Diluted nitric acid is used for etching of zinc and a solution of perchloride of iron for etching of copper. Distinction is made in large shops between the copper etcher and the zinc etcher. Copper plates usually receive further treatment, called reetching, to give proper value to the different tones. An electric etching machine, consisting of an electric bath and framed carbon plates in a stoneware tank, together with a motor and generator made especially for the purpose to produce the proper voltage and amperage, is used in some plants. Holes are bored in the corners of the plate, which is wired and suspended, face down, in the bath where the current, passing through it, pulls the copper from the bottom, or printing face. The precipitation is absorbed by the bath solution.

After the etching is completed necessary corrections and hand tooling is done by the finisher. The router and blocker cuts away the surplus metal and trims the plate. Special machines are used for this purpose. The routing machine, for cutting away the high nonprinting surfaces, consists of a table, or bed, on which the plate is clamped, sometimes over a block of wood, and a small chisel-like cutting tool, mounted in a spindle on a movable arm above it. The tool, or bit, which revolves rapidly, is guided in any direction over the surface of the plate and controlled vertically, gouging out the metal as desired. The different subjects are usually sawed apart by a circular saw, which projects through a slot in an adjustable metal table that is mounted on a hollow pedestal. A number of the plates are sawed roughly, close to the faces, and then placed on the trimmer, which has a sliding bed with adjustable gauges, mounted on a frame over a hollow pedestal. The plate is moved with the sliding bed against a rapidly revolving disc with cutter tools and is trimmed as desired with a straight edge. A combination saw and trimmer is often used, especially in newspaper plants. A similar machine is used for beveling the edges of the plates. The trimming or beveling sometimes follows after the mounting instead of being done first. The plate, which may vary from 0.083 to 0.049 inch in thickness, is finally mounted on a block of wood or metal to make it type-high, if required. Wood blocks for such purposes are sometimes manufactured, from lumber, in the larger establishments, necessitating special woodworking machinery, such as saws and planers, but even smaller shops use separate saws and trimmers for trimming the wood blocks. The plate is fastened to the wood with steel brads, driven through the metal. This is done by hand in the smallest shops only and several makes of nailing or blocking machines are commonly used. Sweating machines, with either electric or gas heating apparatus, are used for mounting on metal bases. It is sometimes necessary to cut a space through the plate and block for insertion of other material. This operation, called mortising,

is performed by means of a drill and a jigsaw, customarily placed on the same pedestal. The bottom of the base is trimmed in a special planer or a flat plate shaver to make the plate exactly type-high. Proofs are made of the finished product, in similar manner as with type, after which it is turned over to the department it is intended for or, in a commercial establishment, to the shipping room.

Just as in the composing room, the classification of occupations is distinctive only in the larger establishments. In a small plant one man may perform part or all of the operations. The work in a photo-engraving department of a newspaper differs somewhat from that in the ordinary commercial establishment or in one conducted for book and job printing. The plates used by newspapers are mostly line engravings, or half tones with a coarse screen, intended for stereotyping and consequently produced on zinc. They do not require so much trimming and are usually not mounted on blocks, eliminating much machinery necessary in other establishments for such purposes. Copper is used for the finer illustrations and is the material mostly required for book and job printing. Some plants specialize in this and others feature process color plates, which require a separate plate for each color to be printed, all blending together to produce the finished result.

Lithographic and offset engraving.—Considerable of the fine color work in printing is produced by the planographic method, which has evolved from a former separate branch of printing called lithography, meaning printing from stone. In lithography the printing surface is a very porous stone, 2 to 4 inches thick, which is polished smooth and on which the design is either engraved or drawn with a greasy ink or crayon. For engraving the stone is first treated with a solution of nitric acid and gum arabic, known as an etch, which renders it grease resisting when damp, after which the design is scraped in the surface with a fine needle that removes the preparation in those spots. The stone itself has a natural affinity for grease, so when a greasy ink is applied this will penetrate into the surface about one seventy-second of an inch and can be removed only by a strong acid or by wearing down that part of the stone. When the design is drawn on the stone a greasy ink or crayon is employed, which penetrates the surface. The acid and gum solution, which is not applied until afterwards, closes up the pores where no grease has penetrated so that the blank parts will repel the printing ink, if dampened properly, but the lines of the design will take up the ink and repel the water. For color work the original design is first drawn on a stone and a tracing made from it with a needle in a sheet of gelatin. The lines in the tracing are filled with red powder, which is transferred to other stones, by pressure with a roller, to act as guide for drawing the different colors. One separate stone is required for each color. A stone on which the design has been drawn can be used direct in the press, but where this is engraved a transfer is made of it by first inking up the engraved lines while keeping the blank parts damp, taking an impression of the inked lines on specially prepared transfer paper in a transfer press, built for the purpose, laying the impression on another fresh stone and transferring the inked lines to it by pressure. The new stone is prepared just as if the design had been drawn on it but, as any number of transfers

can be pulled from the original drawing and the designs deposited on the printing stone, any required number of copies of a single design or of different designs can be placed on it. This original method is still used to a certain extent, but in the majority of cases thin zinc or aluminum plates are now used to carry the design in place of the heavy stones and the hand method of preparation has been largely supplanted by machine work. Fifty-eight of the plants surveyed were producing planographic printing, either from plates or stones, but only 31 of these were using the photographic method.

Plates used in the planographic method are only 0.01 to 0.012 inch thick and differ radically from those for relief or type printing in having the printing parts level with the surrounding surface instead of being raised. The ability of the plate to carry the ink on the design is due to chemical action, just as in lithography. The design is prepared, as for ordinary photo-engraving, by designers and artists, and a negative is made and printed on the metal plate, but this plate has been given a fine grain finished surface before sensitizing instead of being left smooth and highly polished. The etching process differs considerably, as the etching fluid does not eat away the blank portions of metal around the design but merely changes the chemical surface of these so they will repel grease or ink when dampened, while the design attracts grease and repels water, exactly as the lithographic stone will do. The plate is covered with a thin film of gum arabic dissolved in water, to protect the surface during handling, and if the design has been printed direct on the press plate, it is then ready for the press.

In a number of plants the design is not photographed directly on the press plate but on a smaller one, similarly prepared, which can easily be stored away for future use, and a copy or copies of it transferred to the press plate, as in lithography, after which the plate is etched as described previously. Designs can also be transferred in similar manner from lithographic stones. Large shops using the transfer method have a number of men employed at this branch of work, with either power or hand-driven transfer presses. Other establishments, especially those that produce large out-of-door posters, have the designs drawn with greasy crayon direct on the press plates by the artists.

After the press plates have been used they are returned to the plate-making department where, unless they are to be kept for future use, the design is removed by lye and the plate regained for use again. It is clamped in the bottom of a large box, sprinkled with fine sand, emery, or similar substance, the surface covered with small steel, glass, or china balls, and some water added. The power is applied and the machine, which rotates in a circular motion from side to side, agitates the sand and causes it, with the aid of the balls and the water, to produce a grained surface on the plate. This is washed and dried rapidly. Where the printing is done direct from stone the design is removed from the stone used in the press by running it through a stone planer, which shaves off the top, and then polishing it smooth in a machine or by hand. The various operations have developed additional vocations, such as stone polishers, stone engravers, plate grainers, and transferrers.

Rotogravure engraving.—Within the last few years the photo-engraving process has also been applied to the intaglio method of printing, with the result that quite a number of rotogravure plants have been established, either as departments of newspapers or as independent establishments. Seventeen of these were inspected.

Plates used in the intaglio method have the printing design etched or carved below the surface, which constitutes the blank parts of the plate. In rotogravure printing the plate consists of a hollow steel cylinder with a coating of copper, about three-sixteenths of an inch thick, which is highly polished. One cylinder is ordinarily required for each side of the sheet, but in one plant visited part of the product was turned out in four colors, necessitating four cylinders in place of one. A negative is made from the copy, retouched carefully, and a reverse or positive is made from this, which is again retouched and then assembled on the layout table and mounted, together with other positives of illustrations and type, on a transparent piece of celluloid or glass. The layout is printed on a gelatin-covered, sensitized sheet of paper, known as carbon tissue, together with a special rotogravure screen. The carbon tissue is placed around the cylinder and the paper portion is removed with hot water, together with all soluble parts of gelatin, leaving only the designs and screen lines covered. When dry, the margins and other parts of the cylinder that are not to be etched are protected with asphaltum, which is acid resisting. This operation is called *staging*.

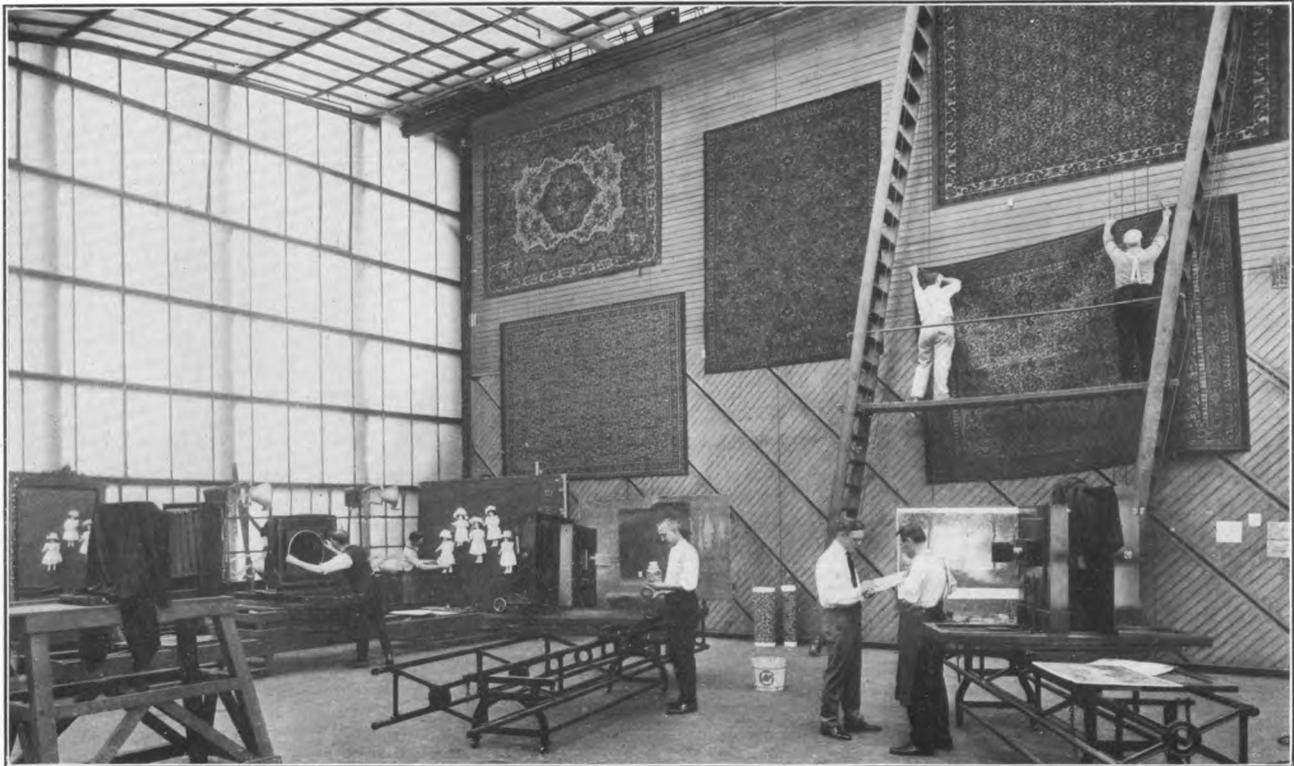
The cylinder is then transferred to the etching room, where it is placed over an etching trough and revolved while perchloride of iron is poured over the surface. When sufficiently etched warm water is applied, which stops the action of the acid, and the cylinder is thoroughly cleansed and given to the finisher. After necessary hand engraving or correction the cylinder is buffed and polished, then turned over to the pressroom.

When the printing is finished the cylinder is returned to the photo-engraving department, where it is placed in a grinding machine, ground down to the depth of the previous etching and polished. It is now ready to receive another design. As the etching is not deep this operation can be repeated about 20 times before the copper shell becomes too thin. When such is the case the cylinder is placed in an electrotyping bath, where a new shell is deposited over it, turned up in a lathe, ground and polished for use again.

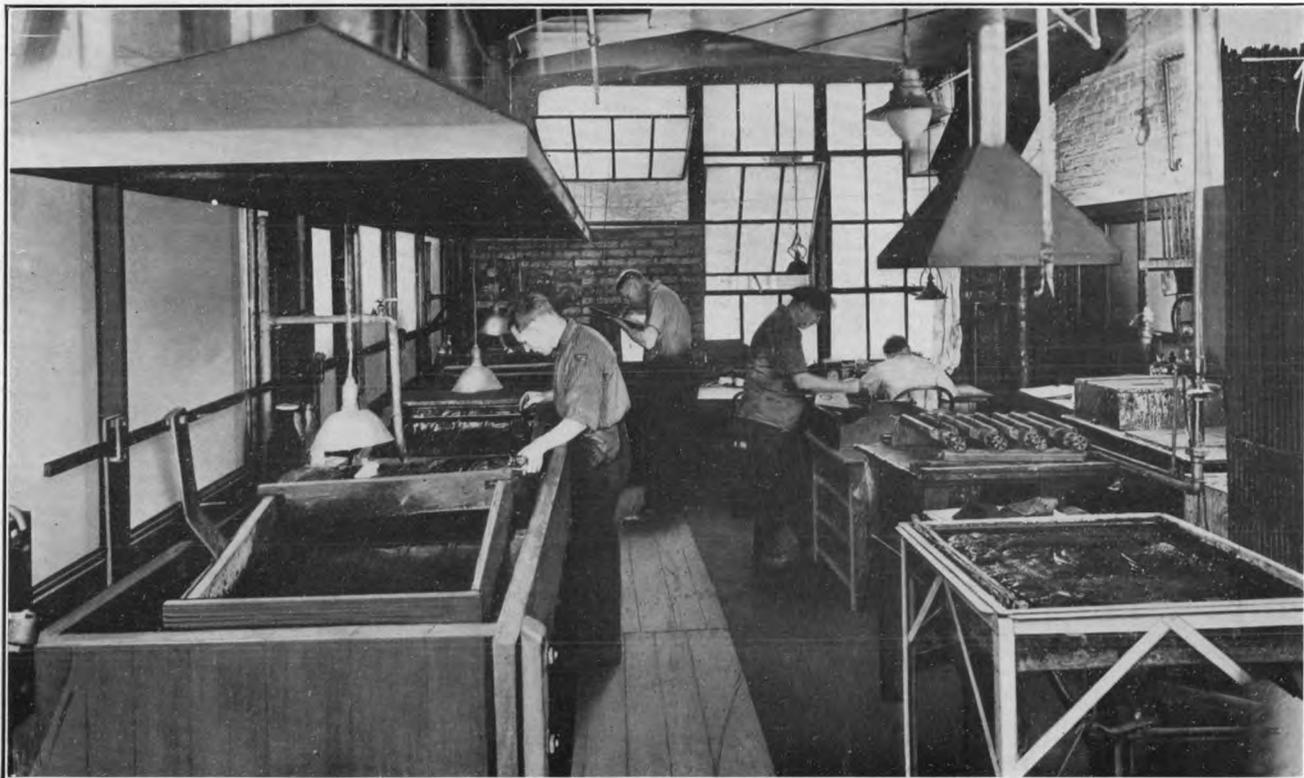
Practically all of the operations in rotogravure photo-engraving correspond with those in ordinary relief plate work, and although the methods and results differ but one new special occupation, grinder and polisher, has been added. The operations in both offset and rotogravure work are more sharply defined than in ordinary photo-engraving because these establishments usually employ at least one man for each special operation.

STEREOTYPING

Printing plates are also produced by stereotyping or by electrotyping, both duplicating processes. Stereotyping was found in 103 of the establishments, mostly newspapers. Only 3 plants were engaged in stereotyping exclusively, but in 9 others it was combined



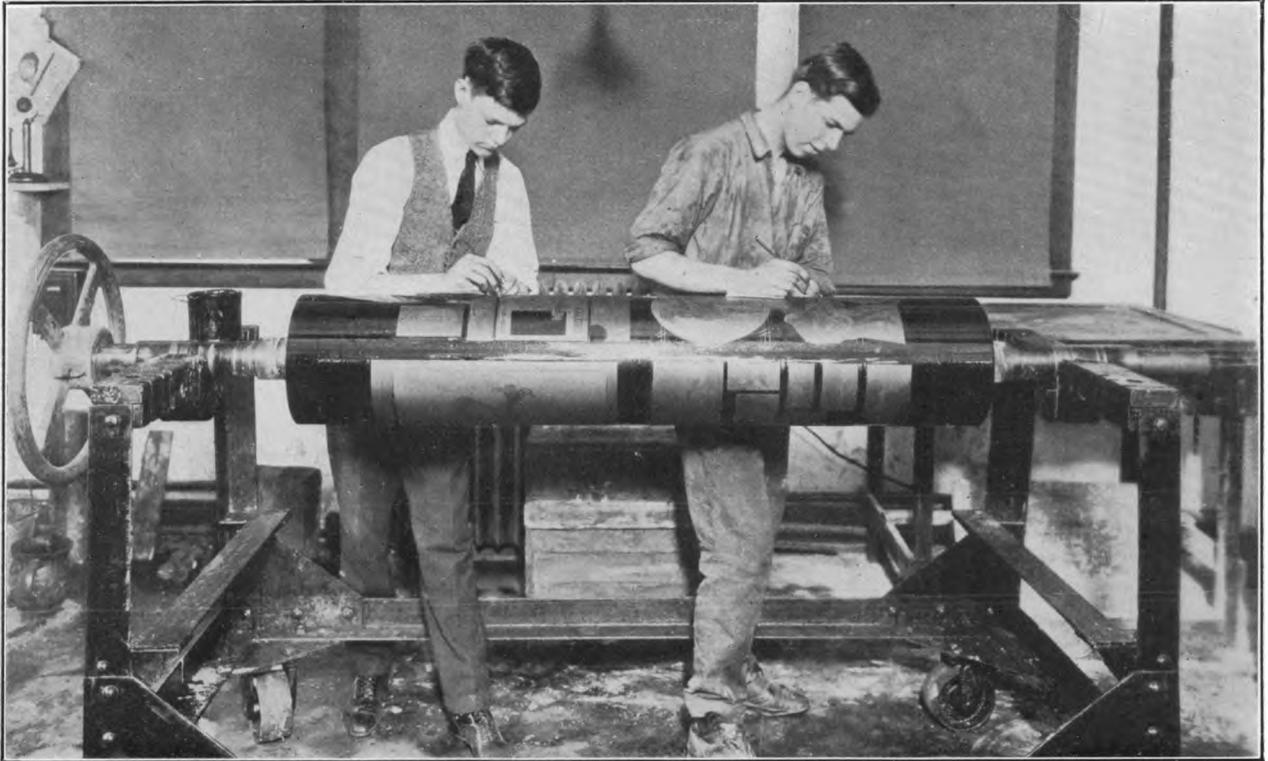
RELIEF PHOTO-ENGRAVING—GALLERY



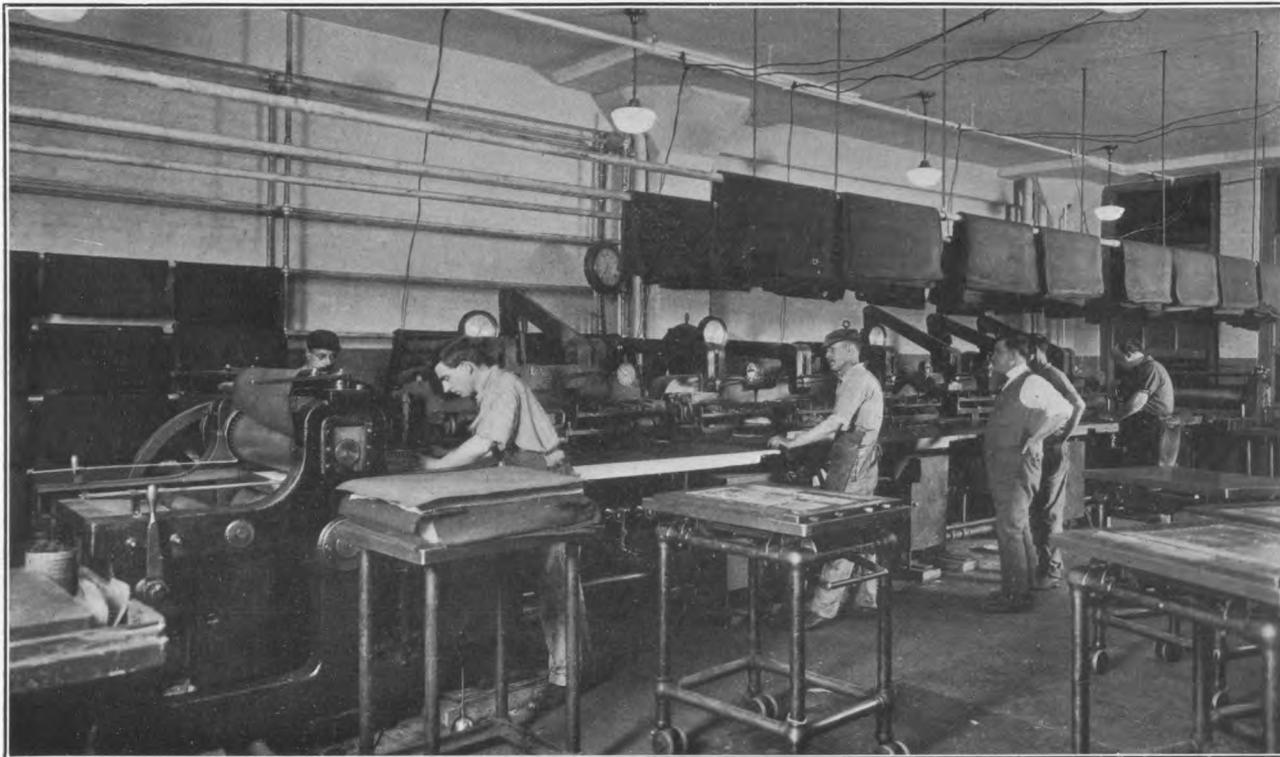
RELIEF PHOTO-ENGRAVING—ETCHING



OFFSET PHOTO-ENGRAVING—TRANSFERRING



ROTOGRAVURE PHOTO-ENGRAVING—STAGING



STEREOTYPING—MOLDING DEPARTMENT



STEREOTYPING—FOUNDRY



ELECTROTYPING—FINISHING



COPPER PLATE AND STEEL-DIE ENGRAVING

with electrotyping for the trade. Two envelope factories, 9 periodical printing plants, and 19 book and job printing establishments were using it for partial production of plates.

Stereotyping consists in taking a mold of the subject in plaster of Paris or in a sheet of papier-mâché, or paper pulp, drying it and using it as a matrix for the casting of printing plates, duplicating the original in solid form. The subject can, as in electrotyping, be either type, photo-engravings, or a combination of forms. The process is used extensively in newspaper plants to produce the large curved printing plates, which are clamped on the presses and for which the flexible paper mold is especially adapted.

The papier-mâché, commonly called flong, is first prepared by pasting together two blotterlike sheets of paper and pasting three or four sheets of special tissue paper on top of these. The paste used is specially prepared, from varied formulas, to combine the whole in a thick, soft sheet which, when dried, results in a hard flexible cardboard with a smooth surface. Some shops use a flong machine, which carries rolls of the various papers used and distributes the paste automatically as the machine draws the sheets forward and presses them together with rollers, making a continuous flong which is cut into sheets of required length at the end of the machine. In a number of places the flong is, however, still prepared by hand.

The flong is kept moist until time for using, and on large newspapers it is necessary to keep quite a number of prepared sheets on hand. Some newspapers use a dry flong, which consists of a specially prepared, thick, and spongy sheet that packs smoothly together when molded and which eliminates subsequent drying in the steam table.

On newspapers the page forms are usually made up on separate steel-topped tables, each large enough to take the form, of the same height as the imposing table, and with large casters on the four legs, for easy transfer to the stereotype molding department. The molder pushes the form onto the table of the matrix roller machine, also of same height, lays a sheet of the damp flong on top of it, tissue side down, and covers it with a thick felt blanket. Pulling a lever moves the table automatically under a heavy iron roller, squeezing the flong down over the face of the form which, with the molded flong still clinging to it, is next transferred to an iron table that is heated by steam or electricity, usually called a steam table. The felt blanket is replaced by soft drying blankets and an iron plate, or platen, forced down tight over the covered form, squeezing it again while the heat, applied from the surface of the table to the type, drives the moisture from the flong into the blankets. On some steam tables the platens are operated by compressed air, on others by electric power, and on the old-fashioned style by hand. After the moisture is expelled the flong is removed from the form, which is pushed back on the small table, or truck, and returned to the composing room. The blankets are hung up to dry. The flong is now a sheet of thick, flexible cardboard with an exact reproduction of the type, rules, and illustrations in the form, commonly called a matrix or mat. The margins are trimmed off and small pieces of cardboard pasted on the back in the larger blank spaces to support the mold when the metal is poured against them, after which it is conveyed to the foundry, or casting department.

The caster places the matrix in a roaster, or hot oven with a curved surface, to make it bone dry, dusts the face lightly with French chalk to assist easy removal from the cast, and lays it in a curved casting box with the face turned inward and the back pressed firmly against the inside of the box. In the smaller newspaper plants the casting boxes are usually placed in pairs near each metal kettle and connected at the top with pipes through which the molten metal is forced by a pump. The casting box is in two parts, the one forming the interior of the curved plate being upright and stationary while the outer section is balanced to swing down to permit insertion of the matrix, or later removal of the plate, and to swing up to close the box. The matrix is held at the sides by hinged strips of steel, which form the straight edges of the mold.

A more antiquated form is found in some plants, where the inside section is hinged to the outside section and must first be raised to allow clamping of the matrix. Detachable side guides are used in place of hinged ones. After the matrix is placed, the inside section is let down again, the box locked by clamps and stood on end, to be filled by metal, poured in by hand with a ladle. In either case the box is returned to a reclining position, after the metal has solidified sufficiently, and opened. The cast is turned face up and the matrix carefully removed, to be replaced in the mold and used over again as often as desired, while the cast is placed in a plate-finishing machine, where it is clamped on a cylinder which rotates slowly, bringing the plate against power-driven rotary saws that trim off the surplus metal at the ends, leaving the curved edges beveled so as to fit under the clamps on the presses. When the curved edges are trimmed, the cylinder stops turning and moves lengthwise, bringing the straight edges of the plate against another set of cutters, which trim these. The plate is next laid upon an inclined runway of another machine, the autoshaver, where the inside of the plate is automatically shaved, or reduced to proper thickness, and, cooled by a flow of water, turned out ready for the press. In order to reduce the surface to be shaved down, all plates are cast with less thickness than required but with projecting ribs, or strips of metal, on the inside surface, about 1 inch apart, and sufficiently heavy to support the plate under pressure of printing. The plates for newspaper presses are usually shaved to seven-sixteenths of an inch in thickness. In the old-fashioned method, still found in use occasionally, the beveling of the edges on a plate is done on a tail cutter, which has only a single saw, requiring the plate to be turned endwise for second edge trim, and the cylinder is rotated by hand power. The plate is next placed face up on a fixed cylinder, the finishing block, where all superfluous metal is removed with hand planes and chisels, then inserted face down in a plate shaver and a lever pulled, which rotates a straight-edged knife on a central shaft, cutting the plate to the required thickness. It is next cooled in a trough of water and turned over to the pressroom. This style of equipment, but two pages wide, is customarily used for the production of double pages when cast in one piece, and often in single-page width for plates intended for color printing, as in comic supplements.

The larger newspapers use a special machine, the junior autoplate, consisting of a metal kettle with two attached combination casting

and finishing mechanisms, each of which will automatically produce a plate ready for the autoshaver and readjust the matrix for a duplicate cast. The box or mold, which is upright, has an outer shell into which the matrix is fitted and which is then closed up against a grooved cylinder, one-half of which forms the concave side of the mold. The metal is forced in from an overhanging spout at the top by means of a hand-worked pump. When the cast is set the mold opens and the central cylinder turns slowly, carrying the plate with it against two rotating saws, which bevel the curved edges. A small arm slightly moves the plate so it can be easily removed by the operator, while the back with the matrix meantime is closed and another plate cast. The tailpiece is first removed and returned to the kettle by the operator, who then picks up the plate and places it in the autoshaver. A more complicated machine, the autoplate, automatically delivers the plate entirely finished for the press. It embodies the same principles as the junior autoplate but has a single casting and finishing mechanism, in which the plate is cast in a horizontal position, face down, the curved edges beveled, the straight edges smoothed down and trimmed close to the type, the inside shaved to proper thickness, the plate cooled and ejected, face up, resting on its two straight edges, another plate being automatically cast while the first one is being finished.

It is sometimes necessary to cut away a part of the metal in the very large blank spaces on the plates to prevent these from smutting the sheet in printing. This is done by hand with a chisel, or by aid of a routing machine, similar to those used for routing curved plates in electrotyping. While routing is very seldom used on ordinary daily newspaper plates there is considerable required on plates for color printing in comic or newspaper magazine supplements. It is also customary to give these color plates a subsequent coating of nickel on the printing face to make it more durable and some newspaper establishments have electrotyping departments or, at least, plating departments for such purpose. After the plates have been used for printing they are returned to the stereotyping department and melted in the metal pots.

In addition to the plate work in newspaper plants, there is also more or less small work stereotyped, such as duplication of headings, engraved blocks or advertisements, and casts made from matrices supplied by advertisers or by syndicates. This is usually termed job work, and requires different machinery from plate work. Flat casting boxes are used, of varying sizes and with adjustable side gauges, into which the metal is poured with ladles, or which are filled through a spout by means of a force pump. Saws and trimmers or combination saw trimmers are used for trimming the casts, flat shaving machines or type-high planers for planing the backs to make casts type-high, while a flat routing machine is used for gouging out the high nonprinting surfaces. These machines are similar to those used in electrotype finishing.

The product of the commercial stereotyping establishments is mostly job work, though on a larger scale, and some of them furnish matrices or stereotype plates to publishers through the country, usually requiring many duplicates of one original. Some of the

shops also turn out special bases of stereotype metal for use with photo-engravings or electrotypes, as desired, which are cast in flat casting boxes specially designed for the purpose. In the larger newspaper plants a separate small metal kettle is ordinarily provided for the stereotype job department, and near to it will often be found the ingot metal kettle, in which the machine composition is remelted for use again as ingots. Different styles of these are used. Some are provided with spouts, through which the metal flows into the molds. In others the molds are attached directly to the kettles and are filled by means of force pumps, while some have no mechanical means and it is necessary to use ladles for dipping out the metal and pouring it in the molds placed near by.

A somewhat different method, which is an adaptation of an old way of producing stereotypes, is used in some places for the manufacture of aluminotypes. The original is placed on an iron slab and a molding frame placed around it. This is filled with a composition of plaster of Paris, clay, asbestos, etc., in a semiliquefied state. After the composition sets the mold is placed in a drying oven, through which a forced draft of hot air is kept circulating at high pressure. A hole is cut in the bottom of the mold, which is locked in a separately constructed casting machine, through which the melted aluminum, alloyed with copper, is forced by aid of compressed air. The molding frame is taken from the casting machine and the plaster mold removed from the cast, which is scrubbed to remove all particles of plaster and trimmed as required.

While the vocations in stereotyping are to a certain extent specialized, it is customary on newspapers to shift the men from one position to another, so they are, as a rule, accustomed to all of the operations.

ELECTROTYPING

Electrotyping, the other duplicating process, was used in 63 of the establishments inspected, but in the majority of these it was in combination with other processes for the plants themselves, mostly periodical or book and job shops, and only 14 of them were exclusive electrotyping establishments. In 9 others it was found combined with stereotyping.

Electrotyping consists of taking an impression of the original in a plastic substance and depositing a thin layer of copper or nickel on the impression, removing this shell from the mold and backing it with metal, then trimming the plate to correct height and size. As any number of plates can be made from a single subject, the process permits printing in multiple and saves wear on type. The subject can be either type, a photo-engraving, or a combination of both.

In making the usual electrotype a metal case is filled with a resinol-mineral wax, ozocerite, which is kept melted in metal kettles with steam jackets and which sets quickly. A flame is passed over the surface to prevent bubbles and the top of the slab is planed down to give it a smooth even surface for molding. This part of the work is performed by the case filler.

The wax surface is brushed lightly with powdered graphite by the molder and an impression is taken in a large molding press of the subject to be duplicated. The projections and sharp edges of the wax are burned or cut off and low spots in the blank parts are built

up by the builder. The face of the molded case is covered with graphite in a black-leading machine, so as to render it more susceptible to electro deposition. Wet black leading, in which the graphite is mixed with water and applied in liquid form, has practically supplanted the dry method at the present time. Thirty-eight of the plants inspected used it exclusively, while 7 still used the dry method and 17 used both, 4 of these being equipped with special combination wet and dry machines.

After the graphite has been applied, the back and edges of the case are covered with wax to prevent a deposit of copper on them, called stopping out, and the molded case is suspended on hooks in a solution of sulphate of copper by the battery man. Sometimes the face of the mold is covered with a copper solution before immersion to hasten the action of deposit. The bath is kept agitated, usually by compressed air, and a current of electricity from a special dynamo is passed through it, which separates the copper from the sulphuric acid and causes it to form a thin deposit, or shell, on the face of the mold. When a nickel surfaced plate is required the case is first placed in a nickel bath and, after a thin shell has been formed, in the copper bath. The shell is stripped from the mold by hot water, or by cold water and compressed air, washed with hot lye water or steam to remove all wax, and the rough edges trimmed off. The case is returned to the case filler, who removes the wax for remelting and fills it up again.

Some plants use the lead mold method for certain high-class reproduction and others specialize in it. In this the plastic medium is a sheet of lead, one-twenty-fifth of an inch thick, in place of wax. No building up or black leading is required, but otherwise succeeding operations are similar.

The caster, who operates the metal furnace, applies a fluxing medium to the back of the copper shell, laid face down on a backing pan, and covers it with tin foil, which melts and forms a solder between it and the electrotype metal subsequently flowed over it, making a plate approximately one-fourth inch thick. After cooling, the face of the electrotype is scrubbed, by hand or by machine, usually with coal oil, and the surplus metal around the edges is sawed off.

In the finishing room most of the superfluous metal is removed from the back of the plate on a rough planer. The printing surface is carefully examined and necessary corrections are made by the finisher. The back is cut down on a smooth shaver to bring the plate to required thickness, high nonprinting surfaces on the face are removed on a routing machine, and the edges are beveled or trimmed to exact finished size. Where the plate is intended to be type-high it is mounted on a base by the blocker, just as in photo-engraving, and the bottom of the base is planed as required. If the plate is to be used unblocked, it is usually shaved to 0.153 inch in height for flat work, while finished curved plates vary up to 0.21 inch. The plate is beveled and trimmed, and when intended for a rotary press—for either newspaper, periodical, book, or job printing—is curved on a bending machine by applied pressure and sometimes with additional heat to fit the cylinder of the press. Curved plates are usually routed after bending. The router for curved

plates has a cylinder, on which the plate is clamped, that can be rotated, while the spindle, with the tool or bit, can be moved lengthwise of the cylinder. In some shops curved plates are produced by inserting the copper shell in a curved casting box and pouring the backing metal into this, as in stereotyping. Similar saws, trimmers, and bevelers are used as in photo-engraving, but also some additional ones to suit requirements, such as bevelers that will finish both sides of the plate at once. The finished product is ordinarily proofed before going to the shipping room.

In a method recently developed special machine operations are applied to produce electrotypes with printing surfaces on a perfect plane. Heavy pressure is used to solidify the backing metal. Plates for rotary presses are curved in an electrically heated bending machine, equipped with fingers that exert an even pressure of the surface against a flexible steel blanket, laid on the bed of the plate and fastened at each end to a half segment of a cylinder. The plate is heated until the backing metal is almost fluid, when the two segments are automatically brought together, forming a perfect cylinder inside of the plate and with the steel blanket covering it. The cylinder is rotated over the bed of the machine and the plate is cooled by circulation of water in the cylinder, the steel blanket is released and the plate ejected, curved to the proper diameter. It is then shaved in a curved plate shaver with knuckle joints, that press the face of the plate firmly against the bed of the shaver, proofed and corrected, repeating these operations until all parts of the printing surface appear on the proof without indenting the proof paper. Combination correcting and proofing machines are used to simplify operations. A special proofing press has been perfected in connection with this method, with an ingenious registering device, permitting proofing in four colors at one operation of the press.

Some plants have small auxiliary composing rooms, where composition for electrotyping can be done for customers and so eliminate any transportation of type. Others use special wax-ruling machines for producing tabular forms, engraving the lines in wax instead of setting up the rules and taking an impression. This latter method is also used for production of maps, where the design is fixed on the wax surface by hand drawing, photography, or some other transfer method. The engraving is done by a ruling machine, or by hand with sharp pointed tools, through the wax down to the surface of the coated copper or brass plate. Lettering is usually done by pressing heated brass type against the wax until the metal plate is reached. The plate is then made by the ordinary electrotyping process from the engraved mold.

The occupations in the electrotyping process are usually strictly divided, even though all the occupations are performed in one room.

WOOD ENGRAVING

There are additional processes of plate making. Among those used for production of relief printing plates is wood engraving, at one time the principal process for illustrations but now seldom used except for large letters, or plates containing these, intended for poster printing. The design is drawn or photographed on the surface

of a type-high block of wood and the surrounding blank parts are removed by hand with small chisels, called gravers, gouges, or scrapers, or by means of routing machines. This latter operation was used in one of the plants inspected. Another establishment, which was doing considerable printing on novelties, was using rubber surfaced blocks of wood and preparing these in a similar manner.

COPPERPLATE AND STEEL-DIE ENGRAVING

The most important of the minor plate-making processes is copperplate and steel-die engraving, by which flat intaglio printing plates are produced. In 36 of the plants inspected copperplate and steel-die printing was performed, but engraving was found in only 25 of them. Five of the establishments were devoted exclusively, or almost so, to the process.

In copperplate engraving the design is marked backward on a highly polished surface of a plate of copper, about one-sixteenth-inch thick, and engraved by hand with a cutting tool, or graver, removing the lines or dots of the design. A needle is used for the very fine lines and a burnisher for pressing together lines that may have been cut too wide. The engraver usually works under a strong magnifying glass, held in a position to allow use of both hands. The plate is supported on a small cushion, covered with leather, where it can be held firmly and turned easily to the angle desired for cutting the line. Engraving machines are also used for making outlines and for the fine detail work. These are of various styles. Some are constructed on the pantograph principle, permitting reproduction of a design in any desired size on the plate by a fine pointed tool. The plate is first covered with an acid-resisting surface, through which the design is scratched by the machine. The plate is then given an acid bath which cuts away the exposed copper, the ground or resist surface is removed, and the wider or deeper lines are engraved by hand. Ruling machines are also used, in which a fine point automatically cuts parallel, straight, wavy, or crossed lines at widths or distances for which the machine has been adjusted. The plate is not mounted but, after engraving and proofing, is ready for the press. In one of the establishments where rotogravure printing was performed the designs were engraved on the cylinders by hand in similar manner, as the designs were only a few simple lines and the hand method consequently was more economical than the photographic.

Plates for steel engraving are usually one-eighth inch thick. The design can be drawn direct on the metal or placed on the ground by photography, tracing, or offsetting. The preliminary method is similar to that used for copper plates but instead of using the original finished engraving on soft steel for printing the plate is ordinarily heated in a solution of cyanide of potassium to the proper temperature and dipped in oil or brine to harden it quickly. The plate is laid on the bed of a so-called transfer press. A small cylinder of steel, called a roll, of sufficient length and circumference to cover the design, is annealed or softened, then placed in the transfer press where it is rolled, under heavy pressure, over the face of the original engraving until all the engraved lines are reproduced in relief on its surface. The roll is taken out and hardened, in the

same manner as the original was prepared, and fixed back in the transfer press. A soft steel plate is substituted for the original engraving and the roll is turned over this until the raised design on it has been transferred to the plate, making an exact duplicate of the original, with the design in reverse sunk below the surface. After the desired number of reproductions have been transferred to the soft steel plate this, in turn, is hardened and carefully polished, then turned over to the pressman, called plate printer.

In steel-die stamping the plates, or dies, used are about one-half inch thick and the cutting is much deeper than in the ordinary steel plates, as they are intended to produce embossed or raised designs on the paper. In this work, which as a rule is for small designs only, the printing is done direct from the original engraving after it is hardened. Copper and steel plate engraving has developed additional vocations, usually highly specialized, such as plate engraver, plate polisher, and furnace tender.

OTHER PLATE-MAKING METHODS

There are other methods of preparing copper plates for intaglio printing, none of which were observed in the establishments visited. Among these is etching, where the plate is covered with a composition of wax and varnish, on which the design is scratched through to the copper and the back of the plate covered with asphaltum, after which it is placed in a tray and nitric acid poured over it until the lines are etched as desired. In another method, mezzotint, the design is placed on the plate with a rocker, a hard steel instrument with sharp teeth on a curved surface, rocked over the face of the plate in different directions by hand. A scraper is used to remove part of the holes in the copper for the lighter tints, or entirely in the high lights, after which the plate is polished with a burnisher. In a third method, dry point, the design is scratched direct in the copper with a pointed steel needle. None of these three methods are ordinarily encountered as they are too slow and cumbersome for commercial purposes, but a special method, called photogravure and which is practically rotogravure in a flat form, is used in some places for fine illustrations. As in rotogravure a negative is first made, then a reversed positive from this, which is printed on sensitized tissue consisting of gelatin-coated paper. The printed tissue is squeezed on a flat copper plate, previously covered with dragon's blood, powdered resin, or albumen by assistance of heat, and washed with hot water, which removes the paper and soluble part of the gelatin, leaving the design on the plate. After the plate is etched in a perchloride of iron bath all gelatin and grain is removed with hot potash and the plate is usually coated with steel in an electric steel-facing bath.

Sheet music, which is often printed by the lithographic or offset method, is in such case commonly engraved on a thin pewter plate, composed of lead, tin, zinc, and copper. The lines of the staff are engraved with a tool resembling a fork with five prongs, the straight lines are ruled or tooled in, while the notes, signs, words or text are punched in the plate by stencil dies or punches, producing an intaglio plate. A proof is taken on transfer paper, which is then used on the stone or plate in the usual manner. Some establishments use special

music type, which is electrotyped after assembling, and print the sheets by the relief method.

The engraving of counter punches, punches, and matrices, in type foundries is practically the same operation as steel and copperplate engraving, and similar methods were found in one book and job printing establishment, as well as in one specialty printing plant, for the production of brass printing plates. In addition two small plants were inspected that were brass die engraving plants exclusively. Brass dies are used for printing on book covers in book binderies. The engraving of the design, or at least outlining, is done by hand and the rest of superfluous metal is removed on a routing machine. Lathes, saws, and grinders are used for the finishing of plates.

PRESSWORK

Printing is divided into three different groups by the character of the surface on the form or plate from which it is done, and which may be either relief, planographic, or intaglio. In relief printing the parts to be printed are raised above the surrounding surface, in planographic printing they are on the same level, while in intaglio printing they are sunk below the surface of the plate. Presswork, which is the actual printing in the natural sense of the word, varies considerably according to the surface of the form, but two of the groups are often represented in one establishment and all three in some of them. It was found, in varied forms, in 425 of the 536 plants inspected. In 4 of these it was the only operation performed in the plant, in 60 it was combined with composition only, in 18 with photo-engraving only, in 1 with stereotyping only, and in 20 with binding only.

Presswork consists mainly of operating, adjusting, or managing a machine for printing, called a printing press, which impresses the inked forms upon paper, cloth, or other material and transfers the ink to the material. A number of different styles are manufactured for each of the three groups mentioned, that vary considerably according to the nature of the work, quality and quantity of production, as well as whether flat forms or curved plates are used.

Printing presses used for relief surface work are classed in three main divisions, platen, cylinder, and rotary presses, according to the manner in which the impression is secured. A platen press has a flat bed to hold the type or form and receives the impression from a flat plate, or platen, which is forced up against it. A cylinder press has also a flat bed for the form but the impression is received from a cylinder, which carries the paper and which turns while the bed moves back and forth under it. A rotary press has two cylinders, geared together. The form, or plate, is curved and fastened around one of these, while the impression is received from the other over which the paper passes.

PLATEN PRESSWORK

Platen presses, development of the old-time hand presses, are at the present time used only for job printing and mostly for small work, as during operations the whole form is squeezed at one time, requiring great pressure and limiting the size of the press. Several

different makes are used, mostly of American manufacture, but also some English and German. These vary slightly in style, each having special features in which it excels, but all embody the same general principles. The form used on the platen press may consist of either type, photo-engravings, flat electrotypes, flat stereotypes, or combinations of these. After receiving the form from the composing room the platen pressman places it on the bed of the press, which is vertical, where it is held in position by two grooved lugs at the bottom and a clamp with a strong spring at the top. The bed may be in a fixed position, or swinging, and the platen, which is located directly opposite so they can close together to give the impression, is automatically forced up against it in printing. As it is not practical to print directly against the metal surface of the platen, this is covered with packing to provide proper resiliency and to give just sufficient impression for the form. Packing consists of a hard, smooth-surfaced cardboard, called pressboard, and several sheets of paper, the top one of which is named tympan or drawsheet, and is held down over the upper and lower edges of the platen by clamps. The proper position for the sheet to be printed is located and guides are placed on the packing where the edges should strike. Some make-ready is required at times, especially on the better class of work. To make ready consists of pasting pieces of thin paper on one of the sheets in the packing over certain spots where the printing does not show up well, or perhaps cut out part of a sheet, or more where it shows too much impression. Sometimes it is first necessary to build up certain portions of the form, especially photo-engravings or other plates mounted on wood bases, by pasting sheets of paper under these to raise them to the proper height. The ink is applied automatically to the surface of the form by composition rollers, that first have received it from a distributing surface, which may be either a revolving ink disk on which the ink is fed, either by hand or from a fountain, or a small cylinder to which the ink is transferred from the fountain by a separate roller, called a ductor roller. When the power is applied the rollers, held in a frame, pass over the distributing surface and pick up the ink, then over the surface of the form, where it is deposited, and return to their previous position above the form. The platen, on which has been placed a sheet to be printed on, is automatically forced up against the bed by arms on either side, and then returns to its open position long enough to permit the operator to take the printed sheet out with his left hand and place another sheet in proper position with his right hand. The press is supplied with two grippers, long adjustable metal blades, which close automatically against the sheet on the platen when the press closes and prevent the printed sheet from sticking to the inked type when the press opens afterwards. A throw-off lever is used to prevent the press from closing entirely together whenever a sheet is misplaced or it is desired, for any other reason, not to take an impression.

The platen-press feeder assists the pressman in getting the press ready for operation, feeds it while printing, washes the rollers, oils the press, and keeps it clean. The stock to be printed is placed on the feed board at the right of the press, convenient to the right hand of the feeder, and fed in one at a time. The feeder places a sheet

on the platen with his right hand, sliding it along the bottom guides to the proper position against the side guides, while the press is open. After it is printed it is removed with the left hand as the press is opening and a new sheet is inserted. During the last few years the human element has been largely supplanted by attaching mechanical automatic feeders, especially where long runs are required from one form, as one operator can easily handle two of these. There are several makes of automatic feeders for platen presses on the market, which pick the sheets up, one at a time, from a pile, place them mechanically in proper position on the platen for printing and remove them afterwards, depositing them in another pile. In shops that have only one or two platen presses it is not unusual for the pressman to feed a press himself, but in larger shops one pressman usually has charge of several presses, with a feeder employed on each hand-fed press.

Some plants are equipped with self-feeding platen presses, using flat sheets, or a special style which is fed from a roll. The latter consists of several units, coupled together, with the web passing through these in rotation. It has automatic attachments for perforating, punching, die cutting, numbering, reinforcing, eyeletting, slip-sheeting, multiple feeding and cutting, slitting, rewinding, or folding, and is used for the printing of tickets, labels, or other jobs which demand a number of colors or operations. Platen presses are also built for creasing and cutting, an operation used for shaping folding paper boxes, or for embossing, which consists in raising the design above the surface of the paper. Some of the presses used for these two operations are supplied with inking mechanisms and rollers, while others are not.

Platen presses are also used for proofing in photo-engraving establishments to obtain a true reproduction of the copy and show the best possible results that can be obtained from the plate. Customarily a heavy variety with good ink distribution is used for four-color process work, but the majority of offices use a hand press, of a style that has been in use for about 100 years and is an improved model of the hand press used in the fifteenth century. The bed, which is horizontal and directly under the platen in this press, slides on a track and is run in or out from under the platen by turning a crank. The form is placed on the bed and inked up, by hand in the older styles or mechanically in the newer ones. The sheet of paper to be printed is laid over the form and covered with the tympan, an attached frame covered with cloth, the whole thing slid back under the platen, which is then pressed down on it by means of a curved lever acting on a toggle joint. Heavy springs on each side of the platen raise it when the lever is released. The bed is run out, the tympan raised, and the printed sheet removed. Hand presses are also at times used for proofing in electrotyping or stereotyping establishments and, very rarely, in composing rooms.

Platen presses are often called job presses and the workers, consequently, designated as job pressmen or job press feeders, creating some confusion in terms because in some localities job presses include also several varieties of small cylinder presses, called job cylinders or baby cylinders. In the larger shops the occupation of platen pressman is highly specialized, the position of feeder acting as a

stepping-stone to it, but in small shops containing both cylinder and platen presses the cylinder pressman often looks after the platen work also. Color proofing in photo-engraving plants is considered a specialty, differing considerably from ordinary platen presswork but practically the same as the better class of color work on platen presses in commercial establishments.

CYLINDER PRESSWORK

Cylinder presses are ordinarily used in book and job printing establishments but also in some periodical printing plants. The form used on a cylinder press can be either type, photo-engravings, flat electrotypes, flat stereotypes, or combinations of these, just as on a platen press, but differs from this by being considerably larger and consequently heavier to handle. The procedure of preparing the press for printing is also more intricate on account of the more complicated machinery. The form is laid on the bed, which is horizontal instead of vertical, and fastened in proper position. The press is adjusted by the cylinder pressman to handle the stock properly and deposit the correct amount of ink on the form. The cylinder, which delivers the required pressure for printing as does the platen in a platen press, is similarly covered with packing and made ready, after which the paper is run through the press and printed on.

While a number of different styles of presses exist, even among those made by the same manufacturer, they are divided by the varied action of the cylinder into three classes, single revolution or drum cylinder presses, in which the cylinder revolves once for each impression, double revolution, in which the cylinder revolves twice for each impression, and flat-bed web presses, in which the bed with the form is stationary while the impression cylinder travels back and forth, and which prints on a continuous roll or web of paper, while the other two classes print on sheets, previously cut to size.

A single-revolution press has a large impression cylinder, which revolves once for each printed sheet delivered. The stock to be printed is kept on a sloping feed board, ending close to the top of the cylinder and moved one at a time down to the adjustable guides by the feeder. The grippers, which are adjustable metal fingers for grasping and holding the sheet on the cylinder while turning, close on the sheet, and the feed guides raise so the paper can pass under them and then drop back for the next sheet. Adjustable sheet guards or iron straps, called cylinder bands, in front of the cylinder keep the sheet up against it and smooth. The bed, which meanwhile has passed under the inking mechanism, where the face of the form has been covered with a thin film of ink, moves on while the cylinder turns with it, pressing the paper held by the grippers against the face of the form to receive the print. The impression can be thrown off by pulling a lever, as on a platen press, or by pressing a button. The sheet is transferred to a skeleton cylinder, also containing grippers, and carried to the fly, which is a row of long wooden fingers that are fastened on a shaft and on which the printed sheet is deposited. The fly describes an arc of a circle and lays the sheet on top of the preceding one on a table. The cylinder meantime continues to turn in the same direction, but the bed, with the form, reverses

its motion and goes back under the inking mechanism. The circumference of the cylinder is equal to the entire travel of the bed forward and back, so, as only part of the cylinder is required to carry the impression, the rest of it is turned down to allow the form to pass back under it without touching. The bed runs on geared friction rollers and is usually propelled, through a universal or knuckle-joint method, by a gear turning in a rack or row of teeth fastened below it. Heavy springs or an air cushion at each reverse stop the bed quickly and eliminate the strain. A segment of a gear attached to the cylinder and a gear rack, known as the register rack, and which is attached to the bed, harmonize the travel of the cylinder and bed to insure uniform position of the printed matter on the product. High metal strips around the ends of the cylinders, called bearers, in contact with similar bearers on each side of the bed, keep the cylinder at a uniform distance from the form. The ink, which is placed in a trough, called the fountain and extending across the press, passes to a small metal roller and is conveyed by a vibrating composition roller to a larger revolving cylinder. From this it is transferred to the form, either direct by a series of composition and small metal rollers or by means of an ink table, a flat raised extension at the end of the traveling bed, to which the ink is passed by another composition roller. The motion of the bed brings the table under a set of vibrating composition rollers that distribute the ink on it by friction, then under the form rollers, also composition, which pick up the necessary amount of ink and in turn convey it to the face of the form. In another style, known as the stop cylinder press, the cylinder is stopped by a cam motion, pending the backward travel of the bed, but with other mechanisms similar.

In a two-revolution cylinder press the cylinder prints while making one revolution, but while it continues turning it is lifted during the second revolution to permit the form to pass under it on returning. Either a ball and socket universal joint drive or a direct drive is used for the bed motion, and the printed sheets can usually be delivered with either side up. When it is desired to have the printed side up, the sheet is run upon a carrier or apron, which carries it to a delivery table, deposits it and returns to original position for another one. When the other, or clean, side is required on top the carriage is left stationary and the sheet is run onto a fly, just as in a single revolution press, with the clean side down. The fly deposits the sheets in a pile with the clean side up. The general description for the single-revolution press covers all other essential features. There are, however, some variations of this machine, a perfecting press, which prints both sides of the sheet at one operation, and a two-color press.

A perfecting press has two beds, two forms, and two inking mechanisms but only one feed and one delivery. The cylinders revolve in opposite directions and lift alternately. One prints while the bed moves forward and the other when it goes back. After the first side of the sheet is printed it is delivered to the other cylinder, with the clean side out, bringing the freshly printed side against the outside sheet of the packing, called tympan. As more or less of the ink will set off on the tympan this would soon smut the sheet, so an automatically shifting tympan is used, consisting of a small roll of

thin manila paper, placed inside the cylinder. The end is led around the cylinder over the make-ready and wound up on another roll, also inside. It can be adjusted to shift automatically between any certain number of impressions, and can be used over again after the ink has dried. A two-color press is similar in principle but both cylinders revolve in the same direction and print during the same movement of the bed. A transfer cylinder delivers the sheet from one main cylinder to the other without turning it over and, as both colors are printed on one side only, a shifting tympan is not needed.

There are a number of various attachments used on both single and double revolution cylinder presses. Several makes of automatic paper feeders are used to a great extent, some of which handle the sheets by friction and others by suction. One style is provided with bucklers, small revolving propellers that are adjusted at both ends of the sheet on top of a pile of stock. The contact raises or buckles the sheet, loosening it from the rest, and push fingers propel it forward under rubber rollers, which start it into the press at timed intervals. Another kind is equipped with a combing wheel, which revolves on top of a pile of stock and combs or pushes the sheets ahead until they reach the guide, when the combing wheel lifts and a small roller propels the sheet into the press. A different type uses a large combing wheel or roller, extending across the press, which advances the sheets in a continuous stream, lapping over each other, and releases the top sheet into the press. The first two styles, called pile feeders, are often equipped with loose piling boards, mounted upon rollers, upon which a large supply of stock can be piled while the machine is operating. When the supply in the press is exhausted the empty piling board is removed and a loaded one, previously placed in position, lifted mechanically to the correct height. It raises automatically as the sheets are removed, one by one, by the feeding mechanism, always presenting a sheet at the proper, adjustable height. The third or continuous feeder requires the placing of paper direct on the feed board while the press is operated, either by hand, by means of an automatic hoist which takes the so-called lift from the floor to the top of the feedboard, or by a conveyor operated on tracks above the presses. On some feeders blast pipes are placed at each side of the pile of sheets and adjusted to direct a volume of air against the edges so as to loosen the top sheet. Suction pile feeders are used extensively, either with the suction pipes that pick up the sheet from the pile, lift it forward, and deposit it under drop reels, which propel it further, or with wheels provided with suction holes, that perform a similar function. Extension deliveries are also attached, permitting the printed sheets to be delivered on a movable table, which is lowered automatically as the sheets accumulate and descends upon a frame with wheels, that permit easy removal and insertion of a new empty table. Automatic joggers are sometimes used for straightening, or jogging, the printed sheets into an even pile, and sheet driers, or neutralizers, with either electric or gas heat for drying the ink and eliminating static electricity in the paper. Special appliances, such as for numbering and collating in desired quantities, slitting, or perforating are used on some presses to turn out special classes of work. A separate mechanism, the Upham attachment, has also been added to some

single-color presses for use when desired to print two colors at one time. It consists of a plate cylinder, one-half the diameter of the impression cylinder of the press to which it is attached, and an inking mechanism, all mounted in frames to be joined with the side frames of the press back of the impression cylinder. The plate cylinder is grooved so that curved electrotype plates can be clamped on it, for printing the second color on the sheet as it travels around the impression cylinder.

The operation of making ready on single revolution and double revolution cylinder presses is the same, depending only on the quality of the work to be turned out. The form is first corrected to make it type-high, as near as possible, the proper amount of packing placed on the press, and deficiencies remedied by pasting pieces of paper on one or more sheets in the packing. Packing can be either very hard, for the better class of work, composed of pressboard and several sheets of paper, or of varying degrees of softness, for cheaper grades. Special blankets are also used for packing, made of various substances ranging from a fairly solid composition for the better class of printing to soft felt blankets for poster and newspaper work. Halftone printing requires a hard packing and considerable make-ready. The solids, or parts of the plate which print dark, require more pressure than the intermediate, graduated tones, while the high lights can stand only a very light pressure. Overlays consisting of patches of paper are consequently prepared and attached to the packing with paste. Mechanical overlays are also used in a number of establishments, sometimes supplied by photo-engraving establishments, but usually made by the pressman in the shop. These consist of reverse plates of the half tones, made of zinc, or of paper covered with layers of composition, chalk, or emery, but with uneven surfaces, being thicker in the solids, or dark spots, and gradually thinner for the lighter shades. They are attached to the packing just as the hand-cut overlays of paper. Plate mounting devices are commonly used in forms containing many half tones, especially on color process work. These consist of metal blocks, which are grooved, and are provided with special clamps that slide in the grooves. The half tones, or electrotypes, which are not mounted, are laid on top of the blocks and fastened with the clamps. They can be easily moved in any desired direction and, consequently, permit the pressman to register each plate accurately to the correct location. Cylinder presses are also used for creasing and cutting in plants manufacturing folding paper boxes and, like platen presses for that purpose, can be found with or without inking mechanisms.

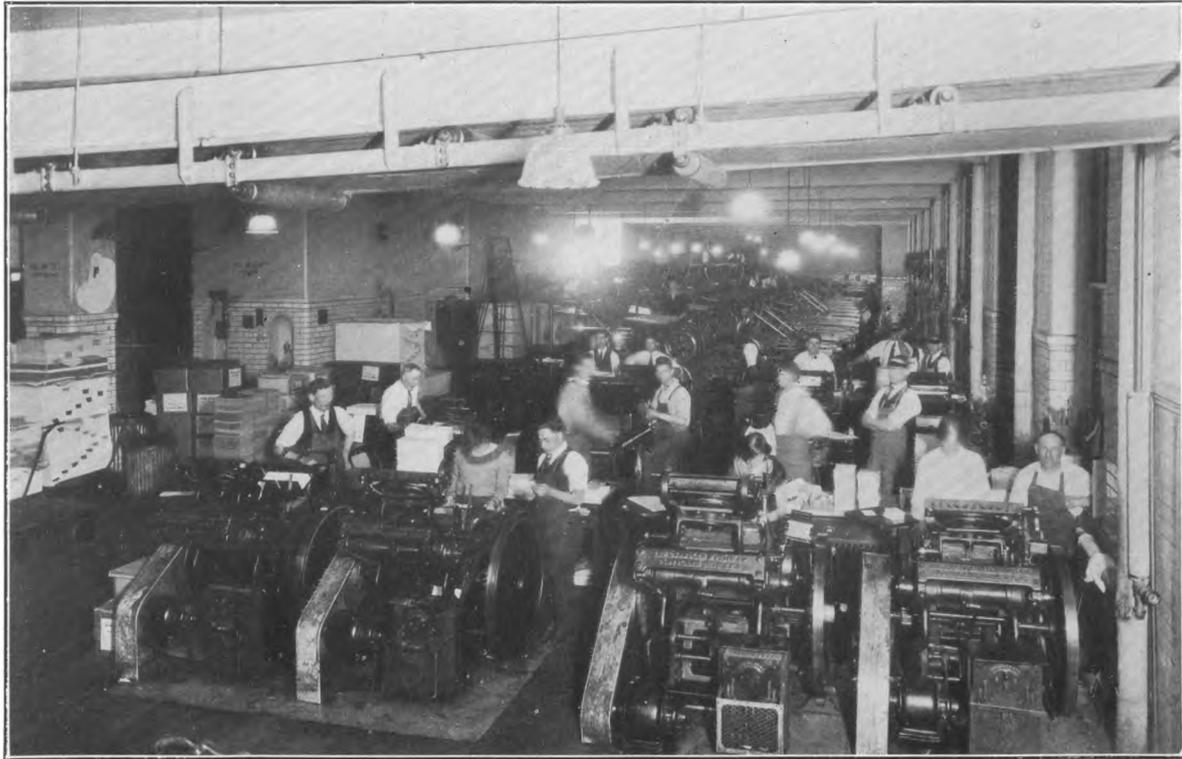
A special class of cylinder presses, for operation at high speed on small job work, has been developed in the last few years. Some of these belong rightfully to the first class mentioned and others to the second, but resemble each other so much that they can be considered separately, regardless of the distinctive cylinder motion. They are usually called job cylinder or baby cylinder presses. Automatic feeding apparatus is attached, varying in style according to manufacturer and using either friction or suction for placing the sheets against the guides. Devices are also used for automatically tripping the press, or throwing off the impression, if the sheet fails to get down to the front guides or if the sheets pile up in feeding. Some

presses are also supplied with delivery tables which lower automatically as the printed sheets are delivered on them. Most of the varieties are built similar to the regular cylinder press, with horizontal beds, but one style uses a vertical bed, on which the form is held by a spring catch and which moves up and down. The cylinder also moves up and down, balancing the bed, and revolves on the printing stroke only.

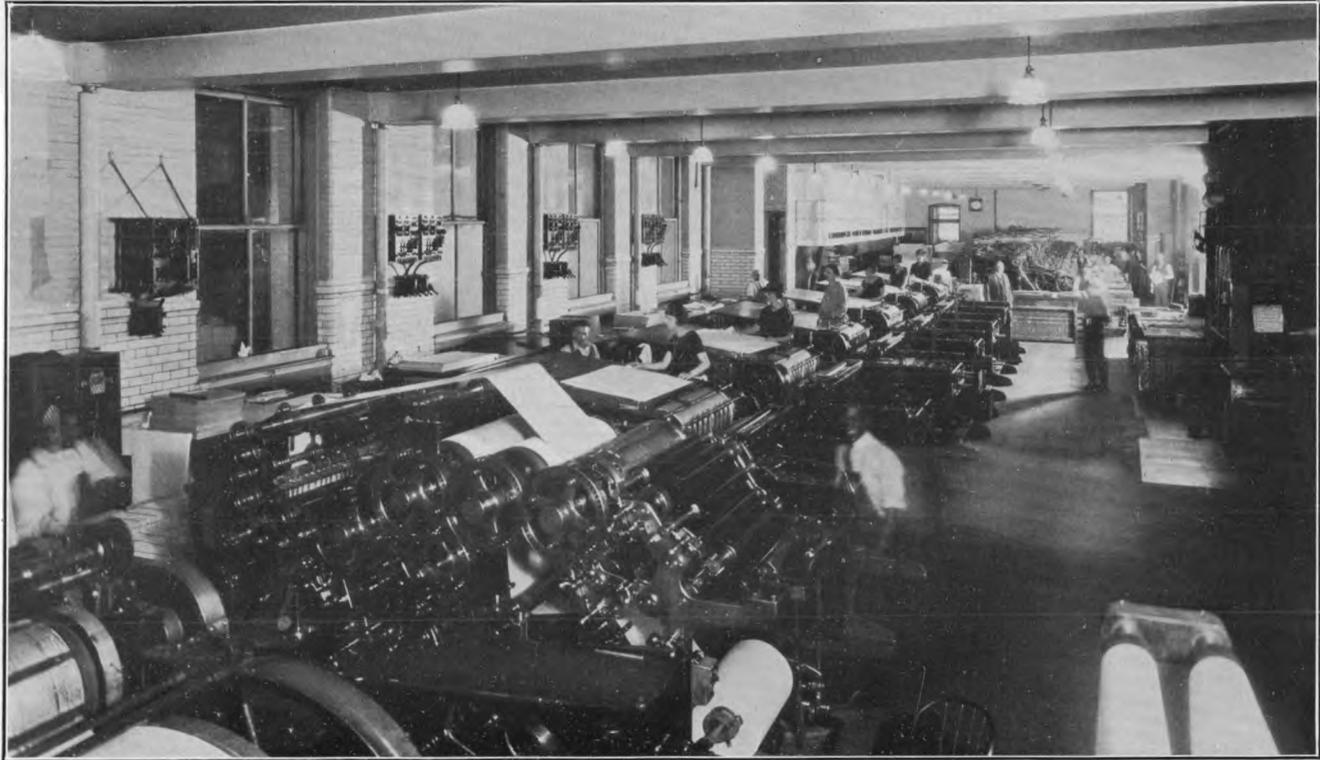
The third class of printing presses differs considerably from the other two by having a stationary bed, while the impression cylinder travels back and forth. A flat-bed web press usually has two beds, end to end or one above the other. The impression cylinders, together with ink distributing mechanisms, operate in bearings in crossheads, which slide in horizontal grooves on the side frames of the press, controlled by driving arms fastened to rims of large driving wheels. The ink fountains are located at the end of the press and the ink distributing systems pick up a sufficient quantity there at the end of the stroke, spreading it on the faces of the forms in passing over them afterwards. As the crosshead goes forward the impression cylinder prints the width of two pages, and while the cylinder is reversing the paper is pulled forward by a special device, sufficient to present a fresh surface for the backward movement of the impression cylinder, repeating this operation again at the other end of the stroke. The paper is used in roll form, in place of single, flat sheets as in other classes of cylinder presses, and passes in one continuous web through the press to the automatic cutting and folding mechanism at the delivery end. This style of press is used for small newspapers, periodicals, or other similar printing and the packing on the impression cylinders consists of soft blankets, which take up any minor inequalities of the form, thereby eliminating make-ready. The various folding and cutting mechanisms used are similar to those on large rotary web presses for rotary work.

The cylinder-press feeder assists the pressman in a general way to get the press ready for operation, feeds it while printing or, if it has an automatic feeder attached, watches the operation of the feeding mechanism and keeps it supplied with paper. He cleans and oils the press, washes the rollers, and makes minor adjustments. Where a press is hand fed it is necessary to carry the stock to be printed on up to the feed board, which is sloping and ends close to the top of the cylinder. The feeder lifts the top sheet and slides it down over the others to the guides by the cylinder, then pushes it gently sidewise against the side guides to insure proper register. The sheet passes automatically through the press and is deposited at the delivery end in a pile, which is removed at intervals. The stock is likewise taken to the top of the feed board for the automatic feeder. Some establishments use automatic lifts to raise the stock for either hand-fed or auto-fed presses.

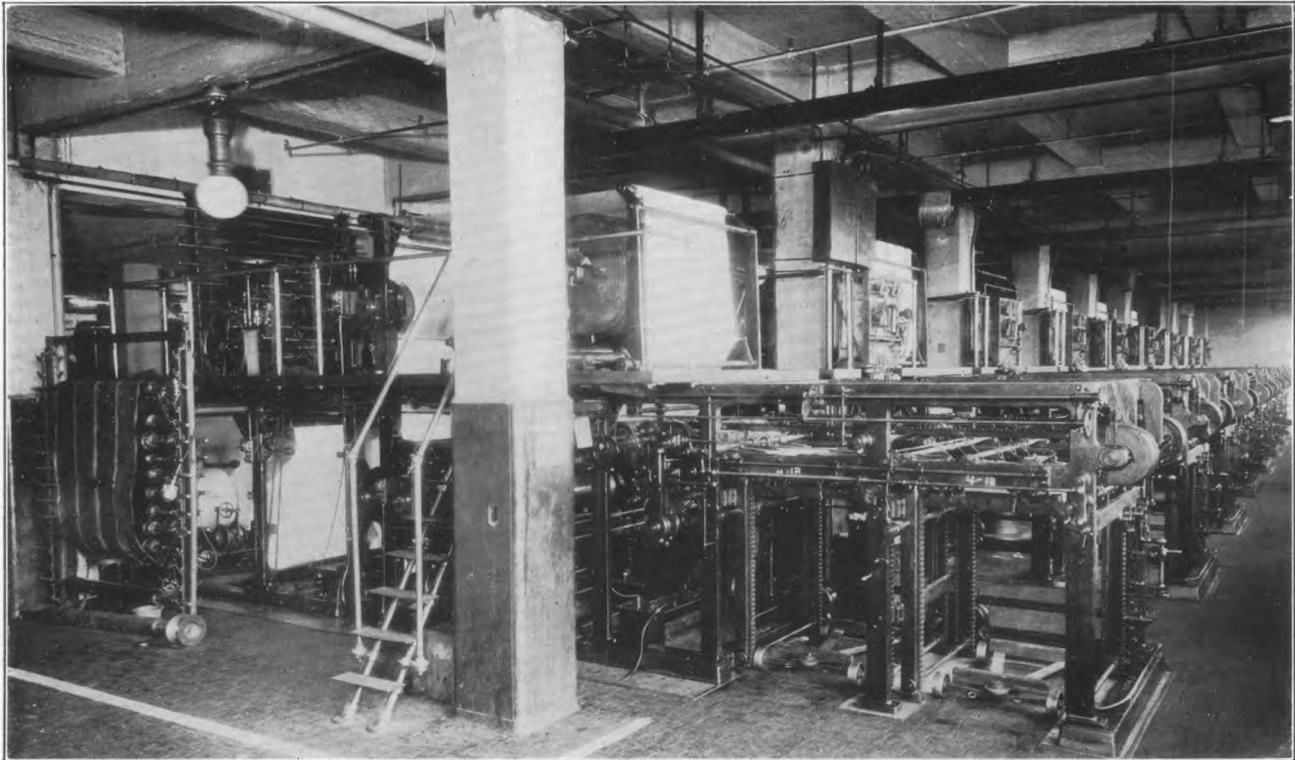
The flat-bed web press is fed from a roll of paper and, consequently, does not need a feeder, but as it requires more than one man to operate it efficiently an assistant or apprentice is substituted for him. During the operation of the press the pressman is busy with the constantly changing adjustments of the machine and ink fountain and the assistant usually stands by the brake lever, ready to stop the press if necessary. He also adjusts the friction necessary to hold



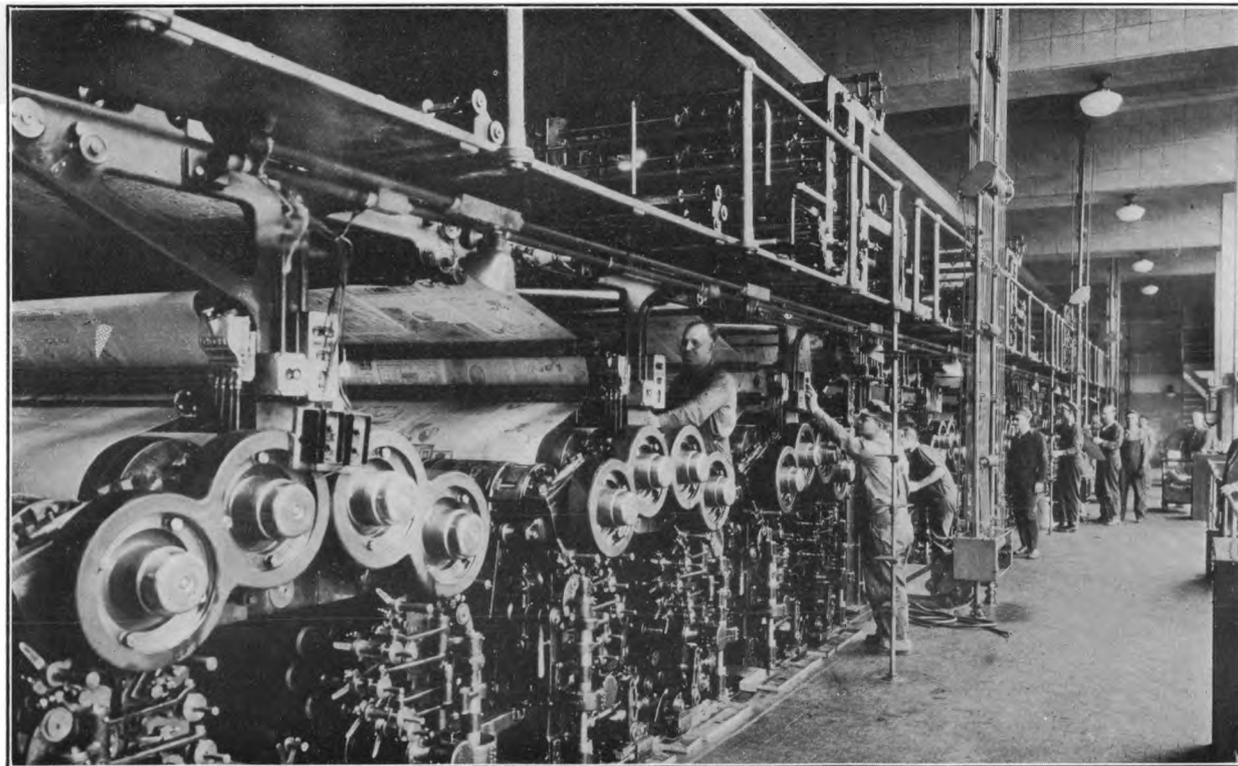
PLATEN PRESSWORK—CYLINDER PRESSES IN BACKGROUND



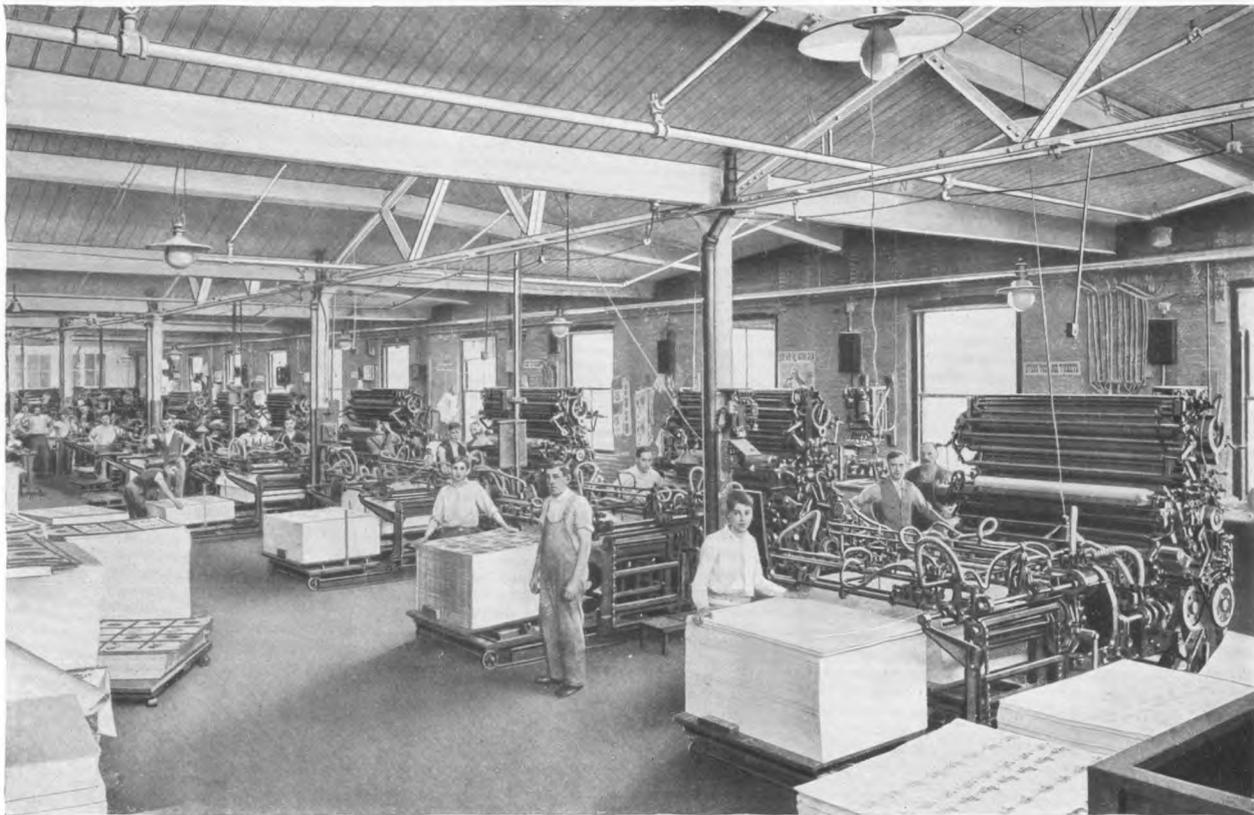
CYLINDER PRESSWORK—ROTARY PRESS IN FOREGROUND



ROTARY MAGAZINE PRESSWORK



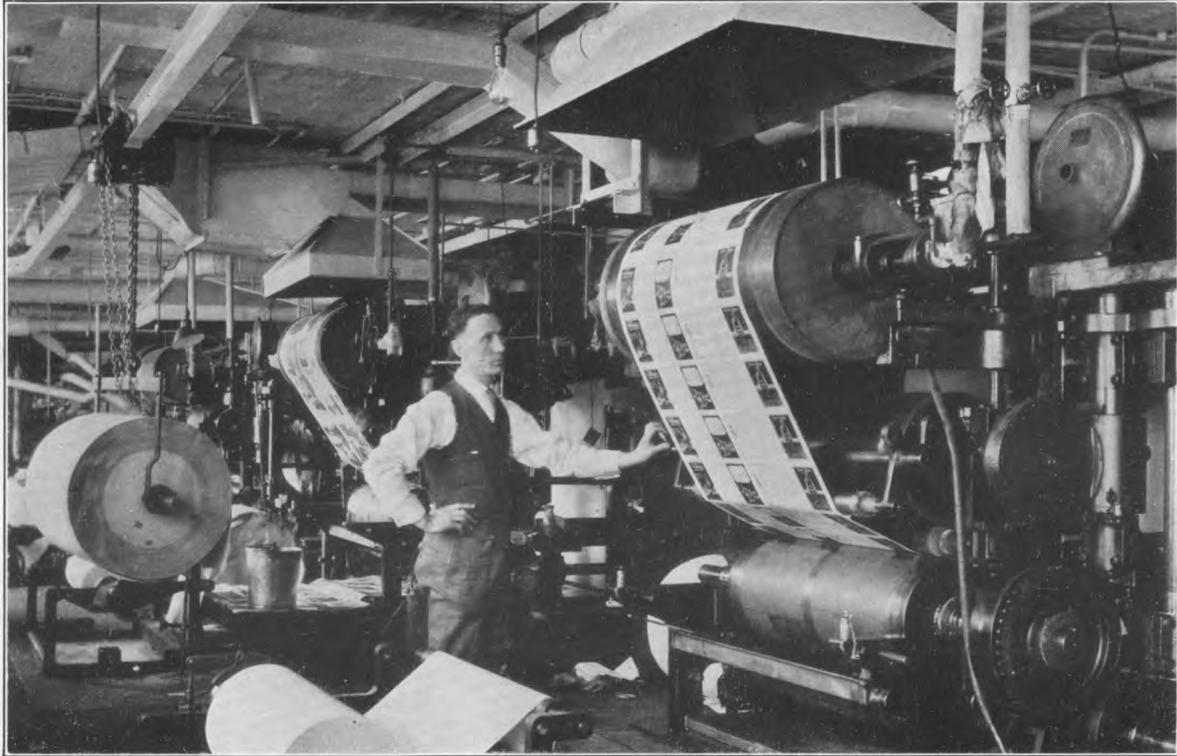
ROTARY NEWSPAPER PRESSWORK



OFFSET PRESSWORK



PLATE PRINTING



ROTOGRAVURE PRESSWORK

the proper tension on the roll of paper to keep the web running smoothly through the press, without wrinkling or breaking. A fly-boy ordinarily removes the folded papers from the delivery and places them in a truck or delivers them to the mailing room. He helps the pressman to prepare the press for operation, cleans and oils the press, washes the rollers, and helps place the paper rolls in the press.

ROTARY MAGAZINE PRESSWORK

Rotary presses are used for book and job work, extensively for magazines and other periodicals and for the production of all large newspapers. The printing is performed by means of two cylinders, or a series of pairs. One of these, called the plate cylinder, carries the forms, which are curved electrotype or stereotype plates, and the other, called the impression cylinder, carries the packing. There are two main divisions of the rotary presses, separated by the manner in which the paper is supplied. A sheet-fed rotary press prints on one side of sheets, previously cut, which are fed into the machine by hand or by an automatic feeder, just as on a cylinder press. The sheet is held by grippers on the impression cylinder and receives the printing as it passes the plate cylinder, which revolves against it. The plate cylinder is usually spirally grooved and supplied with special clamps, sliding in the grooves, for fastening the curved plates in the desired locations. Some rotaries print at each revolution, while on others the impression cylinder is lifted for every other revolution and the plate cylinder consequently receives a double rolling of ink for each impression. The ink is deposited from the fountain on a revolving steel cylinder, or ink drum, where vibrating composition rollers distribute it and transfer it to form rollers, that deposit it on the faces of the plates. The printed sheets are taken to a delivery table by a carrier or apron, or deposited on it by a fly, as in a cylinder press.

A rotary web press differs from the sheet-fed rotary press in printing on a continuous web of paper and, additionally, in usually being arranged to print on both sides of the web as it passes through the press. Rotary web presses are still further divided in rotary magazine web presses, which are used for book and magazine work, and newspaper web presses, used for newspaper work. As there are several manufacturers, each of whom has developed special features and, as each of these has turned out a great variety of designs besides improving former plans frequently, it has resulted in the use at present of a number of various styles, which are similar in the main characteristics but vary in some details, due to the continual improvements applied. A rotary web press is composed of one or more units with a cutting or folding delivery mechanism. A unit consists of two plate cylinders, each geared together with an impression cylinder and an inking mechanism. The plate cylinders are of fixed sizes, either the same circumference as the length of the product or twice as long. On some presses the web is fed into each unit from a separate roll, receiving the print on one side as it passes between the first impression cylinder and accompanying plate cylinder, and on the other side as it travels between the other pair of cylinders. It is passed on to the cutting mechanism, where it is cut into lengths and delivered. On other presses the width of the

cylinders is increased and the web is slit into strips of required width after printing, which are laid on top of each other, carried to the cutting mechanism, and severed at one cut. The machines differ according to the product and any number of units can be combined to suit requirements of the plant. A rotary magazine web press is intended for the better class of printing on a good grade of paper. As a rule electrotype plates are used, the plate and impression cylinders are equipped with bearers, and hard packing with considerable make-ready, similar to that used on cylinder presses, is required, especially for fine illustrations and color work.

In late years the cylinder press has been largely replaced by the rotary magazine web press for this kind of work, where long runs are necessary, on account of the increased speed. Cutting of the sheet is sometimes done by a blade with a saw-tooth edge, mounted in a cylinder, which perforates the paper as it passes between it and another cylinder with a groove or slot, in which the points of the cutting blade, or knife, enter. A sudden pull, caused by increased speed, tears the spaces between the perforations and separates the product. A straight cut is also used on some magazine presses, by two blades with straight cutting edges, which are mounted in two cylinders set at an angle across the press so as to shear straight across the web without stopping it. The printed product may be rewound on a roll, or delivered flat by a fly or tape delivery, sometimes controlled by grippers mounted on an endless chain that grasp the sheet, carry it to the delivery table, and release it on top of the preceding sheet. In folded delivery the sheet is sometimes slit into two-page wide ribbons, each of which is passed over a turning bar or angle bar, a rounded bar set diagonally to the travel of the web, given a half turn, placing them on top of each other, pasted together or fastened with wire stitches, then given a fold through the center to complete the section, cut and dropped edgewise into a box, where they are held by a block that is moved back by the pressure of each new addition, or sideways into a pocket, which moves forward at fixed intervals when a sufficient number has been deposited on top of each other. The web is, on some machines, folded lengthwise on a former before cutting. A former is a V-shaped piece of iron, over which the printed sheet is pulled by a pair of milled rollers, placed at the lowest point, which revolve together. The automatic shifting tympan, mentioned under cylinder presses, is used on some of the magazine presses on the second impression cylinder. On others a separate roll of special manila paper is placed on the press and the sheet travels with the printing web over the second impression cylinder, after which it is wound up on another spindle.

ROTARY NEWSPAPER PRESSWORK

A newspaper web press is used for printing at a high rate of speed on a soft paper that partly absorbs the ink. The cylinders are not provided with bearers and stereotype plates are used, which are considerably thicker than electrotype plates. The packing, which is very soft, presents an elastic surface that will take up all minor inequalities in the printing face and does not require make-ready. Newspaper web presses are usually considered in special size units, each capable of printing eight pages at each revolution of the plate

cylinders. The number of units assembled together in a single machine determines the name by which it is generally known, such as single, double, triple, quadruple, quintuple, sextuple, octuple, decuple, double sextuple, double octuple or double decuple newspaper web press, indicating that it is composed of 1, 2, 3, 4, 5, 6, 8, 10, 12, 16, or 20 units, respectively. A unit consists of two plate cylinders, each two pages wide, with respective impression cylinders and inking mechanisms. A plate cylinder is provided with two stationary bars, lengthwise of the cylinder, to regulate the position of the plates, a stationary clamp in the center, which fits snugly over the beveled edges of the plates, and movable clamps on the outsides for locking the plates tightly on the cylinder. Each plate extends approximately halfway around the cylinder and at times both the forward and following plates are exactly alike, producing two four-page papers for each revolution of the cylinder.

The ink is transferred at regular intervals in required, adjustable quantities from the fountain to ink drums, where it is distributed by composition rollers. On some presses the composition rollers move laterally as well as revolve, while on others the ink drums have a lateral motion and the rollers only revolve. The ink is deposited on the faces of the plates in a thin film by form rollers, other and usually larger composition rollers, which only revolve. The packing consists of a rubber or composition blanket, stretched around the impression cylinder, covered with a felt blanket, the ends of which pass through a slot into the interior of the cylinder where they are fastened. The outside of the felt blanket is usually prepared to resist oil by a special coating but in some places, where a plain felt blanket is still used, a muslin tympan is placed around the second impression cylinder, to absorb any ink that has not dried on the pages printed first, and changed at intervals to provide a fresh and absorbing surface. In a number of presses the roll of paper is fastened firmly on a spindle, which turns in sockets located in brackets at the rear of the unit. An adjustable brake, fitted with wooden shoes, is clamped over a pulley on one end of the spindle to regulate the tension on the web as it travels through the press. The web passes over equalizing rollers, which take up any possible slack, between one set of cylinders for printing on one side, between the other set for printing on the other side, then over compensating rollers, and sometimes angle bars, to the assembling, cutting, and folding mechanism for the entire product. The units can be placed together in several different ways, such as on top of each other in horizontal, parallel tiers or decks, side by side, or tandem, while the folder mechanisms may be placed at one end, in the center, or at an angle. A number of units are often found in one establishment, such as one of the 64 newspaper pressrooms visited, which contained 133 of these.

A distinction is made between single-width presses, which have plate cylinders two pages wide, and double-width presses, where they are four pages in width. A few are also found that deviate from these and are partly three or five pages wide. A single-width press usually has several decks, each consisting of a unit, and the various sheets travel in a straight line from the rolls at one end, through

the printing parts, to the top of the assembling, cutting, and folding mechanism, commonly called the folder, where they come together, one on top of the other, are pulled down over the former by revolving rollers at the bottom or nose of it, and fed into the cutting mechanism. The ordinary style of this consists of two cylinders, revolving together. One of these, the folding cylinder, which is the same diameter as the plate or impression cylinder, contains two sets of pins that automatically protrude through holes in the cylinder. One set of these pierces the forward ends of the web or webs and carries them half a revolution of the cylinder or the length of a paper. The knife cylinder contains a sharp, serrated blade, fixed between strips of wood supported by springs, which press the paper against a slotted rubber bar in the folding cylinder and hold it tight while the knife severs it. The pins automatically drop back in the cylinder, releasing the forward end of the webs, as a rotating blade, also carried in the folding cylinder, protrudes and strikes the severed section in the middle, forcing it down between two revolving rollers that give it the second or transverse fold. The folded paper is dropped into a rotating frame of curved bands, called the fly, which deposits it on an endless-belt carrier. A device is attached which throws every tenth, twenty-fifth, or fiftieth paper out of position to facilitate counting. At the same time the sheet is severed from the web, the forward end of which is pierced by the second set of pins in the folding cylinder, and the operations are repeated. The cutting cylinder, which is only half the diameter of the folding cylinder, making its circumference the length of the sheet, is also used as a collecting cylinder when it is desired to collect two sheet lengths in one copy. When such is the case a change is necessary in the manner of placing the plates on the plate cylinders. Instead of two plates that complete the circle around a plate cylinder being duplicates, only a single plate is used of each kind, so that these are all different. One set of the pins in the folding cylinders is silenced and another set of pins, contained in the knife cylinder, is connected with a cam motion which propels or retires them automatically. These pick up the first sheet and carry it for one revolution of the cylinder, giving the second sheet time to arrive, then release it to be caught together with the forward end of the second sheet by the active set of pins in the folding cylinder. The two sheet lengths are carried around together until the second one is severed from the web, when they are folded and delivered as a single newspaper. Some presses have a separate collecting cylinder, of the same size as the knife cylinder, which is thrown into gear, when required, with the other two. While this operation, called collecting, permits of publishing twice as many pages in a single copy of the paper, it also cuts the production in two, as every other sheet length is folded together with the preceding one, so only one paper is delivered for each full revolution of the plate cylinders.

A single deck can be operated by itself when a four or eight page paper is wanted, or others can be added as required. One page wide rolls of paper can be used in place of the customary full-width roll by using plates on corresponding sides of unit only and adjusting ink distribution. When a roll of paper expires it is necessary to stop the press and remove the spindle on which the core is

fastened, then place another spindle with a new roll in the sockets, paste the ends of the sheets together and start the press again. On some presses one of the decks can be changed to operate at half speed to deliver a two-page leaf for each revolution and in place of a four-page one. Some presses have cutting mechanisms at the top of the former and the severed sheets are carried down over it to the folding mechanism by tapes. Some of the older style presses, both single and double width, have impression cylinders with twice the circumference of the plate cylinders, or even three times as large. Some have tumbler movement for the folding cylinders, while others have rotary gear movement, which permits of greater speed.

A special type is equipped with plate cylinders one page in circumference and uses circular or tubular plates on these. The journal bearing for one side of the plate cylinder is supported by an arm and the plate has an opening or slot along its entire length, equal to the margin at head and foot of the page combined. This permits the two plates to slide onto the cylinder from one end. The first plate automatically raises sunken clamps, which lock it, the second plate is pushed up against these and locked by adjustable clamps on the outside.

Most modern presses are double width, or four pages wide, but built in a variety of styles, usually to suit the space in the establishment. The plate cylinders on a double-width press are staggered; which means that plates on one end are out of alignment with those on the other, so as to insure an impression on the sheet at all times. A double-width press capable of printing 32 pages for each revolution of the cylinders, commonly known as a quadruple or quad press, usually has two folders. The webs can be assembled together in one of these by splitting them into ribbons, either one or two pages wide, and passing them over angle bars, as required, to correct position in line with the folder. They can also be passed full width to the top of the formers, slit there by a circular rotating knife, and either delivered as separate papers in both flies or one set of webs can be transferred, after receiving the longitudinal fold on one former, over a series of rollers to the cutting mechanism of the other folder, manipulated with the web in this and delivered as a single paper with one section folded in the other. Octuple presses, consisting of eight units, capable of printing 64 pages for each revolution, usually have four folders.

At one time the double-width presses were mainly constructed with a view of conserving floor space and are often found four decks high. In recent years the low type unit style, where all units are on one level, has been installed in a number of large newspaper plants. These permit the use of magazine reels for the paper rolls, located on a separate floor below the pressroom, eliminating the hoisting of rolls to the heights of the different decks and the necessity of stopping the press to replace the used rolls. The magazine reel contains three rolls of paper, one of which is supplying the web for the press. When this is used up the pressure of a button starts a motor that automatically revolves the reel to swing a fresh roll into the position occupied by the used one. The end of the new roll, previously covered with paste, comes in contact with the end

of the sheet from the former roll, sticks to it, and is carried by it up through the press. The empty spindle, which is turned to the bottom position by swinging the reel, is removed and a new roll, located on a small car that operates on tracks in the floor, is put in place of it on the reel. The reel is adjustable sideways by pressure on another button, which operates a special motor for the purpose. On presses with decks it is necessary to hoist the rolls, previously spindled, up to the brackets on which the boxes are located and which usually extend sufficiently to permit one extra roll. Various styles of hoists are used, with hydraulic, air, or electric control.

On the older presses the ink is transferred from a metal roller, turning in the fountain, to the distributing system by a composition roller, called ductor or feed roller, which turns with it and picks up the required quantity of ink, then lifts and is brought into contact with a revolving ink drum, where the ink is deposited. The quantity of ink on the metal roller in the fountain is regulated by a blade resting on it, which is pressed up against it or removed from it by an adjustment of a series of thumbscrews extending through the frame, located across the press. In a later invention the screws are placed at the ends of the fountain, controlling the blade by a rod with a worm movement, making the adjustment more accessible during operation. The latest style, the automatic ink pump system, eliminates the ductor roller and the ink is sprayed directly on the ink drum through a number of small orifices in a feed rail, which extends across the cylinder from a pump box at one side of the press, containing a series of pumps, one for each orifice. The flow of ink through each pump is controlled by a thumbscrew on top of the box. The pump box for each distribution system is connected with the main supply tank, from which the ink is forced through ordinary pipes by air pressure or by gravity, and the pump drive is connected with the drive for the distributing cylinder.

The printed and folded papers were originally, and still are on a number of presses, taken from the endless belt carrier at the delivery end in bundles and placed in a box on wheels, where the mailing room is on the same level, or on a small elevator, where the mailing room is located on a floor above the pressroom. Many presses are equipped with automatic escalators or conveyors, that take the papers in an endless stream directly from the press between running arrangements of spiral bands or belts and carry them, vertically or horizontally, in any desired direction as far as required to the delivery tables in the mailing room.

A number of other improvements are found on the modern presses, such as automatic paper-break stops, mounted on one side of the frame, that disconnect the power and apply a brake to the motor and press if the web should break, and automatic oiling devices. In some papers the various sheets are pasted together in the center, a streak of paste being applied to the web, by the edge of a wheel revolving in a paste fountain, as it travels between the printing cylinders and the folder. On others a fudge cylinder is used for printing the very latest news, such as results of sporting events. This consists of a small auxiliary cylinder, in which tapered linotype slugs or type can be locked, eliminating stereotyping. It is equipped with individual inking mechanism but prints against the regular

impression cylinder for the page. The corresponding parts of the stereotyped plate for the page are left blank.

Some presses are equipped with additional units for color printing. Others are combination presses for part color and part black printing, used principally for comic supplements and magazine sections. These latter vary from the straight newspaper web style, with soft blankets and stereotype plates, to the rotary magazine web type, with hard packing, make-ready, and electrotpe plates. A separate unit is added for each color to be printed on every eight pages, through which the sheet passes in succession. The newest style of these is the universal unit type, in which the units are arranged in tiers, each capable of being used as a separate press or combined with any required quantity of the others, and which have part of the mechanism on tracks so they can be moved aside and allow easy access to the cylinders.

Part of the work in a newspaper web pressroom consists in getting the press ready for operation. The plates used for previous run are taken off the press, the rollers are washed, and pipe rollers, angle bars, and formers are cleaned of any possible deposit of ink from the web. The press is wiped carefully to remove all accumulations of ink and paper dust. On the older style presses the fountains are filled, either with aid of a pump from a movable tank or by a bucket, in which the ink is drawn from a barrel, and the dirty muslin tympan are replaced by clean ones. If a change is made in the number of pages for the edition it often requires a change in the width of the rolls of paper used, consequently the rolls may have to be taken out and replaced with suitable ones, the ductor rollers changed, and numerous adjustments made in other parts of the press to permit proper travel of the web. Sufficient paper for the coming run of the press is usually prepared by stripping off the wrappers, fastening spindles in the rolls, and placing the rolls in handy positions for quick change when the corresponding rolls in the press are exhausted. The webs, which are usually torn out of the press to allow convenient access to various parts for cleaning, are led back through it and the press is oiled up. Where more than one press is operated at one time there is one man in charge of each press, who directs the work of the men under him and takes care of the finer adjustments. The rest of the work is performed by web pressmen and by web press apprentices. In small establishments that contain only one press the man in charge is usually the foreman of the room. In some plants the pressmen prepare the paper for use, but in others there are special paper handlers for that purpose. The composition rollers are adjusted at intervals for contact to insure proper distribution and deposition of ink. The ink fountains are at times emptied and washed out and the blankets on the impression cylinders replaced when necessary.

As the plates are brought from the stereotyping department, either by automatic delivery or carried by the apprentices, they are locked in their respective positions on the press. The sockets in which the composition rollers spin are locked, to hold these in place and, after all the plates have been put on, the press is started revolving. It is turned at slow speed in the beginning while some final adjustments are being made, but this is increased rapidly as

speed is the main consideration on the modern newspaper. The press requires constant adjustment and oiling during the entire run, one man usually taking care of the tension on the rolls so as to hold the sheets with certain required degree of tautness in the travel. During the operation of the press it is necessary to watch the machinery closely, partly by sound, so as to shut it off as soon as possible if the web should break or anything else go wrong. On the old styles, especially those operated by belt drives, it is necessary during the run for one of the men to stand with one hand on the throw-off lever, or brake, ready to shut the press down when needed. The newer push-button system of operation permits more freedom, as it enables any one of the press crew to stop the press at the nearest button station and gives them all a chance to continue with other tasks meanwhile. Where no conveyors are attached to the delivery the papers are removed by flyboys, who usually are the apprentices.

In most of the large newspaper pressrooms there is considerable shifting from one position to the other. In a few shops the duties of each man on the crew are sharply defined and the positions specialized. The workers are commonly classified as men in charge, pressmen, and apprentices. Pressmen in some plants are called tension men and journeymen. In some establishments there are paper handlers and special flyboys employed.

The work on color presses differs considerably, as the plates have to be registered, or shifted on the cylinders, to print in exactly the required positions on the web. They are usually moved both lengthwise and up or down on the cylinder, sometimes necessitating additional trimming. Where electrotype plates are used considerable underlaying is done to project low spots. The operations following final clamping of the plates and finishing of the make-ready are similar to those on the black presses. Adjustments of compensating rollers, over which the web travels between the various printing cylinders, are watched carefully to lengthen or shorten the web so the plates will print on correct spaces.

ROTARY SPECIALTY PRESSWORK

There are also a number of specialty rotary presses, one of which, the McKee press, is used by several large periodical or magazine publishing establishments for two-color or four-color process printing. This press, classed as a multicolor rotary press, has one large printing cylinder, made in two sections, and four plate cylinders, which are grouped around it, all printing in rotation on the same part of the impression cylinder, which holds the sheet firmly with grippers until all the colors have been printed. Since all the plates print against the same surface, this can not be made ready but must be left level, and the surface of the impression cylinder is just covered by smooth hard packing. An elaborate process of make-ready is used for the plates, performed in a department of the pressroom. The plates, usually nickel types instead of ordinary copper electrotypes, are furnished by the electrotype department in flat form and commonly 0.19 inch thick, which is thicker than required. Proofs of each plate are taken and a reverse overlay is made, which is attached to a thin steel or zinc plate and fastened to the face of the

plate, while an underlay, similarly mounted, is placed on the back. The plate is laid, face up, on the bed of a heated hydraulic press, where the pressure applied projects the softened metal in the spaces cut out for the overlay. The underlay, or backstop, is removed and the plate, with the overlay attached, is placed in a knuckle-shaving machine, face down. The bed of the machine moves back and forth, bringing the back of the plate under a row of small steel rollers, mounted on steel fingers with knuckle joints that apply pressure, and an adjustable knife shaves the back of the plate. This operation is repeated until the plate is shaved to proper thickness, usually 0.165 inch in the highest parts, which consists of all the solid black sections, but gradually less for the lighter printing sections, leaving the plate thinnest where the high lights appear. The overlay is removed and the plate returned to the electrotyping department to be curved and routed. In some plants only an overlay is used and the plate is treated first in the knuckle shaver, then placed in the hydraulic press, and afterwards in a cooling box, where it is cooled under pressure.

After the plates are returned from the foundry they are fastened on their respective cylinders in similar rotation as for ordinary process color work—yellow on the first cylinder, red on the second, blue on the third, and black on the fourth. Each cylinder has its own fountain and ink distributing mechanism. The inks vary somewhat from those used ordinarily for printing on cylinder or rotary presses, which are prepared to dry by oxidation, or contact with the air, and which are usually applied one at a time with intervals between. Four wet colors are applied on top of each other, an operation commonly called wet printing. The first color applied is very stiff, or tacky, the second not quite so stiff, the third one still softer, and the last one very soft, almost fluid in consistency. The McKee press is sheet fed, usually by automatic feeders, and a number of them have special attachments which automatically place a manila slip sheet between each two printed sheets to permit the heavy film of ink to dry properly without offsetting, or smutting, on the other sheets.

The sheets are delivered flat, and where slip sheets are used it is necessary to remove these by hand, or by special machines built for the purpose, before printing on the other side. Various methods are tried to eliminate slip sheeting, which is required on some work on cylinder presses as well as on rotary presses, such as brushing the printed surface lightly with various drying powders. In a new method a thin film of paraffin is sprayed over the sheets directly after printing, from a fountain attached to the press, which is declared to have solved the question perfectly.

Rotary presses are also used for creasing and cutting in the manufacture of folding paper boxes or cartons. Some of them are equipped with single-color or two-color mechanisms, while others are without printing mechanisms. Other rotary presses are used for various kinds of specialty work, designed and equipped for the certain product, such as one for printing postal cards in two colors, which trims the cardboard web, divides it in eight strips, $5\frac{1}{2}$ inches each, for the length of the cards, cuts these to widths, $3\frac{1}{4}$ inches, and counts them in lots of 50 each. Another style, used in number-

ing bank notes, is fed automatically with flat sheets containing four notes each. The bank notes are numbered, sealed, separated, counted, and collated in one operation, being turned out in packages of 100 notes each. A rotary wrapping and tissue-paper press is made, which prints in one color on two rolls of paper, or in two colors on one roll, and is equipped with a rewinding and slitting attachment for the finished product. A special press for printing transfers is equipped with mechanisms for printing in one color on one side and five colors on the reverse side, with the second cylinder arranged so the web may be printed on either side by means of a device which reverses the paper. It also numbers it in any desired color, perforates with or across the web, slits, and delivers in any desired form, which may be either fly, tape, folded, rewound in rolls, or cut apart to size. Special presses are designed to perform automatically nearly every feature connected with the printing, and manufacturers are constantly turning out new designs to meet individual demands for theater tickets, street car tickets, railroad tickets, various forms of tags, labels, and stickers, fruit wrappers, manifold salesbooks, or other products. The smaller sizes of rotary presses are often classed, together with some of the job cylinder presses, as automatic presses, and the men operating them as automatic pressmen, but these terms do not seem adequate.

The work on color presses and on magazine rotary presses is divided practically as on newspaper web presses, except for the additional make-ready, sometimes performed by the pressmen who operate the press, but in large shops often prepared by a special staff of pressmen, constantly engaged in this work. As the rotary magazine presses usually are smaller than the newspaper web presses, fewer men are ordinarily employed on one machine, and the smaller ones may be operated by two men, or even by one man who performs all the different functions.

LITHOGRAPHIC AND OFFSET PRESSWORK

Planographic printing was found in 58 of the plants inspected in detail and 4 of them were devoted to planographic work only. Presses used for planographic printing also fall into three distinctive classes, flat-bed lithographic presses, direct rotary planographic presses, and offset presses. A flat-bed lithographic press is practically similar to a relief cylinder press, except for the bed, which is adapted to hold a stone from which the printing is done, and an additional dampening device, consisting of a fountain containing water, which is applied by a series of felt-covered rollers to portions of the stone surrounding the printing design. A direct rotary planographic press resembles, in similar manner, a rotary press used for relief printing but, instead of carrying electrotype or stereotype plates, has a thin, flexible sheet or plate of aluminum or zinc stretched around the plate cylinder and fastened by clamps across it. This plate carries the design in similar manner as the stone and receives water from the dampening device and ink from the inking mechanism. Some of them are equipped for two colors, with one impression cylinder but two plate cylinders, each having its own dampening and inking mechanisms. These two styles have been, to

a large extent, supplanted by the offset press, now used in a number of establishments throughout the country.

An offset press differs essentially from other printing presses in printing from a plate onto a rubber blanket, from which the ink is transferred to the paper. Three cylinders are required for this purpose, the plate cylinder to carry the plate, the blanket cylinder to carry the blanket, and the impression cylinder to carry the paper, all of which revolve in mutual contact. When the plate is received from the transfer department it is clamped smoothly around the plate cylinder and a thin rubber blanket, usually three-ply, is fastened securely around the blanket cylinder. Sufficient paper packing is placed under the rubber blanket to insure proper contact with the plate. The gum arabic coating is removed from the plate and the power applied to the press, revolving the plate cylinder. The plate is first dampened with water, conducted to it from a fountain by metal rollers covered with felt, which keeps the blank parts free from ink. The ink is next deposited on the design, which is greasy and not affected by the water, by metal rollers that are wrapped with several layers of flannel and covered with a leather skin. The inking system is similar to that used on rotary presses for relief printing, consisting of a fountain, ductor roller, distributing cylinder, distributing rollers, and form rollers. The automatic feeder is thrown into gear with the printing mechanism and, as a sheet comes down to the impression or paper cylinder, the blanket cylinder is thrown into contact with the plate cylinder, receiving a reproduction of the design on the surface of the rubber blanket, subsequently transferring this to paper, which is held by grippers on the impression cylinder. The paper is released and usually carried by grippers on chains to the delivery table. Automatic throw outs are provided, for releasing the feeding mechanism, the inking mechanism, and the contacts of the printing mechanism in case sheets do not feed properly against the guides, or more than one is carried down. The older styles are usually equipped with automatic friction feeders while the newer ones have suction arrangements for lifting the sheets from the pile and carrying them toward the forwarding mechanism. A few were also found that were equipped with roll feed, the web being cut after printing and delivered flat. Automatic feeding devices can, as a rule, be detached for easy access to the mechanisms or to permit hand feeding, if desired. Both one-color and two-color offset presses are used.

The offset pressman manipulates the important adjustments and, during the operation of the press, he is compelled to watch the printed results closely to guard against possible destruction of the designs on the plates, liable to occur on account of the peculiar chemical composition of the printing surface. A design may gradually wear away, or the fine lines may thicken up, but material damage can be averted by prompt action when changes appear. The rubber blanket may also require attention, as it is affected by atmospheric conditions and by greases or solvents used. The inks may need doctoring to reduce the tack, or adhesive quality, or to change the drying quality to suit the consistency of the paper. Whenever the press is stopped and stands still for even a short time it is necessary to protect the face of the plate by a gum arabic solution. The

offset assistant takes care of the minor adjustments, washes the rollers and fountain, keeps the press clean and oils it, keeps the automatic feeder loaded with stock, and watches it during the run.

PLATE PRINTING

Intaglio presswork was found in 53 of the establishments surveyed. Five of these were exclusive die and plate printing plants, while six others were devoted to rotogravure printing only.

Presses for intaglio printing consist of three classes, plate printing, die stamping, and rotogravure presses. A plate printing press has a flat bed, supported by a heavy roller, and the impression is received from a curved surface. The oldest form of these, found especially in the smaller plants and called D-roller press or, commonly, copperplate hand press, has a flat, horizontal bed, on which the plate is laid, face up. The entire plate is covered with ink by hand, the surplus is wiped off with a rag of open mesh cloth and the balance of the ink is carefully removed from the surface by polishing it with the bare hand, leaving the sunken lines or dots of the design filled with ink. A sheet of paper is laid on the plate, covered with cardboard or paper, and the bed moved forward by turning spokes, sometimes banded by an iron hoop, bringing the plate under a small curved impression surface, like part of a cylinder, geared together with the bed, a heavy steel roller supporting the bed in direct vertical line with the impression roll above, forcing the paper down into the depressions so the ink adheres. Heavy soft paper is ordinarily used and it is often dampened before printing. The bed is brought back while the impression is lifted, the printed sheet is removed and the operations repeated.

Power drive has been applied to this style of press to facilitate production and on some the wiping with cloth is performed automatically, the cloth, which is wound on a reel, passing over the plate with the motion of the press and being rewound on another reel. The principles of the D-roller press have also been embodied in a large four-bed power press, which contains a track that follows the lines of the square frame and on which the beds travel horizontally. A plate is fastened on each bed and the press is set in motion. The first plate passes under an automatic inking mechanism, which applies the ink, then under a rough-wiping mechanism, where the surplus ink is removed, afterwards coming out in the open, where the pressman polishes it with the palm of his hands, assisted by a little whiting, next passes the station of an assistant, who places a sheet of paper on it, slides under an impression roller while supported by a heavy cylinder underneath, then comes out in the open again, where the printed sheet is removed by another assistant, and repeats the operations. Each plate follows around, in turn going through the same manipulation. In another power driven machine two plates are fastened on an endless chain, operating vertically, which brings them in contact with an inking mechanism, wiping device, and impression surface, on which the paper is laid.

Copper plate printing is ordinarily used for visiting, professional, or business cards, announcements, invitations, and social forms. Steel plate printing is used principally for bank notes, bond and stock certificates, postage stamps, letter heads, and diplomas.

DIE STAMPING

A die stamping press also has a flat bed but receives the impression from a counter die, held in an impression head. A counter die is a reversed counterpart of the die, consequently a reproduction of the design in relief, which is placed to strike the back of the sheet and force it into the depressions of the die, so as to leave the design in permanent relief on the product. For small work a hand stamping press is used, resting on a bench or table. The die is held, face downward, in an impression head operated by a powerful screw, fitted into a slot so it can be easily removed for inking and wiping after each impression. The counter die is prepared by special composition, which is forced into the die and placed into the bottom part of the press. The die is inked and wiped, then forced down against the counter die, over which the paper has been placed. There are several makes of power die presses which are automatically inked and wiped with a specially prepared wiping paper that practically cuts the ink from the surface of the die and eliminates hand wiping. This permits the use of an ink with a varnish base, which will print with a high gloss, while for hand wiping a soft ink is required, with oil as the principal ingredient. The paper is fed to the wiping mechanism from a roll attached to the press and, after wiping, is rewound on another spool. The die is mounted on a sliding table, which carries it under the inking rollers, that are supplied from a fountain under the wiping mechanism, and back under the counter die. The paper to be printed is laid face down on the die and the counter die is automatically forced against it by the action of an eccentric pressure shaft, driving the paper into the engraved lines, causing the ink to adhere to it and at the same time leaving the design raised or embossed. Designs in gold or silver bronze are usually stamped with a second impression, without ink, to burnish them and produce an extra gloss. Some power die stamping presses are provided with automatic feeders and others have devices for removing the printed sheets automatically, but on the majority the stock is fed by hand by the operator while the printed cards or sheets are removed by hand by an assistant and spread out on racks for drying.

Steel die printing is used extensively on stationery, especially for monograms or emblems and heraldic or fraternity designs on letter heads and cards, for catalogue covers, cigar bands, and other work where it is desired to have the design remain in high relief above the surface. Plate and die printing are usually found together in a plant, although the work varies somewhat.

Embossing is also, at times, executed on ordinary relief presses of either platen or cylinder type, on work previously printed. The inking device is silenced by removing the composition rollers. Either zinc or brass dies are commonly used, though steel dies can also be used. The die, which is locked in a chase, is placed on the press in the usual manner and a plastic compound built up on the platen sufficiently thick to fill the lines of the die, covered with paper and pressed into the die by turning the press slowly. After hardening by drying, the sheets are fed into the press as usual, where they are embossed between the metal female die and the composi-

tion male die. Sometimes heat is applied to the die, through its base, either by means of electricity or gas.

ROTOGRAVURE PRINTING

Rotogravure presses differ essentially from other intaglio presses in printing from a curved plate surface against a curved impression surface, being an application of the rotary principle to intaglio printing. They are used largely for printing newspaper supplements, but also for the printing of posters, scenes of photoplays, magazine inserts, or entire publications. Several makes are used, which differ in some of the details but all have the same principle.

A rotogravure press for printing newspaper supplements is, like a newspaper web press, fed from a roll. As both sides of the web require printing, it is equipped with bearings for two printing cylinders, one for each side, and which may be either two or four pages wide. When a cylinder, previously prepared in the photo-engraving department, comes into the pressroom it is washed with a solvent, xylol or naphtha, to remove thoroughly all grease, and placed in the bearings of the press, where it is locked and connected with the gearing. The printing cylinder, which corresponds to a plate cylinder with attached plates on a newspaper web press, is usually two pages in circumference and can be lowered, together with the ink fountain in which it revolves, until contact with the impression cylinder is broken. A cylinder may be unhooked and revolved, or shifted sideways, independent of the other cylinder to obtain register. The printing cylinder revolves in a fountain, or trough, of ink which floods the entire surface but this passes under and in contact with the edge of a thin, oscillating steel blade, called the doctor, which scrapes all the ink off the surface, leaving the lines and dots of the design filled.

The impression cylinder is a small metal cylinder, covered with about five-eighths of an inch of medium hard rubber, and is driven by friction. As the web passes between the printing cylinder and the impression cylinder it is squeezed into the pockets of the design and picks up the ink from these. After the sheet is printed on one side it travels around a heated cylinder, through a heated box or over blowers, where the ink is dried, then to the second printing cylinder, where it is printed on the other side, dried in a similar manner and passed to the folder, where it is cut, folded, and delivered. The drying mechanism can be heated by hot air, steam, or electricity. The ink dries very rapidly with the application of heat, as it is ground in and mixed with volatile solvents, such as xylol or naphtha. If the press is stopped for any length of time it is necessary to lower the printing cylinders, with the fountain, from the impression cylinders and keep them revolving in the ink to prevent it from hardening on the cylinder surface. Various styles of folders are used, some of which have the shear system of cutting, each blade located in a separate cylinder, and a delivery cylinder with two sets of grippers and tucker blades, that fold the paper as required, and can be regulated for collecting. Other folders are similar to those used on newspaper web presses. Where the cylinders are four pages wide the web is split and carried over angle bars and compensating

rollers into the folder. In some places presses are used that combine the relief method with the intaglio method, the web being carried through sections built for each. One establishment surveyed was also producing multicolor printing by the rotogravure method, printing the cover for its Sunday supplement on a specially constructed press, then carrying the web over angle bars and rollers to an ordinary rotogravure press, placed along side of it and on which the inside pages were printed, where it was folded around the product and fastened to it with wire staples. The press used for the multicolor printing was specially constructed for the purpose and equipped for five printing cylinders, one for each of the four colors used on the outside of the cover web and one for the inside pages. A special device controlled the web between the printing cylinders to give accurate register of the colors, and individual drying systems were used between the colors.

Some rotogravure presses used for other work, such as printing of periodicals or posters, cut the sheets and deliver them flat, to be folded afterwards on separate folding machines. Other presses, for the more particular work, are sheet fed and have flat deliveries. Some that print on one side only are equipped for only one printing cylinder as, for instance, a special design used for transfer patterns, which prints on tissue paper with a wax ink and is equipped with an automatically controlled heating device on the fountain, or another special design used for printing of postage stamps. This latter press is fed from a roll, the printing cylinder is wiped by an automatic, felt-faced device, over which a wiping cloth travels, and the paper passes, after printing, over a series of electrically heated cylinders, which dry the ink. The back of the sheet is covered with gum in passing over a glass roller, revolving in a fountain, and the gum dries as the web travels through a steam heated drying box. The web is perforated crosswise and slit into strips, one stamp wide, which are rolled up in coils, or perforated both ways and cut into sheets which are automatically fastened into packages of the required number.

The rotogravure pressman makes necessary adjustments of the press, registers the cylinders, and takes care of the doctor blade, which must be kept sharp and smooth. During the run he watches the density of the ink closely and keeps it at the proper consistency. The rotogravure assistant cleans and oils the press, keeps it supplied with paper, helps the pressman place the cylinder or remove it, and during the run operates the tension.

BRONZING

One of the operations in the pressroom, commonly called bronzing, requires an additional machine. Bronzing consists in covering certain parts, or all, of the design with a fine powder, bronze or aluminum, that sticks to the ink, or size, previously applied to the sheet in a printing press, and is fixed permanently when this dries. A bronzing machine may be stationary, either fixed in line with one of the presses and connected with its delivery end by a tape conveyor that carries the sheet over the feed board of the bronzing machine into the grippers on the cylinder revolving in it, or standing alone,

requiring transporting of the sheets between the two machines. In some plants portable machines are used, which can be placed in line with and connected to any desired press. Bronzing machines are ordinarily used in connection with cylinder presses or lithographic stone presses, though some small ones are used for platen work. The common styles have vacuum attachments that remove most of the surplus bronze powder and deposit it in a receptacle, as the sheet is ejected, face down, on a fly and piled up on the preceding one.

Bronzing machines were found in 50 different establishments. Twenty-four of these contained only one apiece, but in the others the equipment ranged from 2 to 12 and brought the total up to 140, of which 60 were permanently connected with presses. Pressmen who work with bronzing machines in the larger establishments usually follow that operation for a number of years.

SPECIALTY PRINTING METHODS

There are several variations of presswork which technically belong under printing, but were avoided during the survey as involving too much detail. They are usually performed as parts of manufacturing processes in special plants for such purpose. Among these is wall-paper printing, which was encountered in one periodical printing plant. Special rotary multicolor presses are ordinarily used for this process, but the equipment in the plant mentioned was not in operation during the visit. Another is tin-plate printing, which was also found in one novelty printing plant, where the printing and embossing were done on platen presses and subsequent varnishing performed on a cylinder press, after air drying. The usual method is to do the actual presswork on an offset press, dry or bake the inked plates in a hot oven, and after drying emboss the plates in a stamping press or cut them to required shapes, then apply the varnish. The work is often executed in several colors.

In one establishment printing was done on tin foil instead of on paper. Platen, cylinder, and rotary presses were used, and most of the printed work was in four colors. Transparent inks were used, which permitted the luster of the tin foil to shine through.

Varnishing is at times performed in pressrooms on labels, calendars, or similar products, where it is applied to the surface of the sheets just as ink would be. This is, however, only an emergency method and, as a rule, special varnishing machines are used, in which the printed sheets are fed by hand, caught by grippers in a cylinder, and the varnish applied by rollers from a fountain, similar to the inking device on a cylinder press. The sheet is released on a belt conveyor, which carries it through a long box or oven, heated by electricity, gas, or steam, emerging dry at the other end. A varnishing machine usually has one assistant to feed in the sheets and another to remove them, in addition to the operator. Only a few establishments visited were equipped with varnishing machines.

Printing on wood is usually done in box factories, on packing boxes of all kinds and on cigar boxes. It is also used extensively on toys and signboards. Platen, cylinder, or rotary presses are used for this work, but mostly rotary presses with one plate cylinder for each color to be printed at one operation. The printing is ordinarily done after the material is cut to size and ready to put to

gether, but may also take place before it is cut out. Brass dies are commonly used for plates and the stock is often supplied to the machine by a hopper feeding device. None of these establishments were included in the survey, nor were any that were printing on textile fabrics, commonly called calico-printing plants.

Where creasing and cutting are performed, such as in a folding paper box factory, special forms are prepared in a separate department by a die maker, usually the pressman. These consist of steel rules or strips, that are cut into required sizes and shaped into designs, held on edge in the chase by wood furniture placed around them. Cutting rules, which are 0.923 inch in width, or slightly more than type-high, have knife edges. Two kinds are used, soft, which can be bent into various shapes, and hard, where no bending is required. These are used for cutting out the box or other shape from the sheet of stock. Creasing rules, which are type-high and have flat edges, are used for creasing the cardboard shape where a fold is required. The press is made ready so that the cutting rules will penetrate the stock and cut out the shapes, while the creasing rules force the sheet into crevices or channels in the make-ready, which really constitutes a female, or counter, die. Small separations are left in the cutting rule shape, so the shapes are not cut out entirely but left clinging to the waste. The finished sheets are turned over to the bindery department for further manipulation.

The difference in the work separates the pressroom workers into platen, cylinder, rotary, or newspaper web pressmen, together with platen or cylinder press feeders and rotary press assistants or newspaper web flyboys, for the relief method of printing; lithographic pressmen or feeders, with offset pressmen or assistants, for the planographic method; plate printers or their helpers, with rotogravure pressmen or assistants, for the intaglio method. In small shops the foreman usually operates a press himself in addition to directing the work of others, while in the larger ones he devotes all of his time to supervision. The various vocations are highly specialized in the larger shops but overlap more or less in the smaller ones. Feeders and assistants usually develop into pressmen, though some of them continue in their special lines without change, either from choice or lack of opportunity. Pressmen often advance from a minor branch of work to a more important one as improved or larger equipment is added to the plant, and a number are found that can handle any style of machinery in a particular line, while others specialize.

BINDING

Binding was found in 393 of the 536 establishments inspected, ranging from book, or edition, binding to operation of a paper cutter, located in one of the other departments. Binding consists in placing the printed product together, by various methods, and finishing it if required. Binding work varies greatly in the different plants according to the nature of the product, which may be either books, catalogues, trade papers, weekly papers, magazines, booklets, advertising literature, stationery, bonds, paper currency, stamps, labels, calendars, postal cards, posters, music, forms, blanks, manifold work, playing cards, tickets, paper patterns, envelopes, wrap-

pers, paper bags, paper boxes, badges, advertising novelties, or combinations of any of these. Daily newspapers are practically the only product which do not require any bindery work. Binding can be roughly divided into three separate branches, ruling, pamphlet binding, and bookbinding. The latter consists of folding, gathering, sewing, trimming, covering, and finishing books. Pamphlet binding is usually meant to indicate similar or varying operations for pamphlets, which are thin books of one or more sections with or without a paper cover, together with all operations for the different products, except paper ruling. This consists of operating a ruling machine, which places fine lines on paper, used especially for blanks, account books, and forms. Some plants are devoted exclusively to bindery work, performing this for other printing trade plants which are not equipped for it, and 27 of these are included among the 393 visited. One of these was manufacturing book covers only, while another was exclusively engaged in repairing books.

PAPER RULING

Paper ruling is ordinarily found in connection with blank book manufacturing, though some shops in the larger cities are devoted exclusively to ruling. Two types of machines are used, the pen ruling machine and the disc ruling machine. A pen ruling machine is supplied with flat sheets, previously cut to required sizes, fed by hand or automatically on an endless cloth belt, called a blanket, on which the sheet is held by cords that travel with it. The sheet passes under a row of metal pens, consisting of strips of metal tapered to smooth points and grooved in the middle, adjusted at a 45 degree angle at desired distances in a beam across the frame. A so-called striker device, regulated through a cam wheel by a removable gear on the side of the frame, permits the sheet to pass through at the proper time and raises or drops the pens to establish a light contact with the paper, so as to deposit the ink at given lines. The gear, called paper-size gear, is one of a series that are interchangeable but have varying circumferences according to length of sheet to be ruled. The pens are supplied with ink, which consists of anilin or eosin powder dissolved in water, by strips of flannel or threads of woolen yarn which are flooded with the thin liquid through stopcocks in the fountains located back of the beam. An attachment, containing small waved discs, may be used in place of pens to produce fancy, waved lines. After ruling the sheet is conducted back through the machine by the apron, another endless cloth belt revolving below the blanket, and deposited on top of previous sheets in the lay boy, a wooden box similar to a delivery box on a cylinder press. Pen machines are constructed principally of wood. They may be equipped with one, two, or three beams, as required for the work, each with striker and inking devices, and one or two decks, designed to rule one or both sides at one operation. Two machines may be placed at right angles to each other, with transfer connection for the sheet, so it can be ruled lengthwise on one machine and crosswise of the sheet on the other without handling the product. Automatic feeders used are practically similar to those used on cylinder presses, continuous, friction, or suction. A disk ruling machine is a rotary machine, supplied either with flat sheets by an automatic

feeder or with a web from a roll. The ruling is done by revolving disks, whose edges touch a rotating rubber roller, the surface of which is covered by ink through contact with strips of flannel suspended in a fountain. One or both sides may be ruled at one time and the product may be counted, perforated, slit, cut, or rewound by special attachments for the machine. The ruling machine operator makes all necessary adjustments, mixes the inks, and regulates the operation of the machine. The feeder, usually a female, is required only for handfed machines and just places the sheets on the blanket.

PAMPHLET BINDING.

Pamphlet binding includes a number of operations that are often executed by hand in the smaller plants, a great many of the operations being performed by females, whose work may vary from day to day according to the special nature of the products. In the larger plants practically all the work is executed on machines that work automatically, but often require the product to be fed in or removed by hand.

Paper cutting.—The first operation, where flat stock is used, consists in cutting sheets into required sizes for each particular job, such as dividing larger sheets into smaller ones or trimming incorrect edges. In large binderies this is usually performed on power-driven, flat cutting machines, located in or close to the stockroom, and handled by bindery workers. In smaller ones it may be executed on the flat cutting machines subsequently used for trimming the product, and in very small ones the stock may be cut by the pressman on a small hand-lever flat cutter. A cutting machine consists of a flat iron table, upon which the stock is placed against an adjustable guide or back gauge, a clamping device to hold the pile of paper in place while the cut is being made, and a knife which is forced down through the paper with a shearlike motion. The operator adjusts the back gauge by turning a handwheel, which controls a cable, chain, or rod that slides the gauge forward or backward to proper measure for the sheet to be cut. Indicators show the distance as the gauge is moved. The larger sizes of cutting machines are equipped with power movement for adjusting the gauge. The stock is laid on a table in a pile, pushed against the back gauge, and the clamp is dropped on top of the pile to hold it in place. A clamp is a horizontal bar located back of the knife and parallel with it. On hand-clamping machines it is controlled by a screw rod with a handwheel on top, and must be screwed down by hand as well as released after the cut is made. On automatic clamping machines the clamp is forced down by power on tripping of machine, followed by the knife, and returned together with the knife to the stop on top.

The knife is a flat piece of steel, beveled to a sharp edge on one side and fastened with screws to a knife bar, which is suspended from swinging links or from rods controlled by an eccentric movement. On small hand-lever cutters the knife is forced down and through the paper by pulling down with sufficient force on a long lever. On larger and modern machines the knife drops automatically when

the machine is tripped, cuts the paper, and returns to its former position, where it is stopped. The knife may descend with a single shear stroke, giving it a sidewise motion but keeping the edge parallel with the top of the table, or with a double shear stroke, in which the sidewise and downward motion is similar but one end of the knife is higher at the start of the cut, gradually assuming a parallel position at the finish. A cutting stick, consisting of a stick of hardwood or soft metal, is set in a slot across the table directly under where the knife strikes to protect the edge of it. The power machines are usually operated by means of a friction-driving clutch and provided with a knocker, a special device fastened to the shaft or gear, which makes one revolution for each cut of the knife, throws out the clutch, applies an automatic friction brake band to a wheel fastened to the driving gear, and throws a safety bolt into a lug on the gear, necessitating pulling of the starting lever for another cut. After the cut has been made the operator removes the paper by hand, places it on a table or truck, and repeats the operations. In some establishments the product is also cut after leaving the press-room, before going to the bindery for further manipulation. Cutting machines are operated by male workers.

Folding.—The first principal operation after the product has been printed is folding, which consists in doubling the sheets in such a manner that the pages follow in rotation, with the printing on one page exactly even with the printing on another, and creasing the sheets in the folds. For some small work it is often done by hand, but there are many different machines that perform all folding operations, even including letter or circular folding. Some of these propel the sheet between tapes to a position above two revolving rollers, between which it is pushed by a thin dull metal blade that is raised or lowered by a cam movement. The sheet is carried automatically to another pair of rollers, where it is folded again in the same manner, and the operation is repeated until the desired number of folds have been made, when the folded sheet is delivered in a trough. Some folding machines are provided with slitting, trimming, or perforating attachments. Rotary folding devices are also used, and other styles of folding machines are tapeless, propelling the sheet by revolving rollers, set at an angle in an inclined frame, to the folding mechanism. The sheets are fed into the machine by hand, usually by a female feeder, or by an automatic feeding arrangement, similar to those used on cylinder presses. The folder operator regulates the adjustments and operation of the machines, while the feeder ordinarily just guides the sheets in. In small shops the operator often feeds the machine also.

Bundling.—If the product is intended for a catalogue, magazine, booklet, or other pamphlet the folded sections, called signatures, are usually compressed in a bundling machine, consisting of a rack, which may be either horizontal or inclined, on legs. The signatures are placed on edge, with a wooden board at each end, and pressure is applied on one end by hand, hydraulic, or air power, forcing the air out from between the folded sheets. The sliding metal heads of the machine, next to which the boards are placed, are provided with large holes that permit inserting the hands to tie the bundles. The

various machines used for bundling, which embody the same principles, are ordinarily operated by males.

Gathering.—After the signatures are folded and bundled they are assembled, or gathered, in consecutive order. This is done by hand in the smaller establishments, where the sections are laid in piles on a table in successive order and the operator picks up one from each pile while walking past them, placing them together. A rotary table is used at times, which carries the signatures past the operators, so that they can be easily picked up in numerical order by the operators. A set of boxes, traveling on an endless-chain system, is also utilized in similar manner, each box containing a pile of uniform sections. In large establishments the work is performed by gathering machines, on which a series of boxes are arranged in a long row on the bed of the machine. Each box contains a pile of sections and is constructed so the bottom signature is removed by a suction device to a fixed position, where it is seized by a pair of grippers and carried over an endless belt conveyor, moving horizontally across the machine, where it is dropped. At the next operation the conveyor has moved enough to receive the section from the next box, which is dropped on top of it, and when it has moved across the machine a complete set of sections is contained in the pile, which is then removed by hand. If one or more sheets are missing, or in case there are too many sheets in the signature, the machine is stopped automatically and a signal indicates where the trouble is located, so the operator can rectify it by placing the imperfect signature with a proper one and start the machine again. The gathered product is removed by hand from the end of the conveyor, if the machine is built for gathering only, but a number of them are equipped with stitcher attachments that fasten the sections together with wire staples. Where this is done the signatures are changed in the conveyor from a horizontal to a vertical position before passing into the stitcher mechanism. After the signatures are gathered they are collated, or examined for possible misplacements. Hand gathering, as well as the majority of work on gathering machines, is usually performed by females but special operators supervise the working of the machines.

Tipping.—Sometimes it is necessary to insert additional single sheets that have been printed separately, such as colored illustrations or maps. This is usually done by hand and the so-called inset may be stitched, sewed, or pasted in. Where a smaller sheet is attached to the face of a larger one by pasting one edge or the entire lower surface of the smaller one the operation, which is called tipping, is usually done by hand by female help. Special machines are used for the purpose in some plants. In one of these the sheet is laid on one flap and the section on which it is to be tipped is laid on another flap. The two flaps fold toward each other, bringing the material in contact with a pair of vertical rollers, which carry the two parts forward. A tongue, extending between the rollers, separates them on one side and a wheel, which revolves in a tank of glue, applies a thin line of adhesive to the edge of the inset, which is pressed against the other part by additional rollers. The finished product is delivered on an automatically descending table.

Stripping.—End papers, which consist of extra sheets making the outside leaves of a book, are tipped on the first and last sections, sometimes by hand but, in larger establishments, usually by machine. This may be done before the signatures are fastened together. A sheet twice the size of the pamphlet or book is used, folded in the center and reinforced in the fold by a strip of tape or muslin. An end sheet stripping machine is used, in which the paper is fed from two rolls, one narrower than the other. The two sheets are aligned in front and the tape, which runs over a paste roller where it is covered by paste, is attached smoothly by a pressure bar, after which the end papers are cut automatically to required length. Another stripping machine will attach strips of gummed cloth to signatures or end papers, folded over the backs or flat on one side. The cloth may be supplied from a roll or fed into the machine in flat or accordion-folded strips, laid in a special cloth holding hopper. The machine is provided with a heated gluing device and automatic cut-off knives. Tipping and stripping machines are ordinarily adjusted by a supervisor and the routine work is performed by female help.

Stitching.—Wire stitching is performed on special machines for the purpose, of which there are various styles. It consists of placing wire staples, usually two or more, through the leaves of one or more signatures to hold them together. A single section, or several laid open over each other, may be fastened with staples through the fold, called saddle stitching. If several sections are stitched together it is customary to place them side by side on top of each other and clamp the staples through the side of the pile, called side stitching. The common individual wire stitchee consists of a table or saddle, on which the operator holds the work in proper position while the staple is forced through the leaves by the stitchee head. The operator slides the signatures along a guide, until the place to be stapled is directly under the head, and presses a treadle, which either operates the machine directly with foot power, or starts it automatically. The wire, which is contained on a reel or spool, revolving on a spindle fixed to the machine, is cut off at adjusted length, forced through the leaves, and clenched on the other side. The operator moves it along until the next place to be stapled is directly under the head, then repeats the performance, doing this as often as required, and deposits the stitched product in a pile at the other end. For saddle stitching the manipulation varies somewhat, as the operator must open the book in the middle and slide it over the table, which in this case has two right angle surfaces with the ridge on top, but in other respects the proceeding is similar. Multiple stitchees are also used, with adjustable heads, for either side or saddle stitching, which will place any required number of staples at once. In the larger binderies automatic stitchee feeders, or gang stitchees, are used, which feed single books or gangs into continuously operating multiple stitching mechanisms. A stitchee feeder is provided with a long saddle, supplied with an endless conveyor chain with equally distant projections. Sections are placed between the projections, which carry them to the stitchee, and after stapling they are delivered mechanically on a slow moving tape conveyor, permitting easy removal by hand. Some stitchee feeders will automatically place sections inside of one another before stapling, while others require them to be placed on top of each other, if more than

one is to be included for saddle stitching. Stitcher feeders are used with multiple heads, which place one or more staples at one time, and which is also the style used as attachments to gathering machines. One stitcher feeder is equipped for placing a wire hanger loop in each pamphlet while it is being stapled. The ordinary work on stitching machines, such as feeding, taking away, and making minor adjustments, is usually performed by females, occasional major adjustments being done by a supervisor.

Thread stitching is at times used for the better class of pamphlet work, and there are several machines which stitch pamphlets through the fold or through the sides with either two stitches or one stitch and a loop for hanging. Hooked needles are used, that pierce the paper and pull the thread, supplied from a spool on a spindle fastened to the machine, through the holes, looping it by the assistance of a shuttle with a gripping device at one end, which passes through the loops, or by grippers which draw the thread through loops formed by a rotating, fork-like device, or through a gripper needle which pulls the thread through loops made by another gripper and a pin. The two ends are automatically secured by a square knot at one end of the stitch, the thread is cut by a knife or a shear-like device, and the stitched product is removed by the operator by hand. Silk-stitching machines are also used in some establishments, which will double-stitch a pamphlet with heavy silk cord, tying a knot in the center. Thread-stitching or silk-stitching machines are, like wire-stitching machines, operated by females.

Covering.—Covers are sometimes added on signatures and stitched together with them but, especially on magazines, are often glued over the stitched sections. Like all other operations this is usually done by hand in small plants and by machines in the larger ones. Hand covering consists in placing paste or glue on the backs, setting each of these on its cover, folding the cover over it and rubbing it down. A covering machine, such as is ordinarily used for magazines, performs these operations mechanically and automatically. It is elliptical in shape and provided with a series of vertical clamps that travel horizontally around the machine. In the majority of the plants the covering machines are connected directly with the gathering and stitching machines and the books are conveyed mechanically direct to a mechanism, which drops them, backs down, into opened clamps which close and grip them tightly. In traveling around the machine the books pass over rollers, which revolve in tanks containing heated glue and apply a thin coating of glue to the backs, then over covers which are fed automatically into the machine and adhere to the glue, over a device which presses the covers firmly against the backs, and are finally delivered on a conveyor, or on a table, from which they are removed by hand. In one of the styles, used for magazines, telephone directories, or similar products, the book is first conveyed by the clamp to a horizontal, revolving knife, which cuts the folds from the back, is then carried over a series of small circular saws that roughen the edges, over the gluing device, and next over a small moving table where a small strip of thin, starched cloth is applied over the glue. The strips of cloth may be supplied by hand to the machine, but in the newer styles they are mechanically cut from a roll that revolves on a spin-

dle attached to the machine. The glue, which penetrates the meshes of the cloth, picks up the top one of a pile of covers, over which the magazine is carried next, and the back is pinched in a special device to attach the cover securely. Covering machines can also be found detached, used mostly for job work, and are then supplied either by hand or by an automatic feeding device with the product to be covered. Special covering-machine operators look after the adjustments and working of the machines, while only the minor operations are performed by female assistants.

Trimming.—After the product has been covered it is trimmed in a cutting machine, which may be a flat machine, like that used for stock cutting. Catalogues and pamphlets are often trimmed on these and some styles are provided with special back gauges that are made in three sections, permitting the two end sections to be clamped in any desired relation to the center one. The right one is adjusted for trimming the head and the left one for trimming the tail, while the center is left for the front edge cut. After the operation has started this simplifies the handling of the piles, as it enables the operator to lift out the finished pile at the left side and place it on a table, change the pile in the center (which has received two cuts) to the left side, move the pile from the right side (which has been trimmed at the head) to the center position and place a new stack at the right side, then trip the machine, cutting the three piles at once, and repeat the operations.

A duplex book trimmer is also used, which is provided with two parallel knives and a movable table which carries interchangeable pattern blocks, corresponding in sizes to the piles to be trimmed. The proper sizes are placed on the table, two piles of books are laid on them, back to back, and the knives are adjusted to proper distance for size of pile. By pulling a lever the piles are automatically clamped, the knives descend and trim the two front edges, then rise while the table is given a quarter turn, bringing the knives into correct positions for the head and tail trim, after which the clamps are released so the books can be removed by hand and replaced with new piles.

Another machine, somewhat similar, is provided with only one knife and trims a single pile on three sides with one clamping but three cuts. The revolving table, which is turned by hand, locks itself automatically in position for the second cut and similarly for the third cut. A different style, called continuous trimmer, has three knives and delivers a small pile of books, with three sides trimmed, at each operation. The revolving table is divided in four sections. The operator places a pile of books on the empty section in front of him, against a gauge, while the table is at rest and applies a temporary clamp by foot pressure to prevent displacement of the pile while the table rotates. The table revolves automatically one quarter turn, bringing the pile under two parallel knives. The table is locked, the pile is automatically clamped, and the knives descend, cutting the heads and the tails of the pile, while the operator places another pile on the empty section which has been brought in front of him. By the second movement of the table the first pile is carried under the third knife, which trims the front edges, while the second pile receives the head and tail cut and a

third pile is placed in the third section. A third turn brings the first pile, completely trimmed, to a delivery point where it is removed by an assistant, the other operations meantime being repeated, and at the fourth quarter turn the empty section is again brought in front of the operator, insuring continuous operation. Some of the machines are constructed to give the front edge cut first, with the double cut following; some use a shear stroke on the knives and others are equipped with a tumbler head movement for these, giving them a curved stroke.

Large magazine-publishing establishments also use automatic book trimmers, supplied with three knives, some of which are fed by means of conveyors that pass the books in a steady stream to the cutting mechanism, which ejects them finished at the other end. In some the material is fed to back and side gauges, which recede automatically as the knife descends, while in others it drops into a holder that supports it and carries it against the three knives, which are held by a stationary plate and provided with shear motions. After trimming, the plungers are released and the finished product is dropped into the delivery.

Material to be cut, or trimmed, in a cutting machine is usually brought to the machine on a truck, or on a platform that is moved by a special style of truck which can be mechanically compressed and pushed under it, and afterwards extended to raise the platform off the floor so it can be conducted to any desired location in the plant. It is at times removed from the truck and placed on a table in front of the machine, back of the operator, and the trimmed product is placed by him at the other end of the table, or in a truck, to be removed by other help. In some places the table is built as a box and used for temporary storage for the waste and trimmings. In other places these are disposed of in sacks or box trucks, placed near the machine or, in some establishments, through chutes that transmit them by gravity, or by a suction system, to the waste department.

Many of the large establishments were equipped with grinding machines for sharpening knives used in flat paper cutting machines, but in the majority of them the grinding machine was located in the engine room or the machine repair shop, not in the bindery, and the operation was performed by the engineer or a machinist. Some places had the grinding machine placed in part of the bindery, where the operation was watched by one of the binders. The machine consists of a bed placed at an angle to bring the bevel of the knife blade, that is fastened on it, in correct contact with a large emery or sandstone wheel, which automatically revolves and at the same time travels sideways in the machine, parallel with the bed, reversing itself at each end. Water or oil is supplied to the point of contact from a trough in which the bottom of the wheel is immersed.

A number of other products besides magazines, catalogues, pamphlets, and periodicals require trimming. Most of them are turned out in piles with straight edges by the presses, but otherwise they first require jogging, which consists in straightening the sheets so the edges of a pile will present an even surface. In some of the large establishments a special machine is used for that purpose, which

consists of a sloping box that is provided mechanically with a shaking motion, which causes the sheets to slide into one low corner and rest against one side frame and one end frame in alignment on top of each other. In the majority of plants the jogging, where necessary, is performed by hand. Specially designed trimmers are used on certain products, such as for paper currency, some of which is printed with four notes on a sheet and later fed into trimming machines that trim each note on four sides at one time, or for playing cards which were cut out in one establishment one at a time from strips previously cut from sheets, kept in rotation, and collected automatically in full decks. A different style of trimming machine cut out a full deck one at a time from a sheet and assembled them. Labels are often cut out in irregular shapes on a so-called die press, which consists of a heavy flat bed or table above which a heavy platen is moved automatically up and down. A die is used, which consists of a steel band on edge, sharp on the bottom and about one-half inch wide on top, about 2 inches high, shaped to correspond with the outlines of the design. The printed sheets are placed on a special cutting board, the die is placed over the design top, the cutting board is pushed on the bed of the die press when the platen is at the highest point, and when the platen comes down it presses the die through the sheets, cutting out the labels. This system of cutting is also used in some envelope factories, for cutting out the regular shaped patterns, previously printed in outline on large sheets. Female operators customarily handle the special cutting machines, which are used on standard size productions and do not require continuous changes in adjustments. Die presses are usually operated by males.

Round-corner cutting is required by some products, and is performed either on small machines operated by foot or on large ones operated by power. They are equipped with right-angle guides, against which the sheets are held by hand while they are clamped, and a half-round knife is pushed against the clamp, cutting the corners semicircular. These are usually operated by females. An entirely different method is utilized for trimming paper patterns for dressmaking, which are printed on tissue paper. These are placed in a thick pile on a table, where they are clamped while the edges outside of the design are removed by a rapid-moving band saw, against which the operator guides the pile.

Perforating.—Printed sheets, such as checks or blank forms, often require perforating. This consists of piercing the material with one or more series of small slits, slots, or round holes, to permit easy separation. Various styles of machines are used for the purpose, either flat or rotary, and some of the principal mechanisms are used as attachments on folders or other machines for combination operations. On flat perforating machines, which may be operated either by foot or by power, the sheets are placed on a horizontal table, or bed, by the operator, pushed under the blade, which is held in a frame above, against an adjustable guide in the back. Pressure on a treadle forces the blade down against and through the paper, raising it again mechanically so the operator can remove the sheets. The blade consists of a series of small dies of required shapes, extending across the machine. Some flat machines are made to perforate

lengthwise with the sheet as well as crosswise. Rotary machines are equipped with adjustable wheels, fastened on a revolving shaft above the table, containing required patterns on the faces of the wheels. The sheets are fed into them as on a folding machine, and on some are carried by tapes through several perforating mechanisms if required, afterwards being deposited in a receiving box. Special designs are used for perforating postage stamps, revenue stamps, or other special products, and for perforations on paper patterns for dressmaking pneumatic perforators are used. Perforating machines are ordinarily operated by females.

Punching.—Punching, which is used extensively for loose-leaf work, consists in cutting holes through sheets or cards. Some single punching machines are used, ordinarily with foot power; but the majority of machines are multiple styles, each containing several heads for interchangeable dies in a multitude of varied forms. The paper or card stock is placed on the table by the operator, adjusted to guides, and the machine placed in operation by the usual treadle system. The punching members, or dies, which operate up or down with the rotating of the shaft, cut holes of required shapes through the material against a fixed base of soft metal for each die. On some machines the paper is pulled back by the operator, while on others it passes through the machine and is dropped in a receiving box on the other side.

Punching machines are sometimes supplied with index-tab cutting machines, which will cut the top off a card, except for a projecting tab that can be left in any desired location on it. A sliding carriage is ordinarily used for feeding cards into tab-cutting blades. Thumb indexes on catalogues, directories, and blank books, which are cut out of the leaves, are usually executed on special machines. One style, which can be held in the hand, is operated by compressed air. It is inserted in the place previously designated by a brass marker, the point is slipped into the plate, the starter is pressed with the thumb, and the cutter removes a half circle. Another machine has a sliding table which can be clamped by the foot in adjustable stops, a sharp blade which drops down on the leaves and cuts the edges at adjustable widths, and is provided with an indicator for each cut. The operator holds the leaves and drops them on the table one by one. A receding gauge holds and drops the leaves when cut. Cut-in indexing is usually executed by males, usually in the finishing part of the bindery.

It is sometimes necessary to make one or more holes through work which is too thick to be handled in a punching machine, and a number of establishments are equipped with paper drills for that purpose. A paper drill consists of a stand with a table and one or more adjustable drills, fastened on a beam or on arms above it. The material is placed on the table under the drills, against guides, and the machine started, which raises the table automatically against the revolving drill or drills. After the holes have been drilled the table is let down, the material removed by hand, and fresh stock substituted.

Eyeletting is often combined with punching to strengthen the holes on shipping tags, cards, calendars, etc. Eyelets are metal caps, that are fed into a grooved arm of a machine by brushes with

a circular movement. A projection picks up one eyelet at a time, guides it into a hole, which has been placed over a similar projection, and clenches the eyelet firmly. The majority of eyeleting machines are operated by hand or foot power, except in establishments which perform a great deal of this work. Punching and eyeleting are usually executed by female help.

Numbering.—Numbering or paging, on pages or on checks, is often performed in the pressroom by a type-high numbering machine in the form. This consists of a small box containing a series of disks with numbers in relief on the edges. It can be adjusted to print either consecutive numbers, odd numbers, even numbers, multiples, or repeats of one number as often as desired, then changing to another for similar action, number backwards, or skip as required. For blank-book work or other products the numbering is sometimes executed in the bindery on special machines, consisting of a stand with a table, above which the revolving head is fixed on an arm. On some of these the printing is done by pressure of the fingers on a smut tape that moves automatically with each impression, but on others ink is supplied to the faces of the figures by a small inking attachment. A numbering machine may be operated by foot or by power but the sheets are ordinarily both placed on the table and removed by the operator. Where the numbering is done on the leaves of a book, these are turned by the operator. One special machine has the figures fastened to an endless chain and moves them forward in proper rotation, permitting numbering of two pages in one operation. A special machine is used in some plants, which numbers automatically, consecutively, or in duplicate, and also perforates in two directions. The sheet is carried automatically to the proper distances, the operations are repeated as required, and the sheets are delivered in consecutive order in the receiving box. Numbering machines are usually operated by females.

Other operations.—Calendars, hangers, and similar products are often edged with a strip of brass or tin at the top and bottom to hold them flat. The strip is folded over the edge by pressure in a special machine, which is usually operated by hand or foot power and requires separate operation for each strip. Crimping, which consists in bending or mangling a sheet near the binding edge from both sides, is done to permit sheets, such as used in loose-leaf binders, to lay flat. The operation is usually performed on a rotary creaser provided with several pairs of small wheels or creasing rollers, into which the sheet is fed as on a folding machine, passing through and dropping into a receiving box at the other side. Both edging and crimping machines are operated by either sex.

Printed sheets with high gloss surface are often run through a stippling or roughing machine to relieve the luster effect. A stippling machine is provided with metal rollers, whose surfaces are roughened with a small grained design. A similar machine with a smooth roller, called a plating machine, is used for burnishing or restoring a smooth glossy surface to paper which has lost this through wetting and printing, such as paper currency or postage stamps. Very heavy pressure is applied by a smooth-faced roller to the pile of sheets as it passes through the burnisher, squeezing the surfaces against zinc plates, previously inserted alternately, and giving the

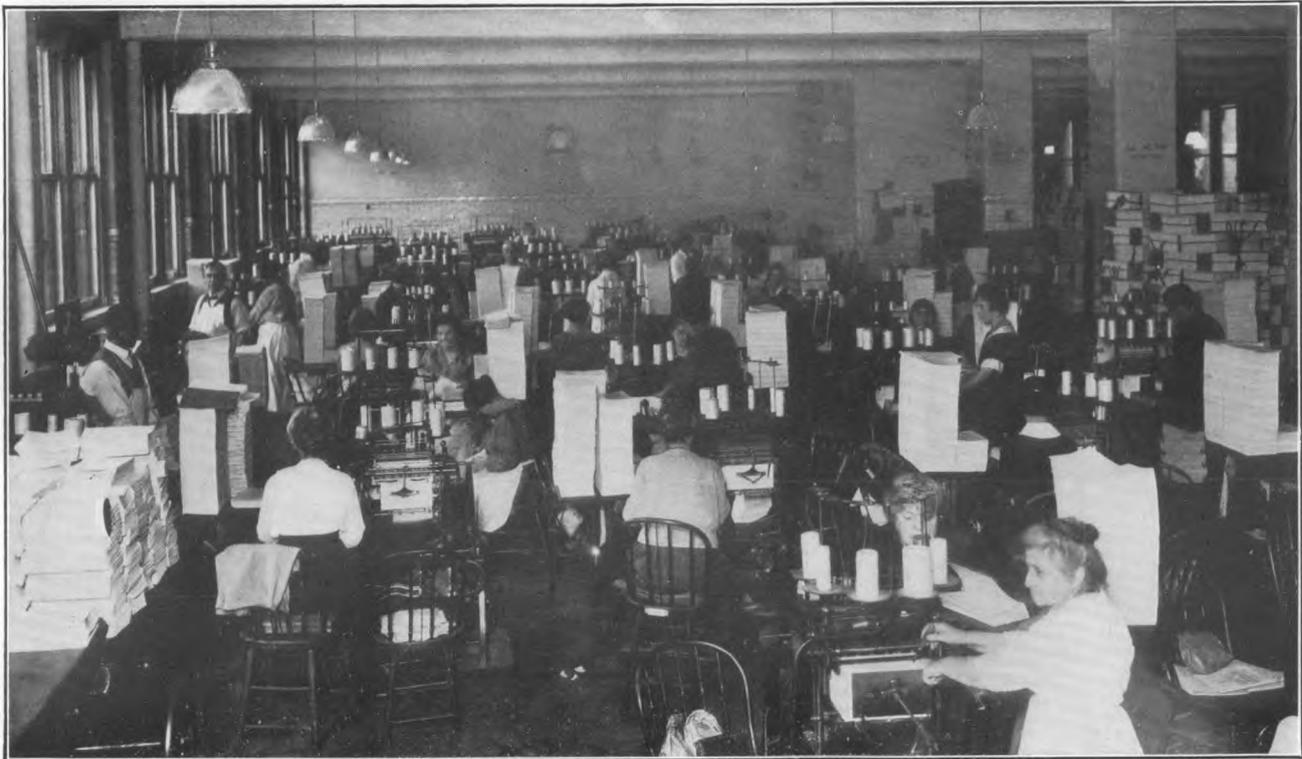


BINDING—PAPER CUTTING

12



PAMPHLET BINDING—STITCHING



BOOKBINDING—SEWING



BOOKBINDING—FINISHING

paper a smooth satin finish. Pebbling and burnishing machines are usually operated by males, though in some plants they are fed by female assistants.

Blank forms and other printed matter are often made into tablets or pads for convenient use. The sheets are trimmed, divided into pads of required thickness by pieces of cardboard, and piled in a small press, similar to a bundling press, or under heavy weights. A thin coating of flexible glue is applied to one edge, while under pressure, sometimes reinforced with a strip of muslin and another coat of glue, and after the glue has dried the pads are cut apart. Padding is ordinarily executed by female help.

Maps or other products that are handled considerably often require mounting on muslin. This is in some places done by hand, spreading paste over the back of the sheet to be mounted, laying it on the muslin and rubbing it down carefully. In other places a heavy cylinder is rolled over the pasted product to smooth it down, while in some establishments a special gluing or pasting machine is used, which catches the sheet by grippers on a cylinder, carries it over a roller that applies the adhesive, releases it on top of the mount which is fed in the machine separately, and carries it between rollers, smoothing it down and sometimes drying it, to the delivery carriage. Adjustable scrapers keep the roller which applies the adhesive free from lumps and where glue is used the fountain is, as a rule, provided with heating apparatus. Similar machines are also used for coating one side of a sheet with an adhesive, such as gumming postage stamps or labels, and delivering them wet side up on an endless belt conveyor, which travels from the feeding operator over the top of a long table, permitting easy removal, or to grippers on an endless chain, that carry the sheets through heated boxes and deliver them dry at the other end. Pasting and gluing machines are ordinarily handled by female help.

Establishments that use considerable glue and paste prepare these in the plants. In smaller ones the paste, which consists of wheat flour mixed with water and some preservative, is often cooked by inserting the free end of a steam pipe in the container and turning the steam on. Others use gas plates, on which the vessel is placed, while in the larger plants the cooker is placed in a tank with a water jacket and heat supplied to the surrounding water. Glue is similarly prepared in various manners. Some small plants use individual glue pots and dissolve the glue by placing these in hot water on a steam, gas, or electric heater. Others use individual pots, provided with water jackets, either placed on a small stove or provided with heating devices. Larger plants have glue cookers, some of which consist of a tank surrounded by six pots and others of air-tight tanks with water jackets, where the water is kept at uniform heat by electricity or steam and at constant level, from which the melted glue can be drawn through a faucet. In large plants the glue melting is handled by male employees.

BOOKBINDING

Quite a few of the operations in book, or edition, binding are similar to those executed in pamphlet binding. The stock is usually procured in required sizes when used flat, to eliminate cutting, but

otherwise must be cut. In some plants of either class, flat stock is at times prepared from rolls by passing the web through a rotary sheeting machine. These are made to hold one or more rolls of paper, and in the latter case permit several webs to be severed at one time by the heavy knife in a revolving cylinder. After printing, the stock is folded, bundled, gathered, and collated, just as for pamphlets, and necessary inserts made, but later operations differ, though some of these are at times also used in pamphlet binding, such as sewing in place of wire stitching.

Sewing.—In some establishments books, or part of them at least, are still sewed by hand. The signatures are placed in a wooden frame consisting of a bed with two vertical screws, provided with two wooden nuts that control the height of a horizontal crossbar. A number of cords or tapes intended to serve as hinges on the book are strung between the crossbar and the bed. If cords are used, the backs of the signatures are first notched with a back saw, placed with the notches around the cords, and sewed together around these, section by section. If tapes are used, the backs are not notched, but the sections are sewed in a similar manner. Machine sewing has practically replaced hand sewing, and various styles of machines are used for the purpose, with either curved needles or straight needles. In the curved-needle style the signatures are placed, one at a time, across a feed arm that carries it into the machine, where holes are punched, through which the needles insert the thread. This is also carried through the previous stitches, sewing each signature in turn to the preceding one. Some are provided with a single feed arm, others with four revolving radial feed arms. Straight-needle machines have independent sewing heads, adjustable for closer or wider spacing across the machine. Each section is thrown across a saddle-shaped feed arm to a gauge and carried by it up under the needles. Some of the machines are arranged to sew with thread or with tape and through pieces of muslin around the backs. Over-sewing machines that sew through the sides instead of through the folds are also used. The sections are fed onto a shelf and the machine started, automatically clamping, punching, and sewing the book. When the final section is sewed the clamp shelf is swung forward and the book drawn out. Hand sewing is performed by female help and sewing machines are also operated by females.

Smashing.—The operations required in binding a book after sewing and up to the time it is sent to the finisher are known collectively as forwarding, and are usually performed by males. The first of these is smashing or compressing, which is done by placing the books, one at a time, in a book compressor, a powerful machine that exerts a slow uniform pressure. One style is provided with two sets of jaws, one of which holds the book in place, while the other closes on the back and flattens the folds. The jaws, which can be set by a hand-wheel, according to the thickness of the books, slide in two horizontal bars. Another style consists of two flat plates, a stationary but adjustable one below and a moving one above, which rises and falls automatically. Only part of the book is inserted at one time and the operator holds it between the platens while these close, turning it until the whole book is compressed.

Rounding and backing.—After smashing is completed the books are trimmed, then rounded to give the back a convex shape, and backed to spread the back folds of the signatures fanwise. The backs are covered by hand with a thin coat of glue, and before this is dry the books are rounded and backed by hand or in machines. In hand-work the book is laid flat on a table, first on one side then on the other, while the back is tapped with a mallet. It is next placed in a backing press, consisting of two horizontal jaws which are screwed together by turning a handwheel, with the back projecting above the jaws, and the back is struck with a hammer. Rounding is also executed in a small machine, where the book is held against a convex form that rounds one-half of the back at a time. Backing is sometimes done in a roller backing machine, which is provided with two jaws, adjusted by turning a handwheel in which the book is placed and clamped by pressure on a treadle, and a roller, also adjustable for height by a handwheel, is moved forward over the back by pressure on another treadle. The hand method and the small separate machines are used only in small binderies. The larger ones are equipped with rounding and backing machines that perform all the work in one operation. A book is fed into the machine between a pair of rollers with the back resting on a pair of guides, the upper roller descends and presses the book against the lower one, the guides rise out of the way, the rollers rotate to round the back and move the book backward into a pair of jaws, which grasp it and bring it in contact with an oscillating concave plate that does the backing. The jaws move forward toward the operator, who meantime has inserted another book in the rounding rollers, which pushes the first book out of the jaws as these release it.

Lining.—The books are usually stacked up in alternate order next, and given a second coat of glue on the backs, which are then covered with strips of thin, starched cloth or strips of paper, an operation called lining. The better grades of books are also supplied with headbands, which are narrow cloth strips that project at the head and tail of the backs to cover the edges. A headbanding and lining machine, which is used in larger establishments, is provided with a rotary carrier that has a number of jaws, into which the books are fed automatically. These bring the backs of the books over a gluing device, over the cloth cutting and feeding device, over another gluing device and, finally, over the headband device, where the headbands are automatically cut and applied. The cloth and headbands are supplied to the machine in rolls. After headbanding, the book passes to the paper-lining device, where the paper lining is pasted, cut to size, and applied, then returns to the operator, who removes it.

Case making.—When the books are dry, after lining, they are ready for covering, called casing-in, which may be executed in two ways, building them on the books by hand or fitting them into covers, or cases, previously made. Coverings for books usually consist of pieces of binders' or cloth board, commonly called boards, which are covered with paper, cloth, or leather. Where it is done by hand a piece of board, previously cut to size, is placed on each side of the book and holes are punched in edges near the back,

through which the ends of the cords in the books are drawn and laced. In some places this is done before headbands and linings are attached. The covering material, which has previously been cut, is given a coating of glue on the inside, stretched over the boards, smoothed down, and the edges turned over. The end sheets, which were tipped and sewed to the outside signatures, are covered with paste and fastened to the insides of the boards. The books are then placed in stacks in standing presses, which consist of stationary horizontal platens, on which they are piled with brass-bound wooden boards between the layers, and similar platens above the pile, that are squeezed together on it by means of screws, cogwheels, levers, hydraulic or pneumatic action. In some plants a board is first placed inside the press, a similar board is laid on top of the pile and, after the pressure has been applied, the two boards are fastened together by iron rods inserted in grooves and held in position by handwheels, which permits removal of the whole pile to one side, leaving the press free for use instead of holding it until the covers are dry.

In a number of plants cases are made separately by hand, to be placed on the books later or supplied to other firms for that purpose. The majority of large binderies use machines for making the cases, as well as for attaching them to the books. Boards are at times cut to required sizes by means of table shears, which consist of a long knife hinged at one end that is forced through the board, placed on the table, by pressure on the other end. Where used in large quantities it is done on a rotary board cutter that is provided with an iron table on which the sheets of boards are laid, two revolving rollers, which carry them against adjustable, revolving cutting disks that split them into strips, and two similar rollers that carry them out of the machine. The strips are turned and, after adjusting the cutting disks, passed through the machine laterally, being delivered in rectangular pieces. Some boards are beveled on the edges after cutting, in a small machine with an adjustable slanting feed board on which the stock is slid, passing against a revolving circular knife. This machine is also provided with a movable carborundum wheel that can be placed in contact with the knife edge for sharpening it by pulling a lever.

Cloth may also be cut on table shears, but in the larger shops is divided into sheets in a cloth-cutting machine, which is fed from a roll. It is provided with a straightening device that removes the curl of the cloth, which is next pulled by friction rollers between a series of adjustable circular cutters, where it is slit in strips. The cloth is advanced at intervals and, during the stops, a vertical knife descends, shearing the strips into rectangular pieces of required sizes. Part of the cloth may be delivered on a rewinding attachment, if desired, while the cut pieces are delivered on a receiving table.

Leather is usually cut by hand, but leather covers require paring, or skiving, along the edges to reduce the thickness. This may be done by hand or in a skiving machine, which is provided with a feed roll that advances the leather and a foot which presses the leather against the roll, carrying it against a circular knife that bevels the edge. This machine is also equipped with an emery wheel for sharpening the knife.

Case making in any quantity is usually done in a case-making machine. Where they are made by hand one operator ordinarily glues the inside of the cloth, another places the two boards on it at proper distances and a strip of manila paper along the back, also turns in part of the edges, and the third finishes turning the edges, rubs it down, or runs the cases through the mangle, consisting of two revolving rubber rollers that squeeze it together. These operations are at times performed by girls, with the aid of a small gluing machine that applies the adhesive, a long conveyor belt passing over the top of the table, where the boards are placed on the cover, and a mangle at the other end of the table, for smoothing it. Small machines are also used for gluing and turning the edges, or for nicking and turning the fabric on round corners. The operations are performed in the machines while the cases are held, one at a time, by the operators, usually females.

Case-making machines are of varying styles. One of these is provided with a cylinder which grips the cloth as it is fed in, reverse side up, by the operator, and brings it in contact with a roller that revolves in a tank of heated glue, covering one side with the adhesive. A cloth carrier, equipped with grippers, carries the cloth with the glued side up and deposits it on a platform. The boards, which are previously cut and placed in two magazines at the rear, are automatically laid on the glued surface and, if thick paper is used for back lining, this is supplied from a roll of paper, automatically cut and placed in position. The platform descends and the cloth is folded over the head and tail while the corners are nicked. Another set of folding bars turns the fabric over the front edges and the case is run into a finishing press, where it is squeezed by a platen against a flat rubber bag filled with water and held until the next case arrives, when it is delivered on an automatically lowered table. Another style of the machine is supplied with the cloth or fabric from a roll of correct width, which is carried over a glue roller that covers the reverse side with glue. The boards, which are previously cut to size and placed in a hopper, are fed in pairs to relative positions on the glued surface of the web and pressed between rollers. The cloth is cut between the boards by a knife that has a small V-shaped cutter at each end, which shapes the corners, the edges are turned over and pressed down by rollers, the back liner is applied and pressed down, and the case is delivered in a trough, from which it is removed by an assistant and run through a case-smoothing mangle.

Casing in.—Casing-in machines are used to fasten the books inside of the covers. One style of these has three radial feed arms, over which the books are hung, one at a time, by the operator as the arm comes to a stop in front of him. The arm makes one revolution, which carries the book into the center of the machine, where it descends while air pressure from two nozzles hold the leaves from opening. Two paste-rollers apply paste over the outsides of the end sheets and, as the arm rises again, the book is pushed into a case, which meanwhile has been removed automatically from a magazine or hopper in the rear and held over the arm by a clamping device. The cover is pressed on the book and the arm, which has detached itself from the cylinder that carried it and which meantime has

made a second part revolution, is again attached to the cylinder and, at the third turn, carried back to the operator, who removes the book and places a new one on the same arm, the operation being repeated as each arm passes him. A different style of machine places the book in the cover without opening it. The book is placed in a supporting guide and pushed forward by hand onto the book blade, which enters the middle of the book, while a pusher places the book automatically in the proper location on it. The paste is applied by two plates, one on each side of the blade, that first receive it from a pendant extension which dips into a tank of paste, then rises and is brought in contact with the plates. The plates move away from each other as the blade with the book descends, but after the blade has reached the lowest position they advance and apply the paste to the end sheets. The cases are held in a hopper at the rear of the machine, and as the book is being prepared the bottom case is automatically drawn from the pile and fed into a heated former, which rounds the back and forms the joints, then placed directly above the book. As the blade rises again the book enters into and lifts the cover, after which it is removed by hand. Books covered in casing machines are, like those covered by hand, placed in standing presses until dry. Case-making and casing-in machines are operated by males, but usually with female assistants.

Books with flexible covers and large books are usually bound with tight backs, which requires the backs to be glued tightly to the cover material. This can be done on some of the casing-in machines but is often performed by hand. Some additional operations are required for loose-leaf covers, which are made in many different styles, with spring backs, sectional posts, ring clasps or lacing appliances, which are fastened in the covers as they are made. The backs are often molded of heavy binders' board and reinforced with several thicknesses of strips, called hubs, and the insides of the covers are lined. Special machines are used for these so-called patent backs, which differ according to the requirements of the product.

Finishing.—Finishing consists of placing titles and decorations on book covers, where this has not been executed previously. In some places it includes coloring or gilding of book edges, as well as stamping or printing of cases before they are attached to the books, also index cutting and printing. Hand finishing is usually performed after the books have been covered, especially on leather bindings, which may be tooled or stamped and, after sizing, be decorated by gold, silver, aluminum, or imitation leaf, over which a heated tool is applied with pressure in the lines of the design. This causes the metal to adhere in those parts and the surplus leaf is brushed off. If gold leaf is used the brushing is usually done over a table, provided with a screen in the top, permitting the waste gold to drop into a receptacle, and sometimes with a suction attachment that gathers the gold in a hopper. Blank books are, as a rule, also finished in this manner. Lettering is usually performed in the same manner by means of brass type placed in a small holder with a wooden handle. The type is heated and pressed on the gold or other leaf.

Where large quantities of uniform designs are called for, these are ordinarily produced in stamping presses by stamping or embossing, and usually before the covers are placed on the books. Stamp-

ing consists of impressing relief dies into the covers, or binding material, with ink, metal leaf, or metal foil, or without these, which last is called blind stamping. Embossing consists in producing the design in raised form on the cover, similar to steel die stamping, also with or without metal leaf. A number of various machines are used, which all employ the same principle, a platen on which the material is placed, where it is brought in contact with the die, which is held on another platen, and submitted to heavy pressure. Ordinary heavy platen presses are commonly used for stamping covers with ink in one or more colors and, in such case, the method is the same as in platen presswork, though blank impressions are sometimes made first to smooth the surface. A regular stamping press may be operated by hand or by power. It is provided with two horizontal platens, the lower one equipped with gauges against which the material is laid, and which usually rises against the upper one, on which the die is fastened. The top platen, or head, is in the majority of cases provided with a heating device, steam, electric, or gas, for use with metal leaf or foil. Some presses are provided with inking mechanisms while others, intended for blind stamping only, are not. In some establishments the cover is blind stamped in one machine, then placed in another press for the ink, leaf, or foil stamping. Leaf or foil is applied in the same manner as in the hand operation. The cover is sized, if necessary, and a piece of leaf or foil, larger than the die, laid over the part to be stamped, then placed in the machine and pressed against the heated die, causing the metal to adhere in the design. The cover is removed from the machine by hand and the surplus metal is brushed off. Embossing is done by using intaglio dies and preparing a female or counter die in the same manner as ordinary embossing in presswork, but usually with the application of heat.

Coloring or gilding of book edges is performed before the books are bound, or cased-in. For coloring they are usually placed on top of each other in stacks, and a solution of aniline dye is applied with a brush or a sponge while the books are under pressure. In some establishments the thin dye is applied by an air brush. Marbled edges are made by dipping the edges of the books in a trough or vat in which the marbling solution previously has been prepared from mineral or lake colors dissolved in water. When the edges are to be gilded the books are clamped on edge between two heavy pieces of wood, placed horizontally on a stand, where the edges are scraped smooth with a thin, flat piece of steel and sandpapered. After the size has been applied the gold leaf is laid on with heat and burnished by rubbing with a special hand tool. In some establishments the edges are smoothed by holding them, one at a time, against a small rapidly revolving emery wheel before placing the books in the frame. Similar grinding machines are used for smoothing edges of other bindery products, such as the better grade of playing cards, which also are gilded or, as found in one bindery devoted exclusively to the repairing of books, for removing dried glue from the backs of books to be rebound, after the old covers have been stripped off.

Artificial leather, supplied to the binderies by various firms, is used to a great extent for book covers. The material is usually treated

by the manufacturer with special preparations in different colors to imitate grained leather, though some of the binderies also do this. It is applied to the covers in the usual manner but, as a rule, the covers are heavily embossed and the designs embellished with gold or various colors, which are sprayed on them by means of air brushes. A frisket, or stencil, from which the parts to be covered by a certain color have been cut out, is placed over the cover and an air brush, which usually carries the color in a small cup or jar attached to the side, is moved over the exposed surface. The volume of the spray, which is forced out of the nozzle by compressed air, is regulated by the operator in the manipulation of the brush. A special stand is commonly used for this purpose, consisting of a low table, built with one or more stations to accommodate the required number of operators. These stations are separated by partitions extending from the table up to a hood that covers the whole table a short distance above it and is provided with a strong suction fan to carry off the fumes from the spray. After spraying, the covers are placed in drying ovens with hot-air blowers or other heating apparatus for baking them. Spraying in somewhat similar manner is also used for decorating beveled edges of greeting cards or for applying colors. Air brushes are usually handled by females, but the rest of the various operations in finishing are practically all performed by males.

HANDLING STOCK AND WASTE

Several establishments use endless belt conveyors for transporting the products from one operation to another, if separated and on the same floor. In a few of the large establishments stock and other material is handled on small motor trucks, but as a rule ordinary trucks, propelled by man power, are used for the purpose. Stock is often handled by hoists on track beams but a number of establishments use tiering machines, consisting of a table that can be raised from the floor to the desired height for loading or unloading, either by man power or mechanical power, or lowered as desired. The waste paper is handled in a number of ways. Many of the large establishments have chutes extending from the various floors to the bottom one, through which the waste is delivered into or near the baling press. A baling press is a rectangular box provided with channels for the baling wire, and is used to compress the waste paper into bales. The waste paper is compressed from time to time and, when the hopper is filled to capacity, the wires are fastened around the bale, which is then released. Various styles of baling presses are used, ranging from small ones, in which the waste is compressed by turning a crank or pulling a lever by hand, to large ones where the operation is performed mechanically by power, air, or water. Separate baling machines are used in the large establishments for white waste paper and in some specialty plants for waste from certain parts of the product.

SPECIALTY BINDING METHODS

In addition to these general operations there are a number of special ones which require certain methods and sometimes special machines. Among these is the manufacture of envelopes, which was the major product in three of the establishments inspected and part

of the work in three others. Envelopes are first supplied with text or illustrations, if required, on flat-bed presses or offset presses, then cut to correct shapes on die presses. If the envelopes are standard size, the die-cut blanks are placed on the feeding table of an envelope machine, where the gum is applied to the flaps of each envelope as it is automatically carried into the machine. It is forced into a folding box by plungers and shaped, while hinged folders turn the flaps and seal the three bottom ones. As the folders rise the envelope drops through a trap door on a moving endless track or chain, with the gummed top flap separated so it will not stick, and is brought in contact with a blast of hot air, which dries the gum. It is carried around nearly to the starting position, then automatically removed from the rack and placed in a trough with other finished envelopes, each twenty-fifth one being set a little out of line. The operator removes the envelopes in bundles of 25 or 50, wraps a band around each bunch and places it in a pasteboard box, which contains from 250 to 1,000. Different sizes require different machines, as each machine is built to produce one size only. Odd sizes and special kinds are folded and pasted by hand, but some factories are equipped with specially designed machines for making various envelopes for special purposes. In some shops the heavy manila envelopes for catalogues are folded by hand and run through a machine which gums, presses, and dries them. These may be gummed on the closing flap, left ungummed and plain, or provided with clasps or tension fastenings applied subsequently in special machines for that purpose. Some establishments also have special machines for attaching transparent paper over a die-cut opening on the face of the envelope, through which name and address can be seen, commonly called outlook or window envelope. Envelope machines are operated by female help, under supervision.

Another specialty operation is paraffin coating of paper, such as used for bread wrappers, butter wrappers, or similar products. One of the plants inspected was devoted entirely to this and some of the others were equipped with machinery for the same. The tissue paper to be coated, supplied in roll form and previously printed on with three colors from plates in the pressroom, is placed in a paraffin machine, where it is given a thin coat of hot paraffin as it passes over the coating rollers, supplied from a fountain in which the paraffin is kept melted. It may be coated on one side or penetrated and coated on both sides. The paraffin is cooled as the web passes over smoothing and cooling rollers that are connected with a refrigerating system, after which the web is cut into sheets of required lengths, that are delivered flat on top of each other. A similar machine is used in some plants for applying carbon ink, which consists partly of wax, to one or both sides of a web of paper, in the production of carbon paper, such as is used for manifold sales books or for typewriting. Paraffin machines are operated by males.

Folding paper boxes are also manufactured in printing trade plants and 13 of the establishments inspected included equipments for that purpose. After the sheets of cardboard or heavy paper have been printed, creased, and cut they are taken to the stripping department, where they are placed in piles on tables and the waste pieces of the sheet, which still cling to the cut-out shapes, are re-

moved by sharp blows with a mallet. The shapes are next placed in automatic box or carton gluing machines, which glue the boxes together; they are then put through a paraffin machine, if required. The majority of binding work on folding paper boxes is executed by boys and girls with supervisors overseeing the operation of the machines.

The gluing machines usually have bundle-tying machines attached near the delivery end. A bundle-tying machine automatically places a string around a small package, ties it securely, and severs the string from the spool in the machine. Bundle-tying machines of various styles are used extensively in binding establishments for tying up small packages, and in one periodical printing plant a large machine of special design was employed for tying bundles of periodicals.

PAPER SEASONING AND PREPARING

It is necessary at times, especially for color printing, to prepare the paper by submitting it to the same degree of temperature and humidity that prevails in the pressroom, an operation called seasoning. While this is sometimes done directly in the pressroom and by help connected with that department, just as paper rolls are sometimes handled by pressmen or pressroom helpers, the flat sheets are often seasoned in a special department in a large book and job or lithographic printing plant. It is executed by various methods. Some suspend the sheets on drying racks, attached to or near the ceiling, either stationary or with a rocking motion, others just pile them in stacks, while in some plants they are hung in a special seasoning machine, where warm air is blown upon them. Paper for steel plate printing, such as used for paper currency or postage stamps, requires a somewhat different treatment to dampen it before printing and to dry it thoroughly afterwards. The moistening is usually done by placing the sheets in small piles between wet cloths, but humidors are also used, and in one plant a special wetting machine was used for the purpose. Drying cabinets are used, in which heated air is forced through perforated pipes at one side and, with the accumulated moisture, out the other side to an exhaust duct. Large newspaper plants have a special staff of men to prepare the paper for the presses. The large rolls come wrapped in heavy paper, sometimes reenforced with burlap or canvas at the ends and protected by cardboards or wooden boards. These are removed before the rolls are placed in the presses, and after finishing the rolls the paper remaining on the cores, if any, is stripped off and sent to the baler. In small plants this duty falls on the pressmen or their helpers. Periodical, book and job, or other printing establishments that use paper in roll form ordinarily also have special men for stripping the paper and getting it ready, sometimes combined with handling the baling machine and waste.

Two of the plants visited were additionally operating departments that properly belong under paper making. One of them, a playing card factory, was equipped with several web pasting machines for combining two or more webs, several enameling machines for coating the web with wet clay and casein, and several calenders to insure a high gloss finish. The process used was similar to that

employed in paper mills, where the clay which is pure china clay, finely ground, is mixed with a thin solution of the casein (prepared from skimmed milk treated with acid) in large mixing machines, and placed in a trough on the enameling machine, in which a roller revolves. A roll of paper is placed in the enameling machine, and the web is carried over a drum, where it is coated with enamel solution by a cylindrical brush, which also operates in contact with the roller in the fountain. It then passes flat brushes that spread and even the coating, after which it is carried by blasts of hot air for a considerable distance to an automatic carrier, consisting of wooden slats attached to an endless chain on each side of the machine. The paper drops upon a slat, which is carried forward, permitting the web to fall in a long loop before dropping upon the next slat, when the operation is repeated. The paper is conveyed in this manner through the drying room, rewound in a roll and passed through a calender, consisting of a number of highly polished iron cylinders, placed on top of each other alternated with rolls of solidified cotton. They are set close together and revolve rapidly, furnishing the enameled surface with a high gloss. The paper is again wound in a roll and part of it is cut in a sheeting machine for use in sheet form. Some of the sheets are given an additional extra high polish in a plating machine. The other plant, a lithograph and offset printing establishment, also coated its paper with enamel and calendered it in a similar manner.

MAILING

The production of newspapers does not require a bindery department. While some of the large newspaper establishments had small job printing plants for their own work, the binding work in these was inconsequential and had nothing to do with the real product itself. In place of binding the newspapers are handled, after leaving the pressroom, by the circulation department, which includes the mailing room, another important factor. The major part of the work in a mailing room is done by hand. Papers are counted and distributed to carriers and newsboys, others are addressed with a hand-operated mailing machine, which cuts a slip of paper containing the address from a long narrow strip that is pulled forward over a belt, which applies paste to the reverse side of it, and attaches it to the paper by pressure from the operator. The address is sometimes pasted on a wrapper instead of on the paper itself, the edge of the wrapper pasted by hand and a copy of the paper rolled up in it, then placed in a mail sack. Other papers are tied by hand in bundles and loaded on trucks or wagons. Occasionally the issue of the day, especially Sunday newspapers, consists of more sections than the press is capable of turning out at one time and, in such case, the various parts must be inserted in each other to form a complete paper, an operation called stuffing. These methods are used on the smaller newspapers but some of the larger plants are equipped with mechanical devices to facilitate delivery. A number of mailing rooms receive the papers direct from the presses as they are printed by means of mechanical escalators, or conveyors, that deposit them on delivery tables at convenient points, and many of the rooms are

provided with endless belt conveyors which carry the tied bundles from the operators to the loading point or transport bundles around the room. Some are provided with an automatic wrapping and addressing machine, which folds each paper to proper mailing size, gums and places a wrapper around it, stamps the address, and pushes the wrapped paper over a table to the mouth of a mail sack. The papers are placed on the machine folded just as they leave the press, the wrapper is supplied from a roll of paper and cut automatically by the machine, while the address plates, which have previously been prepared in a stamping machine and placed in proper rotation in a long, upright receptacle, are automatically fed in a position for printing and afterwards deposited in another magazine. In one plant an automatic stuffing machine was also used for inserting additional sections.

Several periodical or book and job printing establishments are also equipped with conveyors for handling the products between different departments, or with spiral chutes for packages from the top floor to those farther down. In one plant the mailing room was located in an annex across the street and the product of several large inseting and wire-stitching machines on the first floor of the main building was raised by belt conveyors above the second floor and transported over a covered bridge across the street to a delivery table in the mailing room. Another establishment, situated across the street from a post office, has a large belt conveyor going through the plant, under the street, and into the post office, capable of transporting filled mail sacks. Some large periodical printing plants are also equipped with wrapping and addressing machines, while others use addressing machines only. The manufacture of addressing plates for the machines is usually performed in the office part of the circulation department by female help, on special machines for the purpose, provided with keyboards similar to those on a typewriter. A few book and job printing establishments make a specialty of mailing for customers but this, as a rule, is office work and is also handled by female help, while work in the mailing department of a newspaper or periodical printing plant is performed by men and boys.

INK GRINDING

Among various other processes that at times are found in printing trade plants is ink grinding, which was performed in 25 of those inspected, 20 of which were principally book and job printing establishments, 2 were rotogravure plants, 2 were lithographic and offset printing establishments, and 1 was a steel and copperplate engraving and printing plant. Two other establishments visited were small, separate ink factories, but each producing ink for use in a large book and job printing establishment and really a part of it, though located elsewhere. Different kinds of inks are made for the various styles of printing, relief, planographic, and intaglio, but each of these three groups is again divided into a great many varieties of composition and consistency. Inks for relief printing vary according to the kind of paper used, the style or speed of the press, and the quality of the work. Inks for planographic printing differ in composition for lithographic or offset printing, while in intaglio ink

there is a marked difference between those used for plate, die stamping, and rotogravure printing. Printing ink consists of a pigment or dye, usually produced by chemical precipitation, mixed intimately with a vehicle, which may be principally oil, varnish, water, naphtha, xylol, or a mixture of varied ingredients, and ordinarily with a dryer added. Large ink factories manufacture their own pigments, while the smaller ones usually procure them ready made and just mix them with the vehicle, or use stock inks, obtained from an ink factory, which are blended to required colors or shades and mixed with additional quantities of vehicle. Dry pigments are first mixed with the vehicle in a mixing or kneading machine, which stirs them together, after which the mass is placed in an ink mill where it is ground to proper consistency, sometimes requiring a number of runs through it. An ink mill consists of three horizontal rolls, steel or granite, which revolve at different speeds. The ink is fed between the rear and middle rolls and is carried by the latter around to the front roll, where it is scraped off automatically by a knife attached to a steel apron, over which the ink is delivered to a receptacle placed below. When ground sufficiently it is placed in cans or buckets for delivery to the pressroom, or in tanks located in the factory. Separate ink mills are used for the different colors, to prevent tainting. Some small plants use small tank mixers in place of kneading machines, and tank mixers of various patterns are also used for mixing rotogravure inks with additional solvents. A few places prepare their own varnishes by boiling, or burning, oils. Several of the larger plants maintain laboratories in connection with the ink department, where experiments are conducted and tests made, not only of the ink but also of paper or other materials used. Work in ink departments is performed by males only.

ROLLER MAKING

Another process is the manufacture of composition rollers for printing presses. Three of the establishments inspected, all large book and job printing plants, were provided with roller-making departments. One separate establishment of that character was also visited, belonging to a newspaper, and which had just been moved from the production building to another, located close by. A composition roller for a printing press consists of an iron core, the ends of which are fashioned into journals that turn in sockets attached to the side frames of the press, while the center is surrounded with a smooth layer of composition, which will distribute and apply the ink. Composition consists principally of glue and glycerin in varying proportions, with the addition of small quantities of special ingredients to provide necessary tack and resiliency. It is melted in a stationary melting kettle with a steam jacket, usually placed up high so the composition can be drawn from the bottom into a movable pouring kettle, which has a tight lid with attachment to an air compressor and a hose at the bottom attached to the base plate of the mold. The mold ordinarily used, and commonly called a gatling gun, consists of several steel tubes that are polished smooth on the inside, inclosed together in a water jacket so they can be heated or cooled easily. The old composition is removed from the roller core, which is painted or wound with twine and inserted into a tube of

required diameter. All the tubes are usually loaded, or, if empty, are plugged to prevent the composition running in. The base plate is fastened on the gun, which swings in a frame so it can be placed horizontally for loading and afterwards hung upright, and the gun is heated with live steam. The air pressure is next turned on the pouring kettle, forcing the hot composition up the tubes around the cores, to which it sticks. The heat is turned off and cold water is substituted in the jacket to cool the rollers, which are then drawn and trimmed at the ends to leave the journals free. Rollers are made in different sizes to fit the different styles of presses, and even with different diameters for the same press. Composition rollers are used for relief printing and a few for plate or die printing, but can not be used on planographic presses, on account of the water required in the printing method. The felt and leather covered rollers used for that purpose are ordinarily prepared in each plant by the pressmen. Rollers used for plate and die printing are usually made of felt and covered with fine woven cloth or with leather. A special, so-called rubber roller is used in some plants on both relief and planographic presses. One of the roller factories visited was equipped with an oscillating grinder for this style of roller, to reduce the diameter or smooth the surface. Roller making is handled by male employees.

AUXILIARY WORK

Some of the larger establishments were provided with laundries, equipped with washing machines, extractors, and mangles, for washing wiping rags, and even towels furnished to employees. One large plate and die engraving and printing plant had an additional large laundry for preparing and laundering plate printers' wiping cloths. This laundry was fitted out with washing machines, starching machines, and large drying machines that rewind the cloth.

A number of large establishments had their own machine shops for repairing the different machines used, and some also for experimental machine work, improvements, or new designs. Several also had electric repair shops, blacksmith, carpenter, plumbing, and painting shops included in the plants for their own work solely. A good many had additional power plants for generating power, either all or part of the time, and heat in cold weather. Others had heating plants only, and in some both power and heat were supplied by outside establishments.

HOUSING OF PRINTING TRADE PLANTS

Among the many factors which influence and determine the hygienic conditions of the printing trades are the very important ones of construction of the building in which the plant is situated, its location in the building, and the environment of the same. A number of large establishments occupy buildings erected for them and devoted solely to the business. Some are housed together with other similar or allied plants in structures built for the use of printing establishments only. Others are located in adapted factories which had been remodeled to suit individual requirements. Still others are domi-

ciled in combination office and factory buildings, while a great many small ones occupy small store buildings or dwellings.

Of the 536 establishments surveyed, 221 were located in buildings constructed especially by or for the firms and 185 of these occupied the entire building exclusively. The other 36 buildings erected for printing-trade firms housed additional establishments, either belonging to the firm but operated separately and performing one or more of the printing processes not executed in the main plant or consisting of a rival plant in the same line of production. A tendency was noted to separate some processes from the main plant where this could not provide sufficient work for continuous operation of the departments and operate them as individual concerns, which would allow them to take in additional work from outsiders. Among the buildings containing more than one establishment, 18 were partly occupied by 1 additional firm, 5 by 2 additional, 6 by 3 additional, and 3 by 4 additional firms, while 4 others housed, respectively, 6, 8, 10, and 11 additional firms, a total of 93 extra establishments. Besides the 221 buildings erected especially for these establishments but occupied by 314 firms, there were 9 buildings, previously constructed for other former printing trade plants, 1 housing 2 establishments, a second containing 3 plants, and a third occupied by 5 firms, while the 6 others were used exclusively by 1 establishment in each.

A structure erected especially for printing purposes would naturally be thought to possess all necessary qualifications, but a great deal depends on when the building was constructed. Old buildings that may have been model in their day do not come up to modern standards for factory buildings, and, even though changes may have been made to create more favorable conditions, they fail to provide suitable quarters for production of the work. An old building can not be changed into a new one, so far as construction essentials are concerned, and these limit the extent of remodeling. Among those inspected were found 25 buildings which had been occupied by their respective printing trade establishments for over 30 years, ranging up as high as 80 years. Expansion of business had in most of these cases necessitated additions to the original buildings from time to time, and each of these additions embodied the advancements in standards up to the time of construction.

Twenty-three of the establishments inspected were domiciled in converted factories, originally built for other industries and remodeled to suit requirements. Such buildings were often better from the standpoint of hygiene than some erected especially for printing trade plants, on account of more modern construction. The balance, comprising 183 establishments, occupied space in loft buildings, converted stores, or converted dwellings. Most of the processes in the printing industry require considerable light, and as the majority of them create more or less fumes or gases, ventilation is also of great importance. The structural features of the building have much to do with provisions for both of these factors, but in addition must also provide for the support of extremely heavy loads and be adapted to counteract the vibration created by the machinery. The trend in all industries is toward better factory buildings and the printing industry is no exception. This is not from humanitarian or philanthropic motives, but because employers realize that a well-

constructed building and healthful surroundings are essential for maximum production and, consequently, beneficial from a dollar and cent standpoint. In a number of establishments visited new and better buildings were in progress for housing the plants, including another important item, better surroundings.

The individual factory buildings occupied covered a wide range of structural designs, with single-story or multistory buildings, steel or mill frames, stone, concrete, brick, tile, or wood walls, and concrete, composition, steel and iron, wood-strip or wood-block floors. Book and job, or periodical, printing establishments located in the congested area of a city are usually housed in multistory structures and, in spite of the handicap created by surroundings, some of them are well adapted to the work. One multistory building in New York contained 15 stories, basement, and sub-basement, all occupied by one printing trade firm. Although located in the congested area it had the advantage of facing three streets, and as the adjacent buildings on the rest of the block were low, it had natural light and accessible natural ventilation practically all around. The building was erected 23 years ago, of steel, concrete, and brick, was of irregular shape, and contained about 15,000 square feet of space on each floor except the top one, which consisted of several saw-tooth projections on the roof over the fourteenth story. While not of the latest and most adaptable design, such a building was very suitable for a printing plant.

Another building in the same city, consisting of 12 stories and basement, also occupied by a single printing trade firm and located in another part of the congested section, was built on a corner, but as another building of similar height joined it on one side, it had windows on three sides only in the five top stories, and on two sides in part of the rest. It was erected about five years ago, of steel and concrete, with part stone and part brick facing, containing approximately 14,000 square feet on each floor. Plenty of air space was provided by 16-foot ceilings, and altogether the building was well adapted for the periodical printing performed in it. A large establishment in Philadelphia occupied practically all of a building containing 12 stories and a basement, covering an entire block, with floor areas of about 80,000 square feet each. It was constructed about 14 years ago, of steel and concrete with part marble, part brick facing, and tile walls. Almost one-third of the outside walls and those surrounding the large light court in the center were windows, which provided plenty of access for daylight and air from surrounding streets, two of which had parks on the other side. A covered driveway connected the court with the street. Altogether it was well suited for a printing trade building. Each city visited contained one or more buildings that were splendid examples of factory construction from an architectural as well as efficiency or hygienic point of view. One planographic printing establishment in Detroit had been occupying a six story and basement corner building, shaped irregularly like the letter C, facing two streets and two alleys. Shortly before the inspection it had completed an addition, which finished the building in pentagon shape with sides from 100 to 180 feet in length and a large court in the center, accessible through a covered driveway in one side, making approximate floor space of 30,000 square feet for each story. The older part of the building was brick

and mill construction of somewhat antiquated design, while the new addition was concrete and steel of modern type, but the whole structure gave a favorable impression. The natural facilities are, of course, improved where buildings are placed in less congested surroundings, even though in business districts. In Chicago, for instance, were found a number of multistory structures of various heights and of excellent construction, suitable for the printing plants occupying them, some facing parks and others facing the river or lake.

Buildings may be located where surroundings will permit access of light and air and be well or strongly constructed, but still not be in accord with modern factory ideas or printing plant requirements. An example of this was the largest plant in Washington, which was built very solid and substantial, containing eight stories and basement, with approximately 75,000 square feet of space on each floor. It covered approximately one-half block, with an alley on the fourth side. It was built of steel, concrete, and brick, but although only 17 years old, was not constructed with adequate provision for natural lighting except around the immediate outside part. In contrast with this was a large building in the same city, used for plate engraving and printing, which was of model design. It contained five stories and a basement, which really was the first story at yard level, though the main approach to the building was over a covered walk at street level, one story above. It covered an area over 500 feet long by about 300 feet in width, built in the form of a letter E but with four wings in place of three, providing three open end courts. It was constructed 11 years ago, of steel, reinforced concrete, and sandstone, with about 60 per cent of the wall surface consisting of glass, to minimize the use of artificial light. The building had the additional advantage of being surrounded by grounds and set back from the street at the rear, at ends of courts, and so received full benefit of all light and air.

Several excellent buildings of the single-story type, housing large individual plants and located in various sections of the country, were also visited. Some of these were even constructed without basement. There can not be any set rules for just what type of construction should be used, nor where a building should be located, as this must be determined in each individual case by the nature of the business and the amount of building space. The choice between a single-story and a multistory building depends largely on these two items. Several book and job, or periodical, printing plants had recently erected single-story structures, which gave the advantage of maximum natural light and permitted the product to be started at one end of the plant, either to be completed during its continuous movement in a circle around the room and delivered finished to a shipping room near the starting point, or to travel in a straight line through the various operations to a shipping room at the other end. While the single-story style was adopted 25 years ago, it did not become popular until recently on account of the large ground space required and the common idea that it was necessary for printing trade establishments to be located in the congested area of business sections of large cities. The modern convenience of transportation facilities, the increased use of the telephone, and the gradual change in ideas have

helped to make a change. While a number of plants are still situated in the main business sections, the tendency is toward moving to the outlying districts, where plenty of daylight and air can be obtained for the workrooms. Some of the larger establishments situated in outlying districts were of the multistory type, though of lesser height than similar ones located in business sections. There were also a number containing two stories, or with part of the plant in an adjoining single-story addition.

Newspaper plants are usually located in the business section and often housed in combination office and factory buildings. A gradual improvement is taking place and a number had recently constructed new buildings, many of which were erected for use of the plant only. In Philadelphia a visit was made to a newspaper which was preparing to move the plant into a new building. The old building, consisting of five stories, basement, and sub-basement, which had been occupied by the plant for over 56 years, was entirely inadequate. It was located on a corner, with composing room and stereotype molding on the fifth floor, photo-engraving department and editorial rooms on the fourth floor, newsrooms on the third floor, offices on the second floor, business office, mailing room, and rotogravure department on the first floor, paper storage and waste department in the basement, and stereotype foundry and pressroom in the sub-basement. The building was mill and steel construction, part brownstone and part brick. The top story was the height of two ordinary stories and contained plenty of air space, but did not come up to modern standards for a workroom, and the other stories gave a still worse impression, which was perhaps heightened by the fact that the whole place had been neglected on account of the approaching removal. The new building, which was decidedly different, consisted of three stories and basement, with an additional story over one end. It was intended solely for manufacturing purposes, though the fourth floor was at that time utilized for temporary offices and part of the third floor for newsroom. The rest of the third floor was occupied by the composing room, stereotype molding, and photo-engraving, the second floor by the rotogravure department, job pressroom, art room, and newspaper morgue, the first floor by the stereotype foundry, with a mezzanine floor over it for the circulation department, and the pressroom. The pressroom floor was four feet above the street level and the paper reel room under it formed the basement, extending five feet below the street level and provided with windows on all sides. The building was of steel and concrete, with brick and marble, 215 by 145 feet, and was the first unit of a large publishing building, which will occupy an entire block. Another very pretentious building was found in course of construction for a second newspaper in the same city, which was housed in two adjoining inside buildings, respectively seven and eight stories in height, with basement under both. These two buildings were entirely unsuitable for the work, although one of them had been erected especially for that purpose 29 years ago of steel and brick with terra cotta facing. The other, which had been acquired later, was still older and of mill and brick construction. Among the especially bad features in the joint building was the different height of floors, aside from the insufficient daylight

and the crowded interior. The new building will cover the entire block and has the novel feature of being built entirely over the depressed tracks of a railroad, on a ground area of about 70,000 square feet. It will consist of two sections, the front part of 21 recessed stories, which will be partly occupied by offices for the firm and rentable office space, and the rear section for the printing office, four stories in height. The materials are steel, concrete, brick, terra cotta, and stone. Newsroom, composing room, art room, photo-engraving, and stereotype molding will be located on the fourth floor, stereotype foundry and pressroom on the third floor, which is double the height of other stories in the building, reel room on the second floor, and paper storage on the first floor. The space under the building will be occupied by the railroad tracks and a freight platform, with elevators that will deliver the paper rolls direct from the cars to the storage room on the first floor.

In Chicago a very decided contrast was found between two large newspaper establishments. One was located in the loop district, fronting the elevated street car tracks, in itself an undesirable feature, shutting off light and air, besides scattering dust on surroundings. It was housed in two adjoining inside brick buildings and a third one, forming an L, of four stories and basement. These were among the first structures erected after the Chicago fire, about 50 years ago, one of them built for the purpose and the others converted to the use later on. The floors were of uneven height and the rooms were dark and dingy on account of building location and numerous divisions, together with overcrowding of space. Some attempts had been made to remedy unpleasant conditions, but the structural features would effectually prevent modernizing such a plant and making it a fit place to work. A radical difference was presented by the other establishment, which was located in a detached steel and concrete building, with brick facing, seven stories and basement. The main thoroughfare at that point of the city was level with the top of the second story, though streets were running below it at yard level. Seventh and sixth stories covered only part of the building, which was erected three and one-half years ago and was a model arrangement throughout, except the use of part of the basement for the reel room. The rest of the basement was utilized for paper storage and building machinery.

Other large model newspaper plants were visited, among them two in New York, one of which was housed in a 14-story and basement building, part of which had been completed shortly before the inspection and constituted an excellent plant, except for one thing, the location of the stereotype foundry and pressroom in the basement and the reel room in the sub-basement. The other establishment, housed in a new building, presented a new feature in arrangement for newspapers and will be referred to later in detail. Also, among the large, exceptional newspaper plants was one in Detroit, which occupied a partly three-story and partly four-story building, with the photo-engraving department on the fourth floor, the composing room and stereotype department on the third floor, offices and editorial department on the second floor, pressroom on the first floor, and reel room, with building machinery, in the basement. This building, which occupied about one-half block, facing

three streets, was erected about seven years ago, but recently was found too small and additional structures were placed on the rest of block, one story and five stories in height. Another large and model newspaper establishment, located in Kansas City, occupied a detached building consisting of three stories, basement, and sub-basement, erected especially for the production of the newspaper. One end of the three stories above ground was devoted to the editorial department and offices, while the other end housed the mechanical department, with composing room and stereotype department on the third floor, and photo-engraving department and mailing room on the second floor. The basement, which reached to the top of the first floor, contained the pressroom and engine room. The sub-basement was occupied by paper storage, machine repair shop, boilers, and building machinery. At the time of the visit a new addition was being erected on adjoining property to relieve congestion in some departments and permit installation of additional equipment. The undesirability of basement location for the pressroom was partly overcome by the extension of this to the ceiling of the first floor, making it two stories in height with good provision of windows.

Mill construction for building frames is, of course, found in many of the older structures but in the larger buildings it has been necessary to add extra reinforcements or braces, on account of increasing weight of machinery, stock, and workers, or even to replace the millwork with steel. Reinforced concrete and steel beams are now generally employed for large buildings, taking up less space and reducing fire risks. Where a building had large dimensions, such as some of those visited, which extended three or four hundred feet and had several stories, it had been necessary to place extra supports at intervals, for either walls or pillars, the size and strength of which control the load carrying powers of the floors. These, together with the wall construction, determine to a great extent the lighting facilities of the building, as well as protection from outside influences. They also affect the inside appearance and hygienic condition of the plant, besides controlling the layout. In modern multistory buildings the elevator shafts, with stairways, fire escapes, wash rooms, and lavatories are often grouped in the center of the structure, perhaps at the end of a light court.

The floors of the workrooms are also of considerable importance, though a number of different ideas prevailed regarding the utility of the various materials. In old buildings or small ones, the floors were usually of wood, sometimes with iron or steel plates laid over places where heavy trucking might damage the wood. An exception was found in photo-engraving establishments, in which part of the floors, as a rule, were covered with a layer of composition, or roofing material, to prevent the acids used from destroying the wood. The newer buildings usually had reinforced concrete floors, in some cases covered with composition, steel or iron plates, wood strips, or wood blocks. The quality of the surface affects the workers considerably, as they stand or walk around on it for several hours at a stretch. Where a straight concrete surface is used the compositors often place mats of linoleum or thin strips of wood between the cases to avoid the fatigue caused by nonresilient material. In some places

considerable complaint was heard about concrete surface floors; in others it was thought extremely suitable. Composition is considerably easier on the feet but renders it difficult to make any alterations, if necessary. Steel or iron plates are used extensively in stereotyping rooms and sometimes in newspaper pressrooms. A number of large plants had lately tried wood blocks and in the majority of those where they were noticed they were declared superior to any other. One case was found, however, where they had not proved satisfactory, a periodical printing plant, occupying a large 12-story building. The majority of the floors had been covered with wood blocks when built, about five years previous, and the blocks seem to have been jarred by heavy trucks, which had split a number of them. It is believed that the real trouble was caused by poor workmanship in laying the blocks, because in other places wood-block floors were observed that had been subjected to much harder usage and still appeared in excellent condition. A wood-block floor is unquestionably far easier on the feet of the workers than a concrete floor, and consequently more desirable from a health standpoint. A very undesirable feature was noticed in several plants where ordinary wood floors had been damaged. In place of taking out the damaged pieces and inserting new ones, other pieces of flooring had been placed over the damaged parts and nailed down, making a projection liable to cause workers to stumble. In similar manner entire aisles had been covered when showing wear from the wheels of trucks running over them. Even though the edges are beveled this is always a danger and should be avoided. The same thing holds good with pipes or other material projecting over the floor, even though covered with inclines. In modern buildings pipes, conduits, or similar material is taken care of by trenches in the floor bed, usually covered with metal plates that can be easily removed for access when required, and in removable baseboards.

There are a number of other details in connection with the building construction which affect the workers employed in the plant to a certain extent, such as vibration, which may create fatigue, method of driving machinery, ventilation and heating, sprinkler system or other fire protection, elevator service, and sanitary features. The States and the cities have special laws which partly control erection of new buildings and repair to old ones, but contain no radical departures for the printing trades from the requirements in other industries. In most of the establishments inspected request was made by the managers for information about any unhygienic conditions discovered, so they could be eliminated or remedied as far as building facilities would permit.

Smaller plants occupying their own buildings did not differ essentially in a general way from the larger ones. They were not, as a rule, supplied with as good natural light or chance for ventilation, because the buildings were usually situated on inside lots, admitting light and air from front and rear only. The work, however, was arranged mostly by the windows, and fumes or gases from the processes were so reduced in proportion to size that it practically evened matters up. Those who occupy rented quarters are, in most cases, handicapped. They are often located in old buildings, not specifically intended for printing, which do not have the best of

facilities. It is, in fact, often difficult for them to find suitable quarters, as a great many buildings refuse printing plants for tenants on account of noise or possibility of vibration. This situation has been ameliorated to a certain extent in several cities by erection of special buildings for the housing of printing-trade plants, constructed to meet requirements. One such building in New York, erected about nine years ago, consisted of 23 stories, basement, and sub-basement, occupied by a number of printing-trade plants, 12 of which were inspected. It fronted three streets and rose above other buildings on the fourth side, assuring ample light and ventilation. It had elevator shafts in the center, with hall between two sets of passenger elevators, freight elevators at one side, wash rooms, and lavatories, and was divided by a wall in two main sections with other subdivisions on some floors. A very heavy construction insured freedom from vibration throughout the building. A similar building in Kansas City, which was constructed about the same time, contained eight stories and a basement and was occupied by 11 printing-trade firms. It was located on a corner, with an alley on the third side and a vacant lot on the fourth, giving windows on all sides, was equipped with passenger and freight elevators, and was very suitable for the purpose.

In contrast to these two was another building, located in Cleveland, also erected for housing of printing trade firms but built 25 years ago. It consisted of eight stories and a basement, located on an inside lot but with an alley on one side and in the rear. It was in two parts, connected at one side with hallway and freight elevators, leaving a large court opening onto a private driveway from street to rear alley. The front part was occupied by offices, while the workrooms were located in the rear part. Some firms had offices on one floor in the front building and the actual workrooms on a separate floor in the rear building. Practically all establishments located in it, five of which were inspected, were crowded for space. The building itself was of steel, concrete, and brick construction but was considered dangerous by the fire department, and shortly before the inspection new fire doors had been installed on the top floor to eliminate some of the danger. Undesirable conditions may be created by unforeseen circumstances, such as took place in another western city, where a firm had completed a new building four months previous to the visit of inspection. It had been intended to erect a first-class building, to be partly occupied by the firm itself and the rest rented to other printing-trade establishments, but it was found necessary to curtail expenses and change plans somewhat. This resulted, among other things, in omission of the hot-water system for washing and in reduction of toilet facilities. The building was detached, daylight factory style, reinforced concrete and brick, six stories and basement. The first floor and part of basement were occupied by owners and the rest by other printing establishments. The changes in plans prevented the building from being considered first class, but it was declared by the owners to be 100 per cent better than previous quarters in an old rented building, from a hygienic standpoint. Very small plants can be found in various kinds of situations, even in private dwellings or in out-buildings near by.

There is naturally some difference between buildings located in northern parts of the country and those in the southern sections, but this is similar to what can be found in any other industry. Each locality has its own peculiarities to meet, such as extreme cold, excessive heat, or surplus of humidity, which to a certain extent require construction to minimize these conditions, but this applies to all buildings and no attempt has been made to compare one locality with another.

A great deal depends on what part of a building is occupied by a plant or by the different departments. Where a building consists of several stories and all of these are occupied by one establishment, it is usual to place on the top floor those departments that require the most light, such as composing or photo-engraving departments. There is no set arrangement and each individual plant adjusts this to suit its own requirements. It was at one time thought necessary to place all of the heavy machinery on the bottom floor, both on account of weight and vibration, but the application of scientific production methods and the increased stability of the buildings have resulted in changing such arrangements, so that now there are quite a few book and job printing plants or other establishments, even including newspapers, which are laid out according to a gravity system, starting the manufacturing on the top floor and proceeding in a straight line down through the building. Other buildings are not constructed sufficiently strong to stand such a strain and it is not unusual to see the upper floors occupied by departments which have light-weight equipment, regardless of rotation for work, such as binderies, while the pressrooms are located on the bottom floors. It is common to find a somewhat similar arrangement in newspaper establishments, with the composing and photo-engraving departments occupying the top floor of the building, sometimes with the stereotype molding added, the editorial and circulation departments located underneath, and the stereotype foundry with the pressroom on the bottom floor. There may be quite a distance between top and bottom, such as in one plant in Cleveland, where the first three departments occupied the fourteenth floor, while the last two were located in the basement, the intervening stories housing offices and stores.

The bottom floor in a newspaper establishment does not usually mean the street floor, but more often the basement or sub-basement. Among the 64 newspaper plants inspected, 24 were found in which the stereotype casting department and the pressroom were both located in the basement, one of them with a reel room in a sub-basement under it. In 17 others the basements were occupied by pressrooms, in one instance with an ingot casting furnace added, in another case with a reel room in the sub-basement and, in a third place, with roll stripping performed in the sub-basement. Four other establishments had reel rooms located in the basements and two had stereotype casting departments there, one of these with a reel room on a mezzanine floor above it and the other with a press in the sub-basement below. Another plant had an ingot casting furnace located in the basement, and one had the stereotype foundry on the street floor but the stereotype molding department occupied

the basement together with part of the pressroom. The rest of the pressroom in this plant was located in sub-basements, directly under each other, with the bottom one 55 feet below street level, although the building had only three stories above the ground. In a third plant the basement was occupied by a job pressroom and a photo-engraving department, while the stereotype foundry and the pressroom were located in a sub-basement under it. In 27 of the 64 newspaper establishments the stereotype foundry was placed in the basement, and in 44 of them the pressroom was similarly located.

Quite a few newspaper establishments had previously placed the stereotype foundry on one of the top floors in the building and the pressroom on the street floor, but the method of locating the various departments in consecutive order on a gravity line is a newly developed idea which ought to create better working conditions for the employees in the stereotyping and pressroom departments, aside from increased efficiency in operation. A building in New York, containing seven stories and basement, erected by a large newspaper about two years ago, embodied this plan. The top floor contained syndicate and feature departments, with assembly rooms, the sixth floor administration, business, and advertising offices, and the fifth floor editorial and news rooms. The fourth floor, where the mechanical manufacturing began, was occupied by the composing room, photo-engraving, and stereotype molding departments. The third floor, which had a 20-foot ceiling, contained the stereotype foundry and the pressroom. The second floor was devoted to the reel room and some roll storage. The first floor, at street level, was occupied by the circulation department, with mailing and delivery rooms, delivery area, and counter office, while the basement housed the engine room, building machinery, and paper storage.

Separation of processes, or some special operations in these, is often necessary on account of fumes or gases generated by the operations, special temperatures required, dust, or other conditions. As a rule the larger establishments separate composition, photo-engraving, stereotyping, electrotyping, presswork, and binding from one another, with additional further separation of operations in these. At one time it was a common occurrence to find book and job, or periodical, printing establishments located, at least partly, underground in cellars or basements. This condition is gradually disappearing, with a consequent result of improved hygienic conditions, since basements are not fit for industrial purposes, especially when fumes are produced. At the present time only a few, usually small plants, are housed completely in basements, though the actual percentage of such is larger than would be indicated by inspections in this survey. Only nine of those visited were domiciled in basements alone, six of which were book and job printing plants, performing composition and presswork but with binding additional in one of them, one a periodical printing establishment engaged in composition and presswork, one performing presswork only, and one doing plate and die engraving and printing.

The total workers in the printing trades in these nine establishments was only 108, ranging from 2 to 38 in one plant. One job printing establishment in Detroit was located in a seven-story office building in part of the basement, another part of which was occu-

pied by the plate and die engraving and printing plant. Each establishment was confined to a small space, extending under the sidewalk in front of the building. Small windows above the sidewalk and glass flooring in the same did not admit sufficient daylight, and ventilation was poor. Both plants were crowded and dirty, usually attendant conditions. A small job printing plant in Boston, located in the basement of an old three-story dwelling, consisted of a hand composing room in front, which received some light through the door at bottom of steps and a window, and a pressroom in the rear, which had no windows and with ventilation through a door from the composing room only.

There are, however, a number of buildings in which one or more of the working operations are performed in the basements and this was the case in 70 other establishments visited, though with considerable variation in the arrangements. In 21 of them the ingot casting furnace was located in the basement, to isolate the fumes from it, together with dross furnaces in three of them and with monotype casting machines in one other. Seven offset printing establishments had placed graining machines in the basements, on account of noise made by these, with stone planers additional in two of them. One rotogravure printing plant performed grinding and plating of cylinders in the basement, one photo-engraving plant used its basement for wood trimming, another for etching, routing, and blocking, while a third had a small chemical mixing room in part of its basement, and one book and job printing establishment had its entire photo-engraving plant located in a basement. Five basements were occupied by stereotyping departments, one by resmelting of metals for stereotyping and electrotyping, and two by metal mixing for the type foundries occupying the buildings. Presswork is the process most commonly domiciled in basements and was found in 28 of the establishments, accompanied by bronzing in two of them and a varnishing machine in one. Binding work, including folding, trimming, gluing, calendar tipping, die cutting, embossing, carton manufacturing, or in 6 establishments all binding work for the plant was performed in basements of 17 plants, ink grinding in 8, carbon paper manufacturing in 1, and composition roller manufacturing in another.

One of the largest plants found which performed most of its work in the basement was located in a corner building, consisting of two parts, each 120 by 130 feet approximately, six stories and basement. The first floor of the front building was occupied by offices and the composing room, while the basement of the same contained the pressroom and the basement of the rear building was occupied by the bindery. The two basements, with floor about 6 feet below street level, were connected by a 20-foot-long runway under a court between the two building units. Both basements had windows above the sidewalk, but these did not admit sufficient daylight for the work, especially where obstructed by machinery, and the facilities for natural ventilation were bad.

Some of the basements in newspaper establishments were two stories in height, reaching to the ceiling of the first story, to accommodate the tall presses used in these plants, and were provided with large windows, which created better conditions as far as light or natural ventilation was concerned. This condition prevailed in

22 of the newspaper pressrooms surveyed, including stereotype foundries in two of them, and also in one book and job printing establishment, where composition, presswork, and binding were being performed in one room. In others the first floor was raised above the street level, permitting windows above the sidewalk, sometimes assisted by cutouts in the sidewalk to accommodate larger windows. In the various workrooms located in basements, windows were found in 3 hand composing rooms, 1 monotype casting room, 4 rooms for ingot casting furnaces, 3 for offset plate grainers, 2 photo-engraving rooms, 1 job stereotype room, 1 mixing room for type foundry metal, 19 pressrooms, 3 ink-grinding rooms, 13 bindery rooms, 11 newspaper stereotype foundries, 11 newspaper pressrooms, and 1 paper reel room. In summarizing the various departments or operations located in basements no cognizance was taken of paper storage, cut or plate storage, laundries, engines, boilers, air compressors, refrigerating plants, pumps, waste balers, knife grinders, dressing rooms, washrooms, or lavatories.

A vast difference is often found in the appearance of the various departments of the same plant. Part of it may be excellent and a general view of the establishment may be good, while some of the departments will, on close examination, reveal undesirable features. In the summary of tabulation (p. 228) is given, under the head of "Building: appearance," the general impression derived from the plants surveyed, showing 24.1 per cent classed as good, 47.2 per cent as fair, and 28.7 per cent as bad. The term "good" indicates that all of the establishments gave the impression of being suitable physical environments for the workers, while "fair" means that part of the plant appeared good but some of it did not, or that all of the plant was open to slight criticism. The term "bad" is used for establishments in which the unsanitary condition, poor lighting, or poor ventilation prevailed to such an extent that it was immediately visible at a glance. It is, of course, easy to criticize and, while all possible efforts may be made to improve conditions, the handicap of an old or unsuitable building may frustrate attempts to carry improvements to desired points. Conditions are in general getting better each year, both through the evident desire of a number of employers to establish and maintain model plants and through educational programs of the workers themselves for better environments and closer observance of health rules, assisted with legislation and with regulations by the various State and city departments.

The appearance of some parts of an establishment which at first sight was thought to be good later showed surprising neglect. A job printing establishment in Richmond, for example, was housed in an old, two-story and basement, remodeled warehouse. The office was located on the first floor, with composing room and job presses back of it. All of this floor was well arranged and looked good. The walls were nicely painted, floor and equipment looked clean, the light was good from windows in two sides, and the working space seemed ample. The second floor, which was used for storage, looked dirty and disorderly. The basement, where the cylinder pressroom and bindery were located, was crowded and messy looking. The walls in it, as well as on the second floor, were dirty. The light was good in the bindery department, from a skylight, but bad in the pressroom. Paper trimmings were scattered all over the pressroom,

kicked in from the bindery, where they had been previously thrown on the floor by the side of the paper-cutting machine to be swept to a narrow stairway leading down into a sub-basement containing waste baler, ingot metal furnace, and boiler. It looked as if the part which might be open to the public gaze was kept up well for the sake of appearance, but that health and comfort of the employees were minor considerations. Plants with similar characteristic variations were observed in nearly every city.

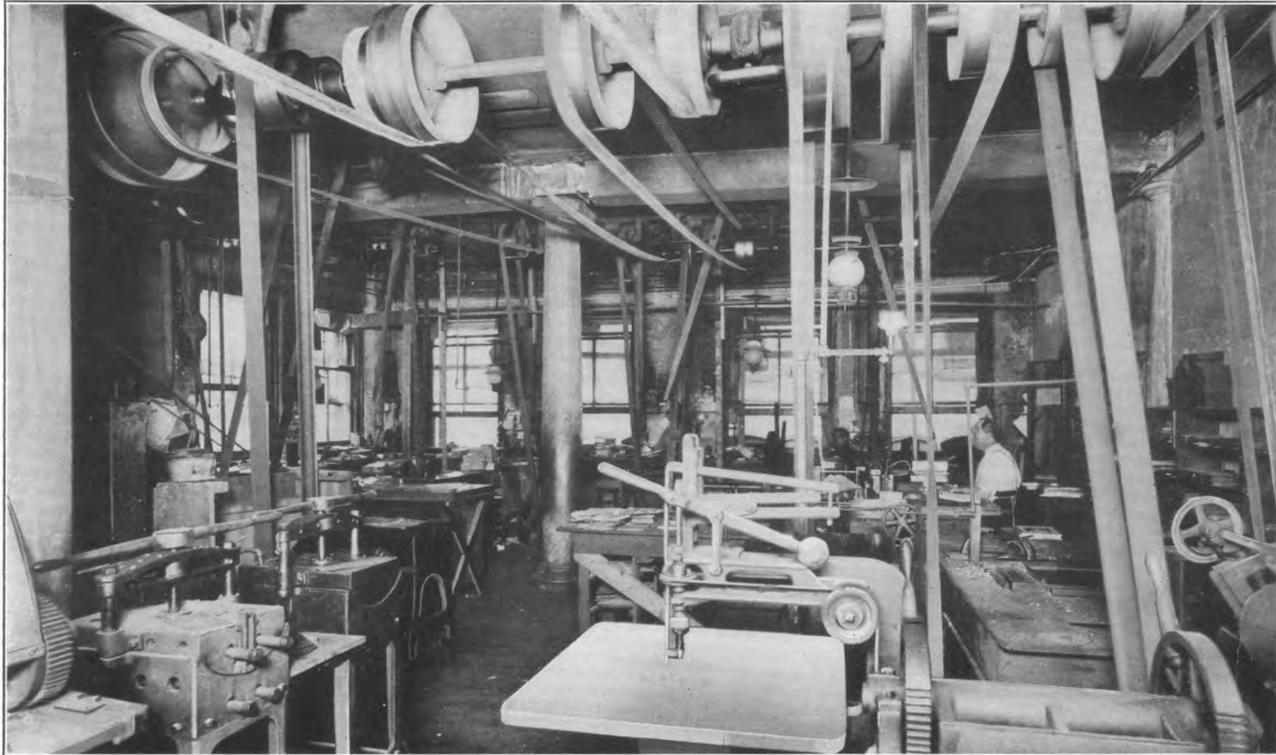
A surprising difference in appearance was also found in otherwise very similar plants, even in the same building, such as presented by two small establishments, each renting part of the same floor in a building partly occupied by a large newspaper and a large book and publication plant. One of them occupied a corner, separated from the main room by a partition, most of which was covered with shelving. Stock was scattered along the shelves and also at various places in the room. The office part occupied one end of the room, followed by hand composition, which contained some type cases but also separate drawers with type, stacked on top of one another on the floor. Some small platen presses were located at one side in the center and a paper cutting machine at the other end, with tables, etc., in the rest of the space. One wall contained a number of windows, but the daylight was feeble on account of the dirt on the panes. Incandescent bulbs with reflectors were used and they also looked very dirty. The entire room, including the office part, seemed entirely neglected and unsanitary. The other plant was altogether different. It also occupied a corner, similarly separated from the main room by a partition, but was clean and orderly. Walls and partitions were painted a light gray. A hand railing had been placed through the center of the room, dividing the office part and composing room from the platen presses. The type was kept in nice looking cabinets, the presses were clean and, although the room was not so well supplied with windows as the other plant, the light was far better because the windows were clean. Artificial light was supplied, if needed, from incandescent bulbs with large diffusing globes. The shop gave a nice, cheerful impression, distinctly a relief after the depressing influence of the other one.

The environment of a building exerts a great influence and affects conditions materially. If located in the congested area of a large city, it is naturally subjected to the obstruction of light due to narrow streets and surrounding tall buildings, which often also prevent proper ventilation. A very large establishment may overcome this partly by having a building which towers above the adjoining ones, just as a smaller plant may by obtaining a location on the top floor of a tall structure; but the natural light and air decrease rapidly as the location is shifted down toward the ground. In some cities the streets are extremely narrow and ground space is too valuable to permit setting the buildings back from the property line and, consequently, quarters near the street level become decidedly disagreeable, from a hygienic point of view, for any industrial plant. This question has been solved by many large plants by moving to outlying districts where property is cheaper and buildings can be constructed that will admit light and air freely on all four sides, which is really the ideal condition. A number of managers declared, how-

ever, that location was of first importance and it was necessary for them to remain in the business area of the city, close to the source of business, consequently they were compelled to put up with the undesirable conditions.

A great deal depends also on the working space in the establishment in proportion to the number of people employed, amount of equipment, and quantity of work performed. There is practically always continual change in this relation. A small plant will start up in what seems to be far more space than required but, as business grows and more equipment is added, the quarters become cramped and the working space crowded. Additional quarters are secured in the same location, or the plant is moved to another place that seems ample at first, but sooner or later the same thing takes place again. This is a common occurrence among printing-trade plants, where most of the large establishments have evolved from small ones and in comparatively short time, especially in the book and job or the periodical printing branches. The same thing also holds good with newspapers, which increase so rapidly in both circulation and size that they outgrow their facilities quickly, and what was thought to be more than sufficient quarters or equipment for a long time ahead must be added to, or exchanged. Several of the plants surveyed were congested by constant addition of machinery. A modern plant has the machinery arranged thoughtfully to make as near as possible a continuous line of progress for the work, but quite a few plants were seen where the equipment was placed in any spot that offered available space without regard to correct location. This may be partly a question of efficiency, but it often also becomes a point of hygiene through placing in certain localities equipment that creates fumes which may affect other workers, or through making it necessary to arrange equipment so that vision will be affected. Some plants were found that contained ideal arrangements, with the floor marked for aisles and with fixed spaces for certain portable accessory equipment, such as trucks, rolls of paper, etc., and instructions were posted to keep aisles clear. In contrast with these were others where a number of aisles were blocked and workers could not move around without hitting against a pile of material, sometimes upsetting part of it, or where balconies or galleries had been placed in the room to take care of additional equipment or material. Storage space for material, both new and finished, is a very important factor and considerable of the overcrowding in workrooms is due to insufficient quantity of room for storage. This is often the case on a newspaper that has reached the limit of space, especially in the pressroom, where large rolls of paper may be placed around in all available nooks, reducing the cubic contents of air in the room considerably.

Several places were found that required daily supplies of rolls, and in one establishment the space was so limited that only a day's supply could be squeezed into the building. If the size of the edition was changed unexpectedly, it was necessary to remove the paper in the room and haul it back to the warehouse, then supply the proper size instead. This, of course, again looks like a question of efficiency but is so closely allied with hygienic conditions that it should be considered from such a point. Overcrowding reduces the air of a room,



OLD METHOD OF BELT DRIVES AND OVERHEAD SHAFTS IN AN ELECTROTYPING PLANT

the light is retarded, and sanitary conditions also suffer, because proper cleaning is out of the question. In addition there is a possibility of creating drafts through open doors or passageways, where material is brought in at all times, which may affect the health of the workers. Some plants are well equipped with commodious quarters for storage, both of material and finished products, such as some large book-publishing establishments in Boston. The summary of tabulation (p. 228), under heading of "Working space," shows 70.3 per cent of the plants surveyed classed as having ample working space and 29.7 per cent crowded. Ample is meant to imply that there was sufficient room for the workers to move around and perform the work in an efficient manner, while crowded is used only for those establishments where the work or equipment occupied so much floor space that the execution of the operations was hampered and cleaning was made difficult. It is, of course, a constantly shifting condition, and a plant which was crowded during the time of inspection may have changed to more commodious quarters since then. The crowding may also not be apparent except on close inspection, such as was the case with the largest book and job printing plant in Washington, which seemed to have plenty of room but in reality was very congested and did not have sufficient space to handle the large amount of work turned out. A large plate-printing plant in the same city was also suffering from the same complaint and overcame it to a certain extent by moving part of the work into a building formerly occupied by it and located close by. That structure is, however, not so modern and consequently it constituted a backward step for the workers who were changed to the old building.

The application for motive power was taken into consideration as affecting the health of the workers. At one time all power for driving the various machines was generated at a central point by a steam or gas engine and transmitted by belts to line shafts with pulleys, usually placed near the ceiling but sometimes under the floor, then by belts from the pulleys to countershafts or to the machines. Later the motor was substituted for the engine or, in some cases, added to it but still used with line shafts and belting until about 30 years ago, when the individual motor system was introduced. Today the majority of printing trade establishments use the individual motor-drive system exclusively, one motor to each machine, with either belt, chain, gear, direct connected, or friction drive. This has resulted in eliminating the hangers, shafting, and overhead belts, which obstructed and retarded the diffusing of light and accumulated or scattered dirt or oil, and has permitted better lighting and cleanliness, aside from the flexibility in layout which admits of the placing of the various machines in the most advantageous manner for better light, etc. It has also proved very valuable in reduction of accidents, through the individual control of machines as well as through the safety attachments and automatic devices for the protection of the operator, the machine, and the electric equipment. A few plants still use collective drive for all of the equipment and some drive small groups of machines, usually in the bindery, by a single motor and collective belt system. In the summary of tabulation (p. 228) is shown, under the head "Motive power," the division of the establishments surveyed into three classes. Individual motor drive was used exclusively in 76.7 per cent of the plants, old-time collective belt drive in

only 3.5 per cent, and 19.8 per cent used both. In the latter class the majority of equipment was driven individually in 65 per cent of the establishments and collectively in 18 per cent, the remaining 17 per cent being about equally divided. Several proprietors explained that they were eliminating collective line shaft drives gradually when replacing old machines by new ones.

Safety guards on machines affect the health of the workers to a certain extent through moral influence, aside from the prevention of accidents, so the plants were inspected closely for condition of these. They were divided into three classes, under the heading "Safety guards," in the summary of tabulation. "Good" means that all reasonable precautions were taken to guard dangerous machinery, regardless of existent State laws; "fair" means that part of the plant was provided sufficiently with safety guards but all of it was not; while "bad" indicates that all, or practically all, of the establishment was neglected in that respect. The summary shows that 57.5 per cent of the plants were good, 31.5 per cent fair and only 11 per cent bad as to condition of safety guards (p. 228).

LIGHTING—NATURAL AND ARTIFICIAL

The majority of the operations in the trade require close application and abundant light, making adequate daylight facilities in all parts of the workrooms highly desirable to keep the vitality of the workers at the maximum and to minimize eyestrain. Aside from the benefits to the workers themselves it also means increased production for the employer through greater accuracy in the workmanship, and a substantial saving in artificial light bills. A printing-trade plant should be constructed so as to admit the maximum amount of daylight, reaching to the center of the room and distributed so it falls as uniformly as possible on the working surfaces from a proper direction. This idea has been carried out in a number of modern plants, where the maximum ratio of the floor space to window area is often four or five to one. Many plants are built in the open, admitting of windows on all sides, some of them reaching nearly to the ceiling. In a congested area of a large city it is usually difficult to obtain desirable conditions, because permanent daylight can be secured only where the building is bounded by streets and alleys, protected by ownership of adjoining properties or placed back from the property line. Light courts and light wells are also employed as an expedient, though not always successfully. The top floor of a multistory building is usually supplied with skylights, mostly of the saw-tooth style, which face north, giving uniform light and no sun glare or heat. Some have hip, monitor, or flat skylights, which require protection from sun glare on clear, sunshiny days, reducing the benefit of the light. Several examples of multistory construction were given in the description of buildings, both good and bad. Quite a few photo-engraving plants were provided with large skylights in the galleries, notably one direct gallery in Chicago, where both sides of the two-story room were glass and the front (glass also) ascended in a curve up over the top. Others in the same city had long sloping glass fronts and glass tops in the direct gallery, providing splendid light.

Practically all of the buildings of the single-story type were found provided with saw-tooth roofs which, together with the windows, made the inside of the plants as light as if there were no obstructions. One in Richmond was visited one afternoon in December and, although it had been raining up to noon and the weather was still gloomy, there was not a single artificial light burning in the plant, which had ample daylight. Similar conditions were found in that class of structures in Atlanta, Louisville, Indianapolis, Chicago, Philadelphia, and New York, as well as single-story parts of large plants located in outlying districts, which sometimes housed the majority of the operations. One establishment in Chicago had just before the visit completed such an addition, 120 feet square, consisting of three glass sides and provided with a saw-tooth roof. A number of top floors in some excellent buildings, two or more stories in height and likewise situated in outlying districts, also were equipped with saw-tooth roofs, eliminating the use of artificial light in the daytime. One such structure, located near New York City, situated on an 18-acre plot and consisting of a main building 450 feet long and, at each end, a right angle wing 200 feet long, had abundant light on the two floors, and even the basement which extended above the ground level and had good-sized windows was well lighted. No spot in the building was 40 feet distant from a window.

The building facilities may be sufficient and the daylight be obstructed by equipment or inside arrangements. This was observed on some floors of multistory buildings in New York, which had a number of large presses arranged around the outside of the rooms. The presses, which reached nearly to the ceilings, prevented the light from getting beyond them and made it necessary to use artificial lighting in the center of the rooms, and even for the back part of the presses. In one newspaper establishment in Denver a battery of about 20 line-casting machines was placed right in front of a large window extending across the building, shutting off the main source of daylight from the rest of the room and necessitating use of artificial illumination at all times. In some plants balconies or galleries had been added to increase available floor space and these usually obstructed the light to a certain extent, spoiling the lighting facilities originally provided for the building. The same held good with partitions erected that were not in the original plan and layout of the plant. In several cylinder pressrooms it had been found necessary to place curtains around the delivery ends of the presses to prevent the wind, created by the fly, from disturbing the paper on another press located behind it and too close to it. These were often hung from the ceiling and obstructed diffusion of daylight.

There is considerable difference of opinion regarding the best quality of glass for windows. Some prefer rough or translucent glass, partly to prevent the workers from being distracted by activities outside of the building. It breaks up direct light beams, diffuses them in all directions, and is very good where there is a large amount of exposure to direct sunlight, but has less lighting efficiency than clear glass. Others favor the clear glass, on the theory that the eyestrain is felt less by the workers when they can obtain a distant view at will. The majority of modern buildings are provided with

wire net glass, which differs very little from the plain varieties in light transmission but is often required by building and fire ordinances.

Window shades are often necessary to avoid the direct glare of the sun. Some plants are found that seemed to have solved the question satisfactorily, especially one in Louisville and one in New York, which were provided with shades consisting of translucent strips that let the light through but killed the glare. Others used ordinary roller shades, which retarded the light more or less, and a decided difference was presented by some establishments where the windows were not equipped with shades and the workers had pasted sheets of paper over them or hung these on strings inside the windows. Two places were noticed that had covered the window glass with green opaque paint to exclude the direct rays of the sun, and in some the same proceeding had been followed with the glass in the skylights.

It is naturally necessary to clean the windows at intervals to preserve good natural lighting but, while the result plays a prominent part in transmission of light, the subject belongs properly under the head of "State of cleanliness," where it will be referred to.

The placing of machines or working tables determines the relative position of the operators, or other workers, toward the windows. Authorities agree that facing the direct source of light creates additional eyestrain. The majority of plants try to arrange the machines and worktables so that the workers will be placed sideways to the windows, but in adding new equipment, especially in an establishment that has not reserved vacant space for that purpose, it is at times very difficult to do so. Consequently the workers were often found facing the windows, particularly in crowded plants, or placed so that they obstructed the light from other workers. It was claimed by many that it was absolutely necessary to certain operations to have the workers face the windows, such as copperplate and steel-die engravers, reetchers, and finishers of photo-engravings, or electrotype finishers. Plate and die engravers were usually placed facing the north light and provided with tissue-paper shades on the windows to prevent glare of the light on the highly polished working surface. In one plant individual steel booths were provided, in which the closed ends were supplied with large circular openings covered with tissue paper. In another plant a shadow board placed across the window above the tissue screen was claimed to enable the engraver to see the incisions better. This is an operation usually performed with the aid of a magnifying glass, creating considerable strain on the eyes. Reetchers and finishers in photo-engraving establishments were ordinarily found facing windows which were not screened for this work, but in a few places they were seated at desks placed sideways to the windows and seemed to perform the work just as efficiently. It may be merely a matter of custom, possibly originated through former inferior lighting facilities of the buildings, which did not furnish the required strong light except right by the windows. Or it may be a question of space, as tables for workers facing the windows do not occupy so much room as tables placed sideways for a similar number. This was emphasized in one long narrow room occupied by finishers, in which the tables were placed sideways, except in the center part, where the elevator

shaft projected into the room and made it too narrow to accommodate the tables in that position. Two of them had been placed against the outside wall, consequently making the workers face the windows. Magnifying glasses are used extensively in this operation also, which involves considerable strain on the eyes.

Electrotype finishers were, with a few exceptions, seated at long tables or benches placed against the outer walls of the building, facing the windows. It was claimed by a number of the finishers that such a position was absolutely essential to secure the proper reflection of light on the work, but those who were seated sideways seemed to get along just as well and the same causes may be responsible for the method in this operation as for the photo-engravers. Wood engravers and brass die engravers were customarily seated facing the windows, but designers and artists for photo-engraving, or similar work, usually preferred the light from the side. The majority of others facing the windows were bindery workers, mostly engaged in handwork, which often in the smaller plants is located temporarily in any available space.

There is another important factor in proper light diffusion which affects not only the natural lighting but also the artificial illumination. The treatment of walls, ceilings, and columns plays a more prominent part than is commonly realized. The upper portion should be painted with a light color to render the light more effective and better diffused. The lower parts should be of a color which is restful to the eyes, preferably a subdued tint. White is an ideal color, because it excels in reflecting power, ranking at about 80 per cent. Other colors range from 65 to 40 per cent for the yellows, according to darkness, 35 for pink, 25 for blue, 15 for green, 12 for dark brown or blue, down to a little over 1 per cent for black. A building may have the maximum amount of window space and the best type of skylights, but the benefits are lost if the walls, ceilings, and columns absorb the light instead of reflecting it, and more or better lights are also required at night for illumination. If a building does not possess the best of facilities for daylight or sufficient artificial light the loss is even larger. The main reasons for using a darker paint for the lower portion of the wall, probably five feet from the floor, are because this part is easily soiled and because the refraction of light is not so necessary near the floor.

There is a great deal of difference of opinion regarding the merits of a gloss surface and a dull surface paint, but the first probably excels for convenience in cleaning. An ideal surface was presented in some plants by white glazed walls, used particularly in several of the large newspaper pressrooms, which reflected light efficiently and were easy to clean. A substitute—white enameled brick—such as is used in the largest plant in Washington and in quite a few other places was also excellent. A large and superior looking plant in Cincinnati was using a white gloss paint, which was waxed after drying and permitted washing when dirty, was then waxed again, and repainted next time. Similar proceedings were revealed in several places, while in other establishments the walls were repainted yearly, as in these cases effort was made to obtain the maximum efficiency of light. Cold-water paints had been tried in some establishments. While they are white they are very unsatisfactory, be-

cause they can not be washed, have a tendency to scale off and drop into the machinery or on the work, absorb moisture, and soon turn from white to gray. The walls of one two-story building in Milwaukee, which had been painted with cold-water paint some time previous, appeared a dirty gray and reduced the light efficiency about 30 per cent. Several of the older buildings were finished with dark colored wood that absorbed a great deal of light. In one establishment, occupying a two-story detached brick building in Richmond, walls and ceilings were covered with wood finished in a dark color, necessitating considerable artificial light (in spite of the windows in all four sides of the building) which could have been practically eliminated if the interior had been painted white. In another plant, located in Pittsburgh, the composing room occupied the third floor of a five-story building. The majority of the room was well illuminated, but the tall wainscoting around the room, the ceiling, and the long balcony at one side (all of wood and finished in dark color) absorbed a large quantity of the light. A third establishment, occupying a six-story corner building in New Orleans, had the walls painted white, but on one floor these were almost covered with dark-colored wood cabinets, which absorbed most of the daylight, requiring the use of considerable artificial illumination in daytime, and the other two floors used for workrooms were in an almost similar condition, though more of the walls were exposed. White on these cabinets would have reflected sufficient light from the windows on the three sides of the building to practically eliminate all artificial light in daytime.

Daylight is much to be preferred, under ordinary circumstances, to artificial light, not alone from the effect on the eyesight, the general health and vitality of the workers, and the efficiency or accuracy of their work, but also from the fact, shown by statistics, that industrial accidents are more numerous during December, when the largest quantity of artificial light is used, gradually decreasing up to July, when there is most daylight, and then increasing again up to December. In this survey the establishments were divided into three classes for condition of daylight lighting—good, fair, and bad. "Good" means that the daylight was sufficient under ordinary conditions for the trade work performed in the establishment, "fair" means that it was adequate in part of it but not in all, while "bad" means that it was entirely insufficient. In the summary of tabulation (p. 228), under heading "Condition of light" and subhead "Natural," it is shown that 40.9 per cent of the plants were good, 40.3 per cent fair, and 18.8 per cent bad, while 8 of the establishments worked nights only, so were not considered in the classification.

Artificial lighting is very important in the printing industry, as many of the establishments work at night and a large number use artificial illumination during the daytime on account of inadequate supply of daylight. The quantity is usually sufficient, but the quality is often neglected. The quality depends on the kind of light used, its intensity, absence of glare, and adjustment with respect to the workers. About 29 per cent of the establishments surveyed were engaged in night work, ranging from a small percentage to the entire production. In one-third of these the output at night was 50 per cent or more of the total production, ordinarily performed in

two shifts, though a few plants were on a continuous operation basis. A number of others were operated occasionally at night in emergencies, but too spasmodically and seldom to figure, while some did no night work at all. The operations in the printing trades require sufficient illumination at the various points where the work is done to see the finest detail without straining the eyes and to make adjustments on machinery with facility and safety. At the same time it is necessary to have sufficient illumination in the entire room to distinguish all objects clearly and not form any violent contrast with other parts of the room. Insufficient light is very injurious to the eyes and affects the general health.

There is no need to guess at locations for placing the lighting units in a plant, because these can be scientifically ascertained to suit requirements. Each room may require its own individual standard, according to the equipment it contains, the work to be done, the height of the ceiling, and the color of walls, and this can easily be determined by a competent illuminating engineer. Electric light has practically replaced gas in industrial plants, creating better hygienic conditions, as gas lights consumed a quantity of the oxygen in the rooms, added to the impurities of the air, and raised the temperature considerably. Of the plants surveyed, 524 were equipped with electric light in some form, though 23 of them were supplied with auxiliary gas lighting systems and 19 were partly using mercury vapor lamps. Six other establishments were equipped with gas lamps, three or four mantle type inclosed in large globes, and two of these plants were also supplied with a few electric bulbs. Six additional plants were mainly lighted by mercury vapor lamps, though using electric lights also in some parts of the buildings.

Some of the establishments, especially those equipped for night work, had splendid installations of both indirect and direct types, with fixtures located so no shadows were observed on the working surfaces. The majority of plants were equipped with ordinary transparent incandescent bulbs, single or in clusters, mostly provided with shades, but some without. Indirect lighting is, of course, an ideal system and prevents glare. Diffusing globes, surrounding the bulbs, also render a soft, pleasant light. A great variety of shades and reflectors were used on ordinary bulbs, some good and some bad, and in a number of places frosted bulbs were used. The common cone-shaped tin reflectors may not be very ornamental, but, if the light is placed at the proper height, this style is far preferable to some of the more fancy shades used, such as those consisting of transparent ribbed glass, because where these are used it is necessary to hang the lights low, and they invariably throw a strong glare into the eyes.

The largest plant in Washington was equipped with large transparent shades, which were gradually being changed to large diffusing globes, suspended by chains from the ceiling, that provided ample and soft light. The shades in this case did not produce so much glare, but as the lights were placed too close to the ceiling most of the rays were directed upward through the shades and not sufficient light was projected downward in proportion to the size of the unit. A similar instance was found in the Middle West, in a building erected shortly before by a printing firm. The architect had selected some special globes of transparent, ribbed glass with flat

tops and spherical bottoms, in which the bulbs were inclosed. The globes were placed near the ceiling and looked very decorative but were absolutely useless for giving light on the work. Most of it was thrown on the ceiling and it was necessary to use drop cords supplied with bulbs and ordinary tin reflectors to enable the operators to work. A few of the establishments showed considerable disregard for, and neglect of, lighting facilities. One establishment in Philadelphia, occupying the second floor of an inside building, practically all one room, which had from 100 to 400 employees, according to season, was equipped with naked, incandescent bulbs, only a few of which were provided with shades. The room was dark and gloomy and it was necessary to use lights, except close to the windows at each end. Some of the workers had tried to lessen the glare from the bulbs by placing paper shades around part of them. An auxiliary stereotype foundry and pressroom to one of the newspaper establishments in Detroit, located in the basement of a separate building, revealed a very bad condition. The plant was operated only on Friday and Saturday nights and the lighting system had not been kept in proper repair, making it necessary for the workers to string cords around the room to replace lights that were out of commission. The workers employed did not care, as long as they could work for the one night, because there were continual changes in the personnel and others might handle the work of the next shift. Several plants were found in which the bulbs were so dimmed by accumulations of dust or smoke, created by the operations, that the illumination was rendered very feeble and far from adequate, or where the shades had been broken and not replaced, except perhaps by paper substitutes placed on them by workers particularly affected by the glare, but such cases were mostly in smaller establishments.

Mercury vapor lamps were used for general lighting in 6 of the establishments and for illumination of some departments, or partial illumination of all departments, in 19 others. In the majority of places they were used in the composing rooms, especially on newspapers. It was claimed in these that, when first installed there were a number of complaints from the workers, mainly on account of the additional blue ray projected by the vapor and the consequent apparent discoloration of the faces, but after about three or four months' constant use, it was declared preferable to any other style and a change would have encountered violent objection. One large book and job printing establishment in St. Louis, occupying a six-story building, had at one time installed mercury vapor lamps all through, but did not like them, so removed all except in the basement and replaced them with incandescent bulbs, provided with diffusing globes on some of the floors and with metal reflectors on the rest. Several other plants expressed an altogether different opinion. In one composing room in Boston about half of the space was lighted by mercury vapor lamps and was said to give such good results that it had been decided to replace the ordinary incandescent bulb system in the rest of the room with these. In another composing room, located in Louisville, the mercury vapor lamps had been used for some time over the make-up tables, and had also proved so satisfactory there that it was intended to substitute others for the incan-

descent lighting in the rest of the room. The statement was made that the vapor lamps gave better illumination, were softer on the eyes and, in addition, did not require the constant replacement necessary with incandescent bulbs. The ceiling of the composing room was very high and the lamps were placed about 9 feet above the floor, but the reflectors diffused the light all around below them, so there was no dark, contrasting space apparent. The same style of lamps had been placed in the pressroom of this establishment but with different result. The room was high, to accommodate three and four deck presses, and the lamps had been suspended close to the ceiling, so high up that the rays could not reach the floor with sufficient strength for illumination, necessitating additional incandescent bulbs for practical use. Mercury vapor lamps are seldom used in pressrooms on account of the blue ray which renders them impractical for color work, though they were observed in seven of the pressrooms visited. Binderies in four of the book and job printing plants, where they were used in the composing rooms, were equipped with them, two electrotyping establishments likewise, and a number of lamps were used in a type foundry. They were probably used most extensively in a large plate and die engraving and printing plant in Washington, where all the printing sections and part of the photo-engraving department were equipped with them, approximately one-half of the establishment. Some iridescent sunlight globes were placed in certain parts of the rooms for convenience in color work connected with it. Rays from ordinary incandescent bulbs do not blend well with those from the mercury vapor lamps, on account of the contrast in color. There is also a danger of getting too strong a light by placing the lamps too close together, such as was noticed in one composing room in Cleveland, in which the glare was very prominent. The superintendent admitted the light was obviously too strong but said that, when he tried to diminish it after the fact was discovered, there was so much objection to reduction by the workers that it was decided to leave it alone.

In two of the establishments using mercury vapor lamps a condition was observed that also existed in other newspaper composing rooms illuminated by other means. The linotypes, or intertypes, are usually grouped together in one part of the composing room, while another part is occupied by hand composition and imposition, two operations which both require intensive light over a large surface. The linotypes, however, do not necessitate high illumination over the top of the machines for the ordinary operation and each is supplied with a small individual lamp, covered with a shade, that throws strong light immediately on the copy from which the operator works. Consequently the space over the machines was often only poorly supplied with illumination, or if lamps were placed there these were usually kept turned off by the operators, who preferred the strong light concentrated only on the small spot occupied by the copy. This created a large dark space in the room, which might not affect the machine operators but certainly was detrimental to those who worked in another part which was well lighted, as the eyes were bound to encounter this dark space from time to time during the hours of work, creating additional eyestrain.

A number of the machines and other equipment used in the printing trades are provided with individual, attached lamps to supplement the general illumination and enable the workers to direct stronger beams on special operation points. To prevent glare in the eyes of the operators these are practically always covered with shades that at the same time act as reflectors, and are often used, even in good daylight, during the time the machine is operated. This, for instance, is the case on linotypes or intertypes, which are often placed so the light from the window falls directly over the backs of the operators on to the copy, though in other plants they are arranged so the operators are seated sideways to the windows, the most ideal arrangement from a lighting standpoint, allowing free access for receiving new copy or taking away the finished product, but is objected to on account of the extra floor space required. Where the work is performed at night the relative location of machines and windows is of no importance, and a number of offices have the machines placed so the operators face the walls. Very few operators will work without artificial light, even where daylight is good, and only one instance was discovered where the auxiliary lamps were not used. This was a small establishment in Richmond, which had two machines located in one corner of the composing room on the first floor, with windows in the wall back of the operators and in the wall at the side of one machine. The ceilings were high, the walls painted white, and the windows large and clean—all contributing factors.

Exits and stairways do not require so high a degree of lighting and, as a rule, are sufficiently supplied, but attention was called to two incidents in connection with this feature. In one large establishment in New York the workers had fallen into the habit of shutting off some of the lights on the stairways, which were located in the center of the building and were not supplied with natural light. This was overcome by placing locks on the push buttons in the walls so the lights could be extinguished only with the aid of the key. This incident was due to careless action on the part of the employees, while the following falls at the door of the employers. A large establishment, situated in Philadelphia, turned off all the lights in the building when the machines were stopped at night, regardless of how the workers found their way out. Some of the female help suffered indignities while groping their way down the dark, inside stairs, but protests to the firm were ignored and instructions from the industrial board, for keeping the lights burning, went unheeded quite a while. The board finally took active steps to enforce the ruling and the lights were afterwards kept burning on the stairways until all employees had left the building. In one book and job printing establishment in Richmond a somewhat unusual occurrence was noted, of the light created in one plant affecting conditions in another. Part of the second floor of the two-story and basement building occupied by the establishment contained a small photo-engraving plant, which was separated by partitions from the main plant. These partitions did not extend up to the ceiling and, consequently, the intermittent glare from the exposure lamps by the camera in the gallery of the photo-engraving plant was projected over the partitions into the composing room of

the other plant, located by the side of it, giving the effect of glare from lightning, though more protracted, a condition bound to create a disturbing influence.

The establishments surveyed were divided for artificial, as well as for natural lighting, into good, fair, and bad, with the result given in the summary of the tabulation (p. 228), under heading "Condition of light" and subhead "Artificial," of 28 per cent good, 53.5 per cent fair, and 18.5 per cent bad. "Good" means that the plants appeared to have an ample supply of a good quality of artificial light, not too strong and free from glare. "Fair" is used where part of the plant was well supplied with ample and good style of lighting but the balance was not, or where the entire lighting system was not of the best and still could not be considered absolutely unsuitable or detrimental to the workers. "Bad" denotes that the supply was inadequate or of such a quality that it would be judged injurious to those working in it.

VENTILATION OF BUILDINGS AND EQUIPMENT

Fresh and pure air is a vital necessity to health, and an industrial establishment needs an abundant supply, because people who perform physical labor breathe more rapidly than those who are still. It is estimated that a man sitting still requires about 2,400 cubic feet of fresh air per hour, 3,200 when doing light work, and 6,000 when doing hard work, to keep healthy. It is consequently important to furnish air to an establishment where workers are occupied, and especially one in the printing trades. In these the air is not only polluted by the breath of those working in it, but dust, fumes, and gases are developed in the processes and contaminate it still further, particularly where the machines are not equipped with special ventilating devices to carry these off. A poorly ventilated room affects the health of the workers, but, in addition, also affects the pocketbook of the employer, through decreased efficiency. The majority of printing-trade plants depend upon natural ventilation for the building, through openings such as doors, windows, transoms, air shafts, and pores, crevices or cracks in the walls. The simplest method of obtaining fresh air is by opening the windows, but this is not always satisfactory. If they are carefully placed and properly constructed, a fairly good ventilation may be obtained when properly supervised, but they seldom distribute the air evenly, and the workers employed near the windows often complain of cold and draft. The modern type of window pivots at the center and opens in such a manner that the incoming air is deflected upward against the ceiling. A somewhat similar arrangement is found in quite a few plants, provided with old-fashioned window sashes that slide up and down. Slanting shields or deflectors are placed on the window sills, which permits raising the bottom sashes to let the fresh air in and deflect it upward. Even then the workers close by the windows, especially in the composing rooms, will insist on keeping them closed, no matter how much others in the back part of the room desire fresh air, and during cold weather in the winter months the windows are, as a rule, kept tightly closed.

Each process in the industry differs considerably from the others and each has special requirements that enter into the ventilation problem for that part of the plant occupied by it. There are several features connected with ventilation that affect the air inside a building, such as temperature, humidity, and movement of the air. Some of the processes require a certain condition of temperature, while others develop an excess of it. A fixed amount of humidity is demanded for the best results of certain special classes of work. In some departments the air is kept practically still and in others it is agitated to a certain extent by the movement of the machinery. The construction of the building, its surroundings, the location of the plant in the building, the proportionate cubic contents of air in the rooms, or fumes, gases, and dust created by the processes, all play an important part, especially where natural ventilation alone is resorted to. Breathing of the air unquestionably reduces the oxygen in a room, unless fresh air is supplied, and exhaling the breath distributes carbon dioxide, which to a certain extent contaminates the air together with the volatile substances thrown off by the bodies in perspiration. These do not, however, affect the air to any great extent and, if no other causes were present, would usually be taken care of by air entering doors and windows, or through crevices in the building. The body heat given off by a large number of people placed together in a small workroom, which raises the temperature and increases the moisture, has a far more detrimental influence. For that reason there should always be sufficient space in a workroom to eliminate any danger from that source, estimated by authorities at approximately 400 cubic feet of air to each worker.

The temperature of a workroom is one of the influential factors in health and comfort, but is closely allied with humidity and the movement of the air, together with the physical exertions of the workers. Humidity is the moisture, or water vapor, mixed with the air in varying quantities, depending upon its temperature. Cold air is capable of holding only a very small quantity of water vapor, about one-half grain per cubic foot of air at zero, while at 70° Fahrenheit it will require 8 grains per cubic foot to saturate it, and at 83°, 12 grains per cubic foot. Air may, however, contain varying quantities of moisture at the same temperature and the amount of this, termed relative humidity and really constituting the governing factor, is expressed in terms of percentage of the amount of vapor actually present in the air compared with all the moisture the air can hold at that certain temperature. A comfortable air condition is one which involves higher temperatures when the air is dry than when it is moist, or when the air is moving than when it is stationary, and can not be determined by the temperature alone. Conditions created by a temperature of 64° Fahrenheit, and the air saturated by moisture, varies only slightly from those resulting from a temperature of 70° combined with about 45 per cent relative humidity, or experienced from a temperature of 76° with 10 per cent relative humidity.

The commonly accepted standard for desirable temperature varies from 60° to 65° Fahrenheit, with about 50 per cent relative humidity, for work requiring considerable exertion to approximately 70°, with similar humidity, for people sitting still. It has been found that

the vitality is affected by increase in temperature and humidity so that physical work performed in a room decreased 28 per cent when the temperature was raised from 68° with 50 per cent humidity to 86° with 80 per cent humidity. Movement of the air is also highly essential, as stagnant air is very depressing and causes discomfort somewhat similar to that caused by excessive humidity. Some establishments keep the windows open at all times, when the weather permits. Others keep them open between working hours, to change the air completely. Still others open them at regular intervals, such as the largest establishment in Washington, where each window was opened for five minutes each forenoon and afternoon during the winter to admit the fresh air. Employees stationed close by the windows were permitted to leave the work during this period, if the draft became too strong. Another large book and job printing plant in the same city opens all windows during lunch hour. Several others were found in various places using one of these methods. In southern plants it is possible to keep the windows open practically all the year round under normal conditions, but in the northern part of the country the weather may prevent this. The direction of the wind also has quite an influence. One establishment, located in the southwest corner of the ninth floor in a twelve-story building in Philadelphia, emphasized the fact that it was practically impossible to keep the windows open during the summer months, as the strong prevailing winds blow from the southwest during the summer and would interfere with the work. Some places were affected by other outside conditions, such as smoke and soot from railroad yards or from other industries, which often necessitate closing of windows to keep the work clean. A few buildings were provided with ducts placed near the ceilings, through which the warm air escaped from the rooms and some cold air entered. Among the establishments surveyed, 361 depended entirely on natural ventilation. These were classed in three groups, as shown by the summary of tabulation (p. 228), under head of "Ventilation of building" and subhead "Natural," with the result that 43.5 per cent were listed as good, 39.3 per cent as fair, and 17.2 per cent as bad. "Good" means that proper atmospheric conditions were maintained in the plant, "fair" that part of it was open to criticism regarding purity of air, quality of temperature, or humidity, while "bad" is used for an establishment containing oppressive air, excessive humidity, or uncomfortable temperature, sometimes coupled with unpleasant odors and fumes, gases, or dust from the operations.

A number of large establishments were provided with artificial ventilating systems for the building, either plenum or vacuum type. A plenum system is where the air is propelled or forced into the room by means of fans, and a vacuum system is where it is exhausted from the rooms by means of fans. Either may consist of large ducts, placed in the walls or pillars, or projecting into the rooms, in a connected system, operated by a large inclosed fan, but may also consist of one or more large rotary fans located in the windows or outside walls and installed to either blow air in or pull it out, or be reversible so it can be used for the first operation in summer and for the latter in winter. The establishments visited which were provided with mechanical appliances for supplying fresh air or removing bad air, totaling 175, were divided for purpose of tabulation into

four main groups, as listed in the summary of tabulation (p. 228) under head of "Ventilation of building" with subhead "Artificial," according to type of system used. A further analysis shows that 4.6 per cent were provided with combination plenum and exhaust systems throughout the plant, 6.9 per cent with plenum for the entire plant but exhaust for part only, 5.7 per cent with plenum only for the whole plant, 15.4 per cent with plenum and exhaust for part of the establishment, 1.7 per cent with plenum alone for part of it, 11.4 per cent with exhaust in all departments, and 54.3 per cent with exhaust for part of these only. Each of the four principal groups is subdivided in the table into good, fair, and bad, with practically similar meanings as applied to these conditions under natural ventilation. The total results for the establishments equipped with artificial ventilation are 42.8 per cent good, 48.6 fair, and 8.6 bad.

The ideal air condition of a working room is one which can be controlled at all times, regardless of the outdoor temperature and the influence of the weather. This can be accomplished efficiently only by using combination plenum and exhaust systems, where the air can be supplied to the room through a conditioning apparatus in any desired quantity, washed and cleaned, heated or cooled, charged with moisture or with excessive moisture removed, and distributed uniformly, at the same time drawing out the impure air from the building. Where plenum alone is used the polluted air is not necessarily removed but is diluted and mixed with the fresh air supplied, usually with good result. Considerable depends, however, on the manner in which it is supplied. It may be introduced into the room through a conditioning apparatus, or simply be propelled into the room by a fan inserted in the outside wall, in which latter case the quality of air would be the same as outside the building. The exhaust system, which is the simplest, only removes the impure air from the room and, if used alone, ordinarily consists of rotary fans placed in the outside wall, that pull the air directly out.

Fumes, gases, and dust can easily be rendered harmless if carried away from their source by proper ventilating devices. The equipment used for such purpose is closely connected with the problem of ventilation for the building itself, because it prevents the surrounding air space from contamination and, in addition, acts partly as an exhaust for the room. Its application varies considerably according to the different processes in the trades and, consequently, that part of the summary (p. 228) prepared for this subject has been divided to fit the main processes which require special ventilation on the equipment, under that heading, separated into "Composing," "Photo-engraving," "Stereotyping," "Electrotyping," and "Other equipment." The last-named group consists of miscellaneous equipment in the pressroom or bindery, and that used for other operations.

The summary shows that the composing equipment was provided with mechanical ventilation in 273 plants, 41.4 per cent of these classed as good, 28.2 per cent as fair, and 30.4 as bad. "Good" means that the equipment was provided with devices or mechanical means to thoroughly prevent pollution of the surrounding atmosphere with fumes, gases, or dust from the operations, "fair" means that the majority of the equipment was provided in similar manner, and "bad" means that the air around it was contaminated.

Authorities have agreed for years that the operations in which type metal is handled or melted constitute a menace to health unless proper precautions are taken, but do not all have the same opinion regarding the actual source from which so-called lead poisoning is derived. Some claim it is contracted from the fumes given off by the metal pots used on type-casting machines, others that lead dust is the most prominent factor, while others claim that the main danger exists in contact through handling the metal. The latter is one risk that can not be eliminated and which, while mainly affecting the hand compositor, also is shared by the machine operator, who must handle the metal to a certain extent. This is, however, a question of sanitation together with personal cleanliness of the worker. The disposal of the fumes from the metal pots on type-casting machines or ingot furnaces, as well as the dust problem, can be solved easily by proper mechanical means, combined with sanitary precautions for the dust. Until it is proved absolutely, as some contend, that there are no dangers from the fumes of type metal as liberated in composing rooms, all efforts should be made to prevent any possibility of jeopardizing the health, and even life, of the workers employed in the industry. This fact has been recognized by the legislation in a number of States, which provides for exhaust in some form on type-casting machines and ingot-casting furnaces, to carry fumes and gases out of the room. The dust question has not been disposed of, except in a few cases, but is usually regulated by the workers themselves.

Legislation does not, of course, always mean enforcement, and the observations in the survey were not conducted with a view of whether the plants were living up to these or not, but merely whether the health of the workers was protected in a sensible manner or abused through the neglect of the establishments or, perhaps, carelessness of the workers themselves. It was found that less than half of the composing rooms were in what was deemed a proper condition, and less than one-third fair, with slightly less than one-third bad. In the majority of the establishments contained in the third class there was considerable complaint from the workers regarding bad health, which in most cases was attributed by them to fumes from the metal pots. This was mostly in small establishments containing only a few machines, but was also the case in a few large ones that did not like the idea of hoods and pipes on the casting machines and were disposing of the fumes by means of exhaust fans located in the windows or walls. While this method will expel the fumes from the building in an effective manner, provided the fan or fans have sufficient capacity, it can not be considered a healthful method at all. The fans are naturally located some distance from the source of fumes or gases that are to be expelled, and consequently these have to travel through the air between the two points, polluting it the entire distance, and invariably being inhaled by any one passing through that stratum.

The majority of type-casting machines are located in newspaper establishments, several of which were equipped with batteries containing over 50 machines, one having 100 machines. This number was exceeded only by the number contained in the largest printing establishment in Washington. In most of the modern plants the

ordinary line-casting machines, linotypes or intertypes, were provided with electrically heated metal pots, which seem to eliminate the necessity for piping the fumes created by the metal, and indicated that the detrimental influence on the health of the operator is not caused by the fumes from the lead or antimony contained in the pot, but by the gas fuel used for heating it.

This can not, of course, be absolutely determined without comparing the accurate analysis of air secured from over electrically heated metal pots with the analysis of air over gas-heated metal pots, but the accompanying information secured confirmed the theory that the pollution of atmosphere around composing machines is really caused by gases and fumes from the fuel gas where this is used, and that illuminating or fuel gas is the most vital factor in the health question for the printing trades at the present time, and is extremely detrimental unless proper ventilation is provided. Some plants had splendid ventilating systems, with large hoods covering the metal pots and large pipes extending from these to main ducts, provided with powerful exhaust fans, which removed all fumes from the building. Others were decidedly different, sometimes from the belief that if the window ventilation was good there was no further protection needed, sometimes from ignorance of the importance of ventilation, and sometimes from reluctance to expenditure necessary for installation of mechanical devices. Linographs and typographs were also found equipped with electrically heated or gas-heated metal pots. In the latter case they were sometimes provided with hoods and pipes, but other establishments had no device for removing the fumes. Monotype casting machines were practically all equipped with gas-heated metal pots, though a few electrically heated pots were found. Three different methods were used for removing the fumes from monotype casting machines equipped with gas fuel. One method was similar to that used for linotypes, hoods covering the pot and piped to a fan exhaust. Another method was to use a pipe that was connected with a fan exhaust, the other end of the pipe being fitted over the exhaust orifice in the pot and having a connecting pipe extending from about a foot above the pot to a point near the surface of the molten metal, calculated to absorb all fumes from it. The third method consisted in placing a piece of pipe, about 2 feet in length, over the orifice in the metal pot to act as a chimney for the gas. As this extends only approximately 5 feet above the floor, the fumes and gases are liberated into the room at that level and, even though eventually expelled from the building by an exhaust fan in the outside wall or window, create a very undesirable condition.

There is usually more or less smoke and odor around monotype casting machines, caused by minor quantities of acrolein fumes, especially whenever an extra heavy supply of oil is poured on the machines. The Elrod slug-casting machine seemed to present the worst individual condition, on account of having gas flames burning in three different places, together with a metal pot with large surface area. It was only in a few instances found equipped with a hood, though this is one machine that should especially be provided with protection for the operator. Altogether there were

3,575 type-casting machines of the various kinds in the establishments inspected, 64.7 per cent of which were equipped with gas-fuel metal pots and 35.3 per cent with electrically heated metal pots, as shown in the table under summary of tabulation, headed "Fuel of typesetting machines" (p. 228). One additional machine was equipped with a metal pot heated by gasoline, seldom found except in small communities not provided with gas, and was installed before the electric pot was perfected sufficiently.

The metal used for casting machines consists of lead, antimony, and tin in varying proportions. The base metal is lead, but as this alone would be too soft and lacks other necessary qualities, antimony is added to give it fluidity when molten and hardness when cold. Tin is mixed in to make the alloy tougher, to increase the fluidity, and to allow casting at lower temperature, as well as to materially assist in forming a smooth face on the type. The proportions vary according to the kind of machine in which the metal is to be used, and further according to individual requirements. The metal intended for line-casting machines, which is the softest, usually consists of about 85 per cent of lead, 10 per cent of antimony, and 5 per cent of tin, while for unicycle-casting machines it ranges from this to 72 per cent of lead, 19 per cent of antimony, and 9 per cent of tin—an extreme mixture used for special work. Lead melts at 621° F., when pure, and antimony at 1,166°, but when antimony is alloyed with lead the melting point is reduced below 621°, gradually growing less with the addition of more antimony. When the alloy contains approximately 12 per cent of antimony the alloy melts at 475°. Increasing the percentage of antimony above that point will *increase* the melting point of the alloy in proportion. Tin which melts at 450° F., does not reduce the melting point of the alloy appreciably. Other metals are occasionally present but rarely exceed 1 per cent of the alloy, and are usually mixed in to modify slightly the main constituents.

The ingot-casting furnace also adds to unpleasant conditions in some establishments. The large plants are usually provided with large, well-made furnaces for remelting the metal used in type-casting machines, and a number of them have molds (for the ingots) attached on the furnace and filled from a spout or by means of a force pump. They are also customarily located in separate rooms and provided with exhaust pipes. In newspaper establishments they are commonly located in the stereotyping department, but in small book and job or periodical or type composition plants they can often be found directly in the composing room. They are sometimes very flimsily constructed out of thin sheet iron, which is easily battered out of shape and, consequently, even though the doors or hoods may fit well at first, there are often large crevices through which the smoke pours in volumes while the old type and refuse is remelted. The smaller ingot metal furnaces are usually not equipped with spouts and it is then necessary for the operator to open the doors, dip out the metal with a ladle, and pour it into the molds which are placed on the floor or on a bench by the side of the furnace. The doors must also be opened to permit skimming off the dross, which floats on top, or to shovel in more metal, which gives a chance for additional fumes to escape, especially where the pipe outlet is not supplied with ample

mechanical exhaust or, as sometimes is the case, is just piped to a flue with natural draft. These fumes consist of acrolein, produced by heating the oil and ink on the old type to the decomposition point, and may not be dangerous, because emitted in small quantities, but they irritate the mucous membranes of the nose and throat, inflame the eyes, produce a suffocating feeling and, when a large quantity is encountered, produce a violent nausea.

Ingot-casting furnaces also give off more or less heat, which will affect the workers and may create additional unpleasant conditions when the furnaces are located directly in the composing rooms. Heat, as well as humidity, is also created in some of the composing rooms in newspaper establishments by stereotype molding departments, placed along one side without any separation between the two processes and, in the majority of cases, without provision for expelling the heat generated by the steam tables, permitting it to be absorbed by the surroundings. In newspaper plants the line-casting machines are usually located together with hand composition in the same room, placed at one side or in one corner, and a similar condition is often found in other establishments, but this need not be detrimental in the least to the hand compositors, provided the proper methods are used for ventilation of the machines. Monotype casting machines are usually separated from the other operations by partitions, partly on account of the noise created by them and partly to localize the fumes. Monotype keyboard operators are often located in special rooms, as are the proof readers.

Some examples of good or bad features in ventilation of plants and equipment, observed in the various cities, will probably explain the present conditions better. No attempt is made to compare one city with another, but examples are given at random and any of them from one city can probably be duplicated in nearly any other one of the localities visited.

A large book and job printing establishment in Atlanta, located in a single-story building with good chance for natural ventilation from windows all around, had found it necessary to install exhaust ducts, extending from each end of the building to near the center and provided with a suction fan at each end, as the windows could not be kept open in summer on account of smoke and dirt from the railroad (by the side of which the plant was situated), and the air in the center of the large room would otherwise become very uncomfortable. The composing room was equipped with six line-casting machines provided with electric fuel melting pots and one machine with gas fuel, seldom used, all placed at one end of the building surrounded by glass-top partitions, and the air in the inclosure did not seem different from the rest. A newspaper establishment in the same city was equipped with 18 line-casting machines and 3 monotype casters, all with gas fuel metal pots. The line-casting machines had been provided with hoods and pipes, but most of these had been torn down. The monotype casters were equipped with 2-foot pipes only. The composing room was located on the top floor of a five-story building. An exhaust fan had been fixed in the ceiling over 10 of the line-casting machines, which were placed in one side of the room; another fan had been fixed in the center of the ceiling. Considerable odor of gas was noticeable all around the machines and, in addition,

there was a large quantity of fumes in the room from the stereotyping department, including both molding and foundry, which was located by the side of the composing room and only partly separated from it. On investigation it was found that the hood on the stereotype metal kettle had a large opening in front to permit use of the two force pumps in it, and that the pipe from the hood was partly disconnected, allowing the smoke from both metal and gas fuel to escape. Similar condition of pipe was found on the ingot-casting furnace, which was placed, together with a small dross burner, in a small separate room. The compositors complained considerably of stomach trouble and seemed to think it was from lead poisoning but the odor in the room would indicate that the trouble was caused by gas used for fuel. Similar symptoms were claimed by the stereotypers. A small book and job printing establishment in the same city had only one type-casting machine, provided with a gas fuel metal pot, which was not piped until two years previous. The operator complained of stomach trouble and blamed it on the fumes from the machine, with the result that it was fixed.

A newspaper establishment in Baltimore was equipped with five line-casting machines provided with electric pots and one Elrod slug caster with gas fuel, which did not have any device for removal of fumes. The room had windows on both sides and two exhaust fans had been placed in the windows by the machines. The stereotyping department, both molding and foundry, was located by the side of the composing room, separated from it by a wood partition with sliding doors. A new floor had been placed over the old one in the composing room, preventing the doors from closing, and the partition had openings above it between the exposed joists in the ceiling, which permitted fumes to escape into the composing room. The stereotype metal kettle had no hood over the metal but the gas fuel was piped, as well as the gas fuel from a small boiler for steam tables. These pipes and a pipe from a small hooded kettle for ingot metal and one from a small inclosed dross burner, all led to a larger pipe out a window. An exhaust fan was located in a window by the metal kettle, but the compositors claimed that fumes from the stereotyping department contaminated the otherwise good air in the composing room. Another newspaper plant in the same city had an equipment of 32 line-casting machines, provided with gas fuel metal pots and automatic metal feeders on these. The machines, which were not piped, were placed in three rows along a wall to the court of the building, in which two exhaust fans had been placed. The odor of gas was very strong in the vicinity of the machines. A separate room contained 11 monotype casters—all gas fuel and short exhaust pipes—and two slug casters, one caster being provided with an electric pot. A balcony above this room, containing dressing room and lockers, was full of fumes (from the machines) which were not expelled sufficiently by the windows. The stereotype flat casting department, which was located adjoining together with the molding department and only partly separated from the composing room, contained one metal kettle for flat casts, not provided with a hood but with gas fuel piped out, and one for ingot metal, which had a hood with a collapsible pipe leading out of a window. A fan was located in the window by the flat cast kettle but the fumes were

strong in the room and drifted into the composing room, as well as into the proof room, placed on a balcony above the stereotyping department. The building had originally been supplied with hot air heat through grates in the walls from a furnace in the basement, but this was used only for the burning of waste and the heating was done by steam radiators, with steam secured from an outside plant.

A third newspaper establishment in the same city was equipped with 36 line-casting machines, with gas fuel, not piped but provided with three exhaust fans in the wall. The ceiling was low, the windows closed, and there were considerable fumes in the room. It is doubtful if the opening of windows would have helped much, because while the room occupied the top floor the building was only three stories above ground, located on an inside lot and surrounded by tall structures. The stereotype molding department, situated in one end of the composing room, helped to render conditions undesirable. Four slug-casting machines were placed in a separate room in the sub-basement. These had gas fuel pots, provided with short exhaust pipes only, and the room was filled with fumes. The firm admitted that conditions were undesirable and stated that the plant had been somewhat neglected lately on account of contemplated removal to a new building, then in progress of construction, which was declared to include a combination of all desirable factors for ideal working conditions. A small book and job printing establishment in the same city had composition, presswork, and binding together in one room, bunched in departments but crowded. The machine equipment of the composing department consisted of two monotype casters with gas fuel and short exhaust pipes. An exhaust fan was located in a window by the casters and disposed of most of the fumes from them, but it also pulled the fumes through the room from gas burners on several cylinder and automatic presses in it, thus contaminating the intervening air space.

One large offset and lithographic printing establishment in Boston was provided with an artificial plenum and exhaust air conditioning system, which changed the air every 15 minutes, regulating the temperature and humidity. It was installed mainly to keep the paper in proper condition for color printing by maintaining suitable conditions inside the plant at all times, but it also created a healthful atmosphere for the workers, free from all outside influences. A newspaper plant in the same city had provided its building with a plenum and exhaust system, with intake on the roof, especially necessary in this case for the several sub-basements, in which the stereotype foundry and pressrooms were located; and in addition had equipped the line-casting machines, monotypes, and ingot-casting furnace, located in separate rooms on the third and second floors, with artificial exhaust systems of hoods, pipes, and fans, all of which kept the air in good condition.

Another newspaper establishment there had installed a plenum and exhaust system for the photo-engraving, stereotyping, and presswork departments, with large ducts and fan exhaust in walls for the rest, except on the fourth floor, where the composing room was located. The walls in this room extended to the top of the fifth story and the ceiling was provided with three natural draft openings for ventilation. The 39 line-casting machines, placed together with hand

composition, were equipped with gas fuel pots and 2-foot exhaust pipes only. The firm claimed that it would have installed electric pots on the machines, but were doubtful of successful operation, and were preparing to extend the plenum and exhaust system to include the composing room and the newsroom on the floor below it. Three monotype casting machines and an ingot metal furnace, all provided with pipe exhaust, were located in a separate inclosure. One large composing and electrotyping plant in the same locality was housed in single-story connecting buildings with natural ventilation. The air in the composing room was good, except in the monotype casting department, which was closed off from the rest by partitions and supplied with an exhaust fan in the outside wall. The 12 casting machines were provided with gas fuel pots and 2-foot exhaust pipes, and the fumes were quite noticeable in the inclosure. The melting kettle for ingot metal was located in one corner of the main composing room but was provided with a good hood and piped out. No complaint was made about it. One establishment in the city was equipped with three monotype casters, with gas fuel and short exhaust pipes, located on the third floor of a six-story building in a separate room, with an exhaust fan in the wall which changed the air every six minutes. The machines had previously been provided with hoods and piped out, but it was claimed that this did not work nearly so satisfactorily. The reason was probably that natural draft was depended on to carry the fumes out of the building through the pipes, something which rarely can be accomplished. The fumes will rise when hot but they cool rapidly and, as the specific gravity is just a shade heavier than the natural air, they have a tendency to sink if the temperature is equal. A slight pressure by wind outside of the building would also send them through the pipe back into the room.

In another plant of the city, situated in a large, double-story height room, which was supplied with washed air plenum and exhaust ducts, the two monotype casters were inclosed by glass partitions, eliminating the benefits of the ventilating system from that part. They were provided with gas fuel pots and the usual short pipes, and a large exhaust fan was located in the outside wall. The fan, however, was not in operation at time of the visit and the air was polluted by fumes, an act of disregard for proper conditions on the part of the operator himself. When attention was called to the fact, he started the fan and the inclosure was rapidly cleared. Workers are apt to get so used to certain conditions created by the work that they overlook the possible danger and neglect to take necessary precautions.

A very bad condition was found in a small newspaper establishment in Charleston, S. C., which occupied a three-story corner building. The composing room was located in the second story, with the stereotype molding and foundry department in an extension of the building in the rear, about half the width of the main part and separated from it by a wall with a large archway. The entrance to the second floor was through a door in the rear wall of the composing room, with access from an outside stairway. The front wall and the wall of the stereotyping department facing the court both contained several windows. Six line-casting machines, with gas fuel pots, were ranged along the inside wall and the operators objected to open-

ing the front windows, due to draft when the door in the rear was opened. The room was full of fumes from the machines, as there was no outlet whatever, and added to this were the fumes from the stereotyping department, where the metal kettle and ingot casting furnace had been piped for the gas fuel only, but not provided with hoods over the metal. A small ventilation trap over the metal kettle was supposed to expel the fumes from it, but the blackened condition of walls and ceiling showed that a great deal was not taken out. The ceiling over the line-casting machines was similarly discolored. The condition was extremely unpleasant, especially when the metal was being melted. The compositors and the stereotypers complained of severe stomach trouble and of a dull, heavy feeling shortly after coming to work. The plant had been established about six years with these conditions, but it had changed hands shortly before the inspection and improvements were under way. Electric pots had been ordered for the line-casting machines, a contract let for skylights, and the new firm declared it was going to be changed to a suitable place for the work.

Another newspaper in that city was equipped with seven line-casting machines and one monotype caster, all with gas fuel pots, located on the top floor of a two-story building. In the beginning the machines were not provided with any device for removal of fumes, in spite of complaints from the workers. One of the operators died and suit was brought against the newspaper, claiming lead poisoning as a result of the inadequate protection against the fumes. The firm stated that, while they were sure it was kidney trouble instead of lead poisoning, they settled the case out of court. Workers in the trade mentioned that the cause may have been doubtful but that hoods and pipes were supplied to the machines directly afterwards.

One of the newspaper establishments in Chicago, which was equipped with a plenum and exhaust system, obtained its fresh air supply from the tunnel under the city and maintained a temperature of less than 70° F. in summer. The large battery of line-casting machines in the composing room was provided with electric pots; two monotype casters and one Elrod caster were supplied with hoods and pipe and suction fan to remove fumes from the metal and gas fuel, leaving the air free from noticeable contamination. Another newspaper in the city had the majority of its line-casting machines in the main composing room. These were, except three, supplied with gas fuel pots and provided with hoods, piped to a duct out on the roof with an exhaust fan. The "ad" room, which was separated from the main composing room, contained eight line-casting machines, also with gas fuel pots and similarly provided with pipes, but the main duct for these pipes was only five inches in diameter, altogether too small to carry the fumes and, in addition, was not provided with an exhaust fan. Consequently the fumes were very noticeable in the room at the time, though according to later information this condition had been remedied by installation of a fan. Two Elrod casters, located in the same room, were provided with hoods and piped out, with a fan attached. The ingot-casting furnace, which was situated in a separate room, was similarly supplied. In one composition and electrotyping establishment in the same city two of the line-casting machines were equipped

with electric pots. The other three were provided with gas fuel pots and one of these was piped to a duct with a suction fan, but the pipes had been removed from the others. They were located in the main composing room, which occupied the principal part of the floor. Seven monotype casters, located in an adjoining room, were equipped with short pipes. Three of these extended up into hoods, connected by pipes with the main duct for the line-casting machines, but on two of them the pipes had rotted off and two were not connected. The windows in this room were partly open but the room was full of fumes, and fumes were also strong in the main room.

One large book and job printing establishment in Cincinnati had a good plenum system with large ducts through the seven-story building. The air was washed and, if necessary, heated by steam from the boilers in the plant. Another book printing plant, which occupied a three-story building, detached and with plenty of air space all around, did not depend on the natural ventilation but had a plenum and exhaust system, using washed air part of the time and keeping the plant at a desirable temperature in hot summer weather. As there was no gas in the building there were not many fumes to be carried out. A different application of exhaust to remove fumes from an ingot metal kettle was seen in a newspaper establishment in the same city. Instead of the usual cone-shaped hood and pipe arrangement a large square hood was placed well outside of the circumference of the kettle from the ceiling to seven feet above the floor, with an exhaust fan near the top in one side, which was formed by an outside wall. The fumes were all kept inside of the hood.

A newspaper establishment in Cleveland had 20 line-casting machines, provided with electric pots, but 18 of these were equipped with automatic metal feeders, consisting of a holder for the metal bar, placed above the metal pot and supplied with a gas flame which melted the metal from the bottom, letting it drip down into the open pot. Long hoods had been placed down over the pots and the mechanical feeders, provided with a door at one side for easy renewal of the metal bar, effectually preventing escape of fumes, and were piped to a main exhaust duct with a fan. Two others were provided with another kind of metal feeder that covered the top of the pot, except for the hole, through which a long, thin bar of metal slid gradually down into the molten metal of the pot, but which did not permit escape of fumes. Two typographs and one slug-casting machine were also equipped with electric pots but not piped, as no automatic feeders were supplied. One Elrod slug caster, which was equipped with gas fuel, had a large hood piped to the main exhaust duct for the machines. The ingot metal furnace was located in the stereotype flat cast department, on the same floor but in a separate room. Electrically heated metal feeders, otherwise similar to those using gas fuel, were being tried out by another newspaper of the city, and if successful would eliminate the necessity of using hoods. Where gas is used for melting the metal, hoods are essential to ideal conditions, but even if provided the workers often become neglectful and leave the doors of the hoods open, permitting fumes to escape unless there is an exceedingly strong suction in the exhaust system. In the same manner the covers of the metal pots are often found open, permitting some escape of gas, if used for fuel, besides

fumes from the metal that may be detrimental to the health or, at least, have not been universally decided to be harmless. One trade composition plant in the same city had seven line-casting machines supplied with gas fuel pots. These were provided with pipes to a duct out of the building, but, as the pipes were too small and no fan was used, the system proved useless, so was taken down. At the time of inspection the room was full of fumes. A book and job publishing establishment in the city had two monotype casting machines, provided with gas fuel on the metal pots and on the automatic metal feeders and equipped with short exhaust pipes, placed in a small room adjoining the hand composing room. An exhaust fan in the window carried out most of the fumes, but whenever the door in the wall opposite the outside wall was opened the fumes were blown into the main room, polluting the atmosphere. Another book and job printing establishment, which performed 10 to 20 per cent of the work at night, was not supplied with any heat for its quarters after 12 o'clock at night during the winter months, making it decidedly unpleasant for the workers on the night shift, even with coats and hats on.

One book and job printing establishment in Denver had five line-casting machines, located in the hand composing room, equipped with gas fuel on the metal pots and on the automatic metal feeders. The metal pots were piped to a main duct in a flue, as was the hood over the ingot casting furnace, also in the room. Two monotype casters, also with gas fuel metal pots, located in a separate, small adjoining room, were provided with short pipes, extending up into hoods, which were piped similarly to a flue. In view of the fact that the machines were just piped with natural draft and located on the third floor of a five-story building, there was remarkably little odor from gas in the rooms. In a periodical printing plant of the same city were seven line-casting machines with gas fuel metal pots, provided with short pipes extending up into hoods, that also were piped to a flue, and where similar conditions prevailed. A small stereotype molding department was located in one end of the composing room but did not create enough heat to render it uncomfortable. The ingot casting furnace was placed in a separate adjoining room and the hood on it was also piped to a flue. One newspaper establishment in the city, which was equipped with 19 line-casting machines bunched in one end of the composing room and provided with gas fuel on the metal pots, which were piped to a main duct with a fan out through the roof, had six very large hoods distributed over the rest of the room, about 9 feet above the floor, with large pipes to the main exhaust duct. The top parts of the windows in front of the casting machines were lowered to admit fresh air and considerable air came up from a form elevator shaft, located at one side, reaching from the composing room on the first floor to the stereotyping department in the basement. Some of the compositors complained of the draft caused by this whenever the door was open. Four monotype casters, separated from the rest of the composing room by partitions that did not reach to the ceiling, were equipped with gas fuel metal pots and short pipes only. but the ventilation system seemed to absorb the fumes well.

One newspaper in Detroit was provided with three separate plenum systems, in which the air was washed, and in winter heated by steam, then distributed through grates in the walls. One fan had an intake of 80,000 cubic feet per minute. Exhaust was made from the workrooms in the main building through similar grates in the walls, with separate exhaust from toilets, washrooms, and restaurant kitchen. The composing room contained 42 line-casting machines, arranged along both sides, equipped with electric metal pots, and three slug casters, separated from the rest of the room by glass top metal partitions, also equipped with electric pots. An Elrod slug caster, placed together with these latter, was provided with a hood piped to the main exhaust from the stereotype department out through the roof, and with an exhaust fan. The two ingot metal furnaces, which were of a quality better than usually encountered, were placed in the stereotype flat casting department, located in an adjoining separate room. Another newspaper in the city, where the composing room was located on the top floor of a 10-story building, had 38 line-casting machines, 10 of which were provided with electric pots. The rest, together with four slug casters, were equipped with gas fuel pots and automatic metal feeders with gas fuel. These were all provided with large hoods, inclosing the feeders and containing doors, piped in sets to a main duct out on the roof with a fan disposing of the fumes in a satisfactory manner. The entire stereotyping department was separated by a glass top partition with sliding doors from the composition room. A trade composition plant in the city had eight monotype casters on the second floor but the ingot casting furnace was located in the basement, which was also occupied by other tenants of the 10-story building. It had a large hood, which was piped out the flue, and the fuel was piped separately to the flue. The furnace was located in a very small inclosure and the approach to it was dark and dirty. The firm claimed that it was used only occasionally, and then at night.

A newspaper establishment in Indianapolis, which occupied a 4-story and basement building with the plant, had a large plenum system, through which washed air was supplied to the 10-story office building in front and the 4-story printing office across the alley in the rear. The intake was on top of the printing office, where the air was cooled by a water curtain, or heated by electric coils, as desired. Second and first floors of the printing office were not supplied, as work there did not require it and they got considerable fresh air at all times. An exhaust system extracted the foul air from the building and, in addition, special fume exhaust systems were provided for photo-engraving and stereotyping departments on the third floor, and for the ingot caster and dross burner in a separate room on the fourth floor. The composing room on the fourth floor was equipped with 26 line or slug casting machines provided with electric pots and 9 provided with gas fuel pots. It had an 18-foot ceiling, along the center of which was placed a plenum duct and along each side an exhaust duct. The casting machines equipped with gas fuel pots were provided with long exhaust pipes, ending near the exhaust duct for the room, which had several openings. The pipes were at first connected with the duct but it

was found that the exhaust was too powerful and pulled the gas too strong, so they were cut off about 12 feet from the floor. An Elrod slug caster, located by the wall by the other machines, was not provided with a pipe but no odor was noticeable from it. The ingot casting and dross melting furnaces, which were located in a separate room, had tight-fitting hoods with collapsible pipes, connected with an independent exhaust duct out through the roof, with a fan. One book and job printing establishment in the same city, occupying a 4-story and basement building, was provided with a plenum system, on which the heat for the air was supplied by an outside plant. It had a condenser with fan in the basement, but claimed the system was not satisfactory as it was one of the early ones and was never completed. The heat from the blast gates was fairly good on the first and second floors, insufficient on the third floor, and not noticeable on the fourth floor. The plant was inspected the latter part of February, when the outside temperature was 32° F. and some heating was essential. Criticism of artificial ventilation was encountered in several instances, but the failures to get results seemed due either to improper installation or to those in care of the systems not understanding how to keep them in order. Judging from the results observed in a number of places, they are very satisfactory and the most intricate or complex ventilating problems can be successfully arranged by competent experts.

A periodical printing plant in Kansas City was equipped with three line-casting machines, provided with electric pots, placed in a special room extending across the rear of the building, but which also contained an ingot metal furnace, using gas fuel. The hood on this had been battered so the door would not fit close, and fumes escaped in considerable quantity instead of going through the exhaust pipe and up the flue.

In one newspaper establishment in Louisville the composing room was located on the first floor, while the photo-engraving department occupied part of the second floor. The equipment consisted of 17 line-casting machines, equipped with gas fuel pots. The room was provided with circulation of air, blown in at one end, distributed by another fan in the center, and exhausted by a third fan in the other end. The machines had been equipped with hoods, piped to an exhaust duct leading to the flue. This system had been installed not on account of the possible action of the fumes on the workers but because the fumes from the metal pots affected the chemicals in the photo-engraving department overhead, as the silver baths used in the wet-plate process seemed to have a great affinity for lead. Two monotype casters, which were partly separated from the rest of the composing room and were provided with gas fuel pots, had only short exhaust pipes, but fumes were well distributed by the circulation of air and were hardly noticeable. The ingot metal furnace was located in the stereotyping department in the basement, and the hood was piped to the flue, but it was stated that the fumes penetrated to the first floor when dross was being burned.

A newspaper establishment in Milwaukee had the composing room on the second floor of an old eight-story and basement office building, occupied by it for three years. The 25 line-casting machines, equipped with gas fuel pots, were placed alongside the windows.

Four monotype casters, provided with gas fuel pots and with short pipes, were placed at one end of the casting machines and separated from them by a low partition. An exhaust fan was located in the window close to the partition, and one in a window at the other side of the room, which contained the stereotype molding department and the ingot metal furnace. The line-casting machines were not piped, and elimination of fumes by the exhaust fans in windows was depended on, assisted by bracket fans on the pillars in the room, placed to blow the air toward the exhaust, together with two ventilation grates in the walls, with ducts to the flue but with natural draft only. There was considerable odor of gas in the room, and the workers complained of feeling tired soon after commencing work. The ingot metal furnace was also piped to the flue.

One newspaper establishment in Nashville was equipped with 12 line-casting machines, with electric pots on two and gas fuel on the rest. All were piped to a duct, but this led only to a flue and was not provided with an exhaust fan; consequently a lot of the fumes escaped and polluted not only the composing room itself but also the quarters occupied by the photo-engraving establishment, located on the floor above and with entrance from a long stairway placed in the composing room. The odor of gas was very noticeable in the photo-engraving department.

It was found that most of the printing establishments in the city, outside of the newspaper plants, had practically discontinued manufacture of machine composition in the individual establishments and were securing this from trade plants, not as a health proposition, but for financial reasons. This, however, had probably created a better atmosphere in these plants. One book and job printing establishment in the city, which had taken out the line-casting machines, had one monotype caster with gas fuel and provided with a hood, which was piped to an exhaust duct with natural draft only, formerly used for the line-casting machines. The openings in the duct, to which exhaust pipes from the machines were formerly connected, had not been capped, and the pipe from the monotype caster was partially disjointed, permitting the fumes to escape. It was explained that the place was partly neglected on account of prospective removal.

A somewhat similar condition was found in the composing room of a newspaper in New Orleans, where the 15 line-casting machines, equipped with gas fuel pots, were piped to a duct that had several openings for other exhaust pipes, which were not capped and from which fumes were polluting the atmosphere of the room. The duct had natural draft only and an exhaust fan in the wall of the hand composing room assisted in pulling fumes from the duct. Two monotype casters, located in a separate room on the floor above, each had an extra 2-foot length of pipe on the orifice of the gas-fuel metal pot. The operator, who was very tall, was troubled with headaches during work and concluded the fumes from the machines were responsible, so added an extra length of pipe on each, bringing the ends above his head, which stopped most of the trouble. The machines were located by the windows of the room, which were open at the time of inspection. A particularly bad condition was encoun-

tered in a small trade composition plant in the same city, which was located in one side of a room occupied by a small book and job printing establishment, and separated from it by a wall with three large archways. These formed the only method of ventilation for the establishment, as there was an inside wall on the opposite side, and the space was consequently subject to conditions suitable for the pressroom of the printing plant, making it hot and disagreeable in the summer. The establishment contained only three line-casting machines, two with electric pots and the third with gas fuel. None of them were piped, and while there were only a few machines, the peculiar construction and condition of the room created a pocket of very unpleasant atmosphere around them. A new building was almost completed for the trade composition plant, with modern lighting, heating, and ventilating system, hot and cold running water, sanitary toilets, and individual lockers, and preparations were under way to move the machines.

Practically any condition can be encountered in New York and surroundings, large or small plants of all kinds, as well as good or bad from a viewpoint of ventilation. One large periodical printing establishment, occupying a large building, was provided only with natural ventilation, except on two floors where some exhaust fans had been installed in windows. The ceilings were 16 feet high, the working space was ample, machines that might create unpleasant conditions were provided with exhausts, and the air was good except in the pressrooms, which felt a little close. Another one was equipped with plenum and exhaust system for each floor, but did not use it. There were some unpleasant conditions in several departments of the establishment which would have been eliminated if the artificial ventilation had been used. One large newspaper establishment had plenum and exhaust system with grates in walls and ducts extending out in some of the rooms, changing the air every 20 seconds, and using an air-conditioning plant to regulate the humidity. Another newspaper plant had ducts with natural draft for intake of air in the composing room, adjoining the stereotype molding department on the fourth floor of a seven-story building, provided with heating coils for use in cold weather, and exhaust through walls of both rooms, with a fan on the roof. The stereotype foundry on the third floor was provided with an exhaust fan in the wall above the windows, that changed the air contents of the room every 5 minutes, and the adjoining pressroom was equipped with an air-conditioning plant, which supplied washed, heated, and properly moistened air to the paper storage and the reel room on the second floor, then through the pressroom, recirculated it to the paper storage in the basement, back to the pressroom, and exhausted it through a duct with a fan. Four large exhaust fans in the wall of the pressroom above the windows removed the excess heat created by the motors, while the stereotype foundry was provided with an exhaust duct for the metal kettles. The ceiling on the third floor was about 20 feet high, but on the fourth floor, containing composing room and stereotype molding department, it was the regular height, about 14 feet. The large battery of line-casting machines, all equipped with electric pots, was located with the hand composition, and two monotype casters with gas fuel pots and short pipes had been placed in a small separate room in one corner, which was

ventilated by an exhaust duct near the ceiling, connected with the main exhaust duct from the building. This was the only place in the plant where any fumes were noticed. The ingot casting furnace, located in another small room, was piped to the main exhaust duct.

Another large newspaper establishment, which had a composing room on the thirteenth floor of a 14-story building, depended mainly on natural ventilation for the room. Sixty line-casting machines, all equipped with electric pots, occupied one side of the building, with hand composition in the center and in one end. The stereotype molding department occupied part of the other side and three exhaust fans had been placed in the windows behind the steam tables, provided with exhaust pipes reaching above the roof. The room had a high ceiling, but part of the space was occupied by a balcony containing lockers at one side over a separate room for monotype casting and stereotype flat casting with ingot metal furnace, and by an additional balcony for lockers, extending from the wall to the center of the room. The monotype room was occupied by 14 casting machines with electric pots and one with gas fuel pot. The ingot metal kettle, also used for flat casting, was provided with an apron and hood, and in addition a large hood had been placed above this, piped out the roof, with a fan. The locker room on the balcony above was, nevertheless, full of smoke from the oil used on the monotype casting machines, which rose through an air space next to the wall and drifted in among the lockers over a low railing, making it very unpleasant for the workers changing clothes. Another newspaper had two exhaust fans in the windows of the hand composing department, which occupied one side of the room, and one in the line-casting machine department, located in the other side and containing 73 machines, all with electric pots. The stereotype molding department, placed in a room at one end, had two fans in a window back of the steam tables and the stereotype job casting department, next to it, had a fan in the window by the metal kettle which was provided with curtains and a hood piped, with a fan, to the flue. The ingot metal furnace, which was located in a separate room, was fixed similarly and this room was also provided with an exhaust fan in the window. The monotype casting room, containing six casting machines with electric pots and one with gas fuel, not piped, had the windows open and the wind carried the acrolein fumes, from excess oil used on the machines, over the low partition into the adjoining dressing room with lockers; the odor was very noticeable on account of the low ceiling. Another newspaper occupied an old remodeled five-story and basement building located on an inside lot. Exhaust ducts had been installed for the photographic and photo-engraving departments on the second, fourth, and fifth floors. Part of the third floor, which was occupied by the main composing room with stereotype molding department in one end, was provided with both plenum and exhaust ducts with a water curtain for the plenum. The 15 line-casting machines were equipped with electric pots and the air felt remarkably good, considering the low ceiling and otherwise inadequate building facilities. An adjoining room, containing two typographs and one slug-casting machine, all with electric pots, was similarly supplied with plenum and exhaust, and an Elrod slug caster, also placed there, was equipped with a hood piped to the exhaust. The

ingot metal furnace, which was located in another separate room, was also provided with a hood and piped to the exhaust duct. No fumes were noticeable in any part of the composing room. The first floor, containing the mailing room, had been supplied with exhaust fans in both front and rear windows, while the basement, where the stereotype foundry and pressroom were located, was provided with both plenum and exhaust. A new departure in piping metal pots on line-casting machines was encountered in another newspaper plant which was equipped with 39 of these, 28 of which were arranged in three rows and the other 11 facing the windows. All but one were provided with gas fuel pots. A pipe, attached over the exhaust orifice of the metal pot, had been curved over the back of each machine down to a duct, laid on the floor, and covered with a platform between two of the rows, and similarly back of the third row, extending outside the wall, with a fan. While not any more efficient, it added to the looks of the shop by doing away with the unsightly overhead pipe and duct system. Three typographs, located in the composing room, were equipped with electric pots, while two Thompson and one Elrod caster, provided with gas fuel pots, had been placed on a balcony and supplied with hoods piped to the main stereotype room exhaust duct. The stereotyping department was placed adjoining, back of glass-top partitions. No fumes were noticeable in the composing room.

One book and job printing establishment had eight line-casting machines and one monotype caster, all equipped with gas fuel pots and piped to an exhaust duct provided with a fan. The metal pots on the line-casting machines were supplied with gas fuel automatic metal feeders, but an improvement had been fitted to the gas burners so that, although the hoods on the exhaust pipes did not cover the fans, no fumes from them could be detected. Another book and job printing plant, which was equipped with 24 line-casting machines, all with gas fuel pots, had small hoods over the orifices of the pots, piped to a main duct out through the wall, with a fan, but the individual pipes, as well as the duct, were too small and there was considerable odor of gas in the room. A different book and job printing establishment was equipped with 18 line-casting machines and 1 monotype caster, all with gas fuel pots. The latter and 10 of the former were provided with hoods piped to an exhaust duct with a fan. It was claimed that 8 of the line-casting machines were new and there had not been time to get them piped. The odor of gas was very strong in the room, which was provided with natural ventilation only. A large periodical printing plant had 7 monotype casting machines among its equipment, located in a long narrow room. They were provided with gas fuel pots and short pipes on these, extending up into large hoods, 7 feet above the floor, with extra large pipes to a duct with a fan, ending in the flue. No odors at all were noticeable. In one large periodical and book printing establishment an ingot furnace was located, together with a large metal kettle, in a separate metal room. The ingot metal furnace was piped out the wall, and the kettle, which was used for a special kind of bars in an automatic metal feeder, was provided with a hood that also was piped out, but the hood was in poor condition and permitted the fumes to escape into the room, from which they

penetrated into the composing room. The kettle was furnished with a spout to convey the metal into the molds for the ingots and the valve on the spout was leaking, allowing the molten metal to drip constantly to the floor. Some good and substantial ingot furnaces had been found in different localities, but one style was seen in this city that seemed better than the rest, not alone from a production standpoint but, according to statements furnished, also from a health standpoint through reducing the temperature of the room where it was used, giving better control of gas for heating, and having an automatic mixer. A furnace of a somewhat similar style, and which had previously been considered the best on the market, had been used in this establishment, but after the tests were made it was supplanted by this one. It was claimed that, while nearly half as much more metal was melted during five days' work, there was a saving of 14.7 per cent of gas during this period and, what affects the health question more, the average temperature of the room while the furnace was in operation during the five days was only 81° F., against an average temperature for the other furnace of 112°. The normal temperature of the room in each case was given as 70°. As the metal is usually heated to nearly 600° to allow proper mixing, this shows a decided reduction in surrounding temperature, which necessarily must be beneficial to the workers.

One newspaper establishment in Philadelphia, which moved into a new building during the progress of the survey in that city, made a decided improvement in the working conditions of its employees. In the old building the ventilation was mainly natural and was not very good. On the fifth floor the hand composing room was separated from the machine composing room, which had a high ceiling, but, as the equipment consisted of 51 line-casting and two slug-casting machines, only 5 of which were provided with electric metal pots, the atmosphere was far from desirable. The photo-engraving department, located on the same floor, was also filled with fumes from the process, as the dark rooms were not provided with outside ventilation. In the etching room one etching machine had been piped through the window and an exhaust fan had been placed in the window near the other one, but did not seem to be sufficient to clear the room. The stereotype molding department, also located on the same floor, felt very hot. The stereotype flat-casting department, where the kettle was also used for ingot metal, was provided with a ventilating trap in the ceiling and the kettle was equipped with a hood and piped through the roof. The stereotype foundry, which was situated, together with the pressroom, in the sub-basement, had been provided with a plenum system but the fan was not running at the time of inspection because the stereotypers claimed the air was too cold. The plant was visited in the middle of January, with outside temperature of 58° to 60°. The metal kettles consisted of two junior autoplates and one ordinary kettle, with force pump to double-page casting box, all with gas fuel and equipped with hoods and aprons, piped to an exhaust duct with a fan, which removed the fumes well, but the air felt close and uncomfortable in both stereotype foundry and pressroom. The new plant offered a decided contrast. The composing room was located in an airy apartment on the top floor of the three-story part of the building, with saw-tooth

roof. The 57 new line-casting machines were provided with electric pots and automatic sliding metal feeders. The stereotype molding department, which was placed in one side of the composing room, was provided with exhausts for the fumes from the fuel for the boilers for the steam tables. The five monotype casting machines, separated from the rest by glass-top partitions, were supplied with electric metal pots and electrically heated metal feeders. Dark rooms in the photo-engraving department were equipped with exhaust ducts connected with the general exhaust system. The stereotype foundry, placed adjoining, but separated from the pressroom on the first floor 4 feet above the street level, contained three junior autoplates provided with flat covers and piped to the building exhaust. An air-conditioning plant was installed, partly to take care of the rotogravure department, which had not been moved from its temporary quarters at the time of the visit. A number of other modern features had been included, radiators on walls and in the skylights, automatic temperature control, cooling plant for the rotogravure process, etc.

Another newspaper establishment in the same city had hand and machine composition together on the nineteenth floor of a 21-story building. The 37 machines, one of them an Elrod slug caster, were all supplied with gas fuel pots and were not piped, except for short pipes on two monotype casters. An exhaust fan had been placed in one of the windows, but was entirely inadequate to remove the fumes. The windows, located on three sides of the building, were partly open, as the outside temperature was 53° to 55° Fahrenheit. Even then the odor of gas was very noticeable and must be very bad when it is necessary to close windows. A large periodical printing establishment in the same city originally installed a plenum system with washed air and an exhaust system in the building, but, as it did not work well, the plenum was discontinued and exhaust only was used at the time of the visit, through large ducts on each floor, the average height of which was 16 feet. Ten monotype casters were placed in a separate room on the tenth floor, and though they were equipped with gas fuel pots and only short pipes the fumes were hardly noticeable, as the strong exhaust absorbed them rapidly. A book and job printing establishment in the same city had four monotype casting machines placed on the second floor, separated by a low partition from the pressroom. These were equipped with gas fuel pots and provided with short pipes, extending up in hoods, piped to a duct out through the window, but two of the pipes had been disconnected and the main duct pulled out of the window. Fumes were noticeable not only in the inclosure, but also in the adjoining pressroom. Another book and job printing establishment in the same building, all contained in one room, had an equipment of four line-casting machines, provided with gas-fuel pots and gas-heated metal feeders. These had been piped, with a small fan, but the pipes were too small to handle the fumes, and were consequently discontinued.

In a newspaper establishment in Pittsburgh the composing room was located on the top floor of a five-story building and contained 38 line-casting machines, all provided with gas fuel pots, 12 of them with gas-heated metal feeders, 2 slug-casting machines with gas-

fuel pots and feeders, and 1 Elrod slug caster. The line-casting machines were piped to three ducts out through the roof, but with natural draft only, and on one the pipe was disconnected. The pipes covered the exhaust orifices only, leaving the gas flames on the feeders to scatter fumes in the room. The slug casters were not piped. The roof was provided with saw-tooth skylights, which were supplied with natural draft ventilators, and the transoms in the glass parts were open. The stereotype molding department was located in one corner, and an exhaust fan had been placed in the skylight above the steam table which had individual gas fuel boilers with the fuel piped out through the roof. Considerable odor of gas was noticeable in the room though it was overpowered by fumes coming up through a descending pole shaft and open stairway from the stereotype foundry on the floor below, creating a very undesirable condition. Another newspaper plant in the city had its composing room located on the third floor of a six-story building. It was supplied with 9,000 cubic feet of air per minute, by plenum through three pipes, with intake on the roof. Twenty-four line-casting machines, provided with three electric pots, the rest with gas fuel, were piped to two ducts out through the window, with a fan extending up above the roof. One Elrod slug caster and two others, all with gas fuel pots, were each provided with a hood and piped to the ducts. Two monotype casters, with gas fuel also and placed in a separate inclosure, were provided with short pipes extending up in hoods that were also piped to the ducts. The ingot metal kettle, which was in a small separate room, was piped above the roof. The stereotype molding department was located in one end of the composing room and some heat was distributed by the steam table, as well as some moisture by the stereotype blankets, hung on a rack above it, but the air was free from gas odor and seemed very good. In winter the plenum fan was reversed and used as exhaust instead. A third newspaper in the same city, where the composing room was located on the top floor of an eight-story building, had an equipment consisting of 34 line-casting machines, 29 of which were provided with gas fuel on pots and on automatic metal feeders, the rest with electric pots, two typographs with electric pots, two Elrod and one other slug caster, all with gas fuel pots. All gas fuel line machines were piped to a main duct out through the roof and hoods over the slug casters were also piped to same, but the pipes were too small and the duct was not provided with a fan, so fumes were noticeable in the room. The windows by the side of the line-casting machines, which were partly open, were provided with deflecting shields at the bottoms. The ingot-metal furnace was located in a separate room, together with a small dross-smelting furnace. Both were equipped with gas fuel and piped together out through the roof with a fan. An exhaust fan had also been placed in the window of the room. The stereotype molding department was located in one end of the composing room. An electric drying table was used, and a shaft with descending pole to the stereotype foundry on the floor below had been inclosed in a small closet to prevent fumes from coming through.

In one newspaper establishment in Richmond the composing room and stereotyping department occupied the top floor of a three-story building jointly. Equipment consisted of 16 line-casting machines

and one slug-casting machine, all of them with gas fuel pots and 14 of which had been piped at one time, but the pipes had been removed. The ingot metal furnace was piped out, and the hood of the metal kettle was likewise piped, but the hood had been raised from the kettle and there were considerable fumes in the room, both from the kettle and the composing-room machines. The windows were closed tightly on account of the low temperature outside, 39° F., wet bulb, and an exhaust fan which was located in a skylight above the stereotype foundry did not seem adequate. The workers complained of headaches and a general feeling of lassitude, easily accounted for by the fumes in the room. In another newspaper plant of the same city there were two slug-casting machines, with gas fuel metal pots, placed under a balcony on which a small photo-engraving department was located. The ingot metal furnace was close by in the stereotype flat-cast department, which together with the molding department occupied the adjoining corner. In another part of the room were the line-casting machines, the majority with electric pots, but six with gas fuel pots and not piped. The odor of gas was very strong, especially on the balcony above the slug casters and close by the line-casting machines. The operators on these objected to opening the windows on account of draft, and an exhaust fan placed in the wall of the stereotype molding department seemed to aggravate the situation by drawing the fumes through the room. The door was missing in the hood of the ingot metal furnace and heavy fumes were emitted, especially when metal was being melted in the morning. The compositors admitted that they were feeling bad and laid it mostly to the ingot metal furnace, but it was unquestionably caused mainly by the other fumes in the room, though the furnace would be a contributing factor. One book and job printing establishment in the same city found the fumes from its ingot furnaces so obnoxious that it was moved from the basement to a vacant room on the top floor, where it was piped out of the building. The main trouble, which was evidently overlooked, was that ordinary natural draft is not sufficient to carry off fumes created by operation, and the only method for sure elimination of them is by application of mechanical exhaust.

A book and job printing establishment in St. Louis was equipped with a plenum system, obtaining fresh air through a large duct in a window and blowing it through heating coils and a water curtain, but using it only for its office and stationery store on the first floor. The composing room located on the top floor of the six-story building was equipped with 5 line-casting machines (placed with the hand composition) that were provided with gas fuel on metal pots and feeders and piped to the flue, also with 5 monotype casting machines, placed in a separate room, having gas fuel pots and provided with short pipes. A large exhaust fan in this room eliminated the fumes well, but there was some odor noticeable around the line-casting machines, again a question of natural draft. A newspaper establishment in the same city had the composing room and the stereotype molding and flat-cast departments in one room on the fourth floor of an eight-story building. The building was provided with a plenum system, with intake on the street level, heating coils, and water curtain, for supplying washed and tempered air to the office,

mailing room, stereotype foundry, and pressroom, comprising the first floor and basement only. Exhaust fans were used in the windows of the photo-engraving and rotogravure grinding departments on the fifth floor and in the wall of the composing room on the fourth floor. A special exhaust system was used for the rotogravure presses on the fifth floor, and the stereotype casting machinery in the basement was provided with fan exhaust. The 38 line-casting machines in the composing room were equipped with electric pots. Three monotype casters, which had gas fuel pots, were provided with short pipes up in hoods and piped out of the building with fan exhaust. The ingot metal furnace and the hood over the kettle for flat casts, located together, were also piped to this exhaust. The air in the composing room felt very good, in spite of the fact that the windows were closed on account of the cold weather. It was 42° F. outside.

The largest book and job printing establishment in Washington was supplied with ducts for plenum and exhaust in the columns on each floor, but the system was claimed to have proved unsatisfactory and had been discontinued. Natural ventilation was used, except in the etching room of the photo-engraving department and in the monotype casting room, where an exhaust fan had been placed in a window. The windows were equipped with deflectors at the bottom and adjustable ventilators in frames below the sashes. Some ceiling fans and a number of bracket fans, placed on the columns in the center of each wing, were used to keep the air moving. The various operations in the ordinary composing room had been separated, divided into the linotype section, monotype casting room, monotype correcting and assembling room, typesetting and casting machine repair shop, and the metal room, all on the seventh floor; the monotype keyboard room, proof room and the hand composing room, all on the sixth floor; while on the fifth floor both hand and machine composition were performed for a special section in a room containing presses also; and on the second floor machine composition for the job section was performed in one room, with hand composition in an adjoining room. The 88 line-casting machines and 2 slug-casting machines, grouped in the linotype section, were equipped with electric metal pots, as were 10 others that were placed in the other rooms, and the air appeared good and wholesome. The monotype casting room contained 126 casting machines, all with gas fuel pots, but with individual pipes to two exhaust ducts that were carried out through the roof and provided with strong fans. This was the largest collection of gas fuel machines observed in composing rooms, and gave an effective illustration of the fact that no matter how many machines are used the fumes created in their operation can be disposed of through continuous piping or good hoods with piping, if sufficient exhaust is used. The air felt very comfortable, probably rendered even better by the exhaust fan, placed in the wall, a distinct difference from places where the fumes were carried only a slight distance toward the ceiling by a short exhaust pipe, and either scattered from there among the surroundings or drawn by an exhaust fan through the room, polluting the air in transit, and finally expelled by the fan.

The monotype correcting and assembling room did not contain any machines that created fumes, but the metal room, in which the

ingot metal kettle was located, was quite different. As the amount of metal used per day in the casting machines averaged 15 tons, a large kettle was required in which to melt it and, as the metal for the platemaking section consisted of different mixtures, other kettles for mixing these separately were also used. The kettles, which were heated by gas, were all provided with good hoods, piped with large pipes out through the roof with fan equipment. Considerable heat was noticed in the metal mixing room, but the fumes seemed to be well under control during the two days spent in the plant for a thorough inspection of it, and the separate visits to this room did not reveal any variation in conditions, even when linotype slugs were being melted. A dross refining furnace was stationed in one corner, but was not in operation during the inspection. This was supplied with charcoal fuel and fan blast when used, expelling the recovered metal through a spout near the bottom, and was piped to the exhaust fan for the kettles. The metal room was provided with good natural draft on account of its location on a bridge between the two wings. The monotype keyboard room contained 100 keyboard machines, but no fumes are developed by these machines, and no fumes were in either the proof room or the hand composing room. The machines in the special combination section, as well as in the machine room of the job section, were also provided with electric metal pots.

In the same city, good provision for ventilation was also found in a large plate engraving and printing establishment equipped with plenum and exhaust system. A large fan in the basement supplied washed air through the rooms by means of ducts or by means of grates in the walls. The ceilings were very high in the workrooms, the windows in the ends of the wings were louvered and some of those in the sides were partly open during the visit, which was in the middle of October when the outside temperature ranged from 50° to 60° F. Bracket fans on the columns down the center of the wings assisted in distribution of the air. Special exhausts were used for some of the various operations, keeping the air of the building in good condition.

A newspaper establishment in the same city was supplied with plenum in winter and exhaust in summer by a large fan on the second floor. Additional natural ventilation was used at the time of the visit through deflecting sections in the center of windows, as the outside temperature was 53° to 68° F. The composing room was located on the eighth floor of a nine-story building, and was two stories high with a gallery around part of it on the ninth floor level. Sixteen of the line-casting machines in the room were provided with electric metal pots, while 19 of them were supplied with gas fuel pots and piped to two main ducts leading out of the room, one with fan exhaust, the other with natural draft only. One slug-casting machine, also in the room and provided with a gas fuel pot, was piped together with hoods over the two monotype and two Elrod slug casters, located in a separate room in the gallery, to a main duct leading out of the building. As this duct was dependent on natural draft the fumes were not fully eliminated and were noticeable in the small room. A reversible exhaust fan in a window on the north side of the composing room, provided with a shutter outside, was used to remove any possible fumes there, as-

sisted by bracket fans in the room, blowing toward the outlet. No fumes were noticeable during the visit but the natural draft for the one duct on part of the line-casting machines might not be sufficient at all times. The stereotype molding and flat-finishing department was located in a separate parallel wing and contained the ingot metal furnace, which was heated with gas fuel, provided with a hood and curtains and was piped, together with fuel from the boilers for the steam tables, to the flue. One book and job printing establishment in the same city was equipped with four line-casting machines and provided with gas fuel on the metal pots and the automatic metal feeders. The metal pots were piped to a duct leading out through the window, with a small fan attached, but the fan was not running and the odor of gas was noticeable around the rear of the composing room, where the machines were located.

In practically all establishments where the odor of gas was noticeable there was a general complaint from the workers of headache and stomach trouble, as well as a feeling of lassitude commencing soon after entering the plant, increasing while present there and gradually disappearing after leaving it. Where good provisions for absorbing the fumes existed, or in composing rooms where the casting machines were equipped with electric metal pots, the workers did not seem affected in this manner. This pointed to the fact that the principal cause of the trouble was not fumes from the lead but the fumes and gases liberated by the fuel gas.

Adequate provision for heating is sometimes a perplexing problem. Where the plenum system is used this, of course, takes care of the situation and large plants, or modern buildings housing small plants, are usually well provided with one of the various kinds of heating systems. Small establishments housed in old buildings have inadequate facilities and several plants were encountered in which it was necessary to use auxiliary heating stoves during cold weather, some provided with coal or wood stoves, others with oil or gas fuel stoves. It is, however, comparatively easy to produce and maintain a proper condition of heat indoors in winter time, but in summer, when the outside temperature ranges from 95° F. up, it is very difficult to attain except through blowers and humidifiers. A number of establishments were found that did not have any provisions for cooling the atmosphere in the rooms, except by opening the windows or doors, and were uncomfortably hot. Others were well provided with ceiling fans or bracket fans, that kept the air in continual motion, which produced a cooling effect and reduced the discomfort. The metal pots on the various casting machines naturally throw off some heat, as the metal is usually kept at a temperature of about 540° F. in line-casting machines and 680° to 720° in unotype casting machines, but sometimes higher in either according to composition of the metal and size of type produced. The pots are, however, small and the application of electricity for heating has helped to reduce the amount of heat created, as most of it is retained inside of the pot and, in addition, the current is automatically cut off whenever the temperature reaches a certain point, adjustable by the operator, and is thrown on again automatically at a lower point to prevent the metal from freezing. Where gas is used this must be kept burning for some time to melt the metal, if the machine

is used intermittently, but continuously during the operation. In some plants the gas was kept burning under the metal pots the full 24 hours. The heat generated by operations in the composing room itself is inconsequential, but where the ingot metal furnace, the dross refining furnace, or the stereotype molding department with steam tables is located in the composing room, some methods should be used to protect the workers from the influence of these.

It is impossible to prevent dust formation in a composing room, but most of the dust created can be removed at the point of origin. The dust, which is composed of the metal used in the process and consists of lead, antimony, and tin, is a possible source of lead poisoning, and it is really surprising that so little caution is used in some places to prevent scattering of the dust, usually through the carelessness of the workers themselves. The chief source of danger, and one which seems more important than any possible fumes from metal pots on casting machines, is the dust which is brushed off, or otherwise removed, from the plungers used in the metal pots to force the molten metal into the mold. Through the continued use of the machines the plungers become covered with a deposit of oxide of lead, preventing them from working smoothly in the wells and necessitating removal. In shops containing one or at most only a few machines this is often one of the duties of the operator, but in large establishments, especially on newspapers, the operation is performed by the machinists. Some machinists realize the possible danger involved, while others ignore it completely and expose others to danger as well as themselves. The old method, and one which is still used in a number of establishments, consists in removing the plunger from the well and, while still hot, brushing it rapidly with a flat wire brush, which removes the deposit in the form of a fine gray dust. One large newspaper establishment in New York, which had an equipment of 72 line-casting machines, was using this method. During the survey of a newspaper plant in Kansas City, the operation of cleaning the plungers in this manner was watched. The inspection of the composing room extended through the lunch period. As soon as the 18 line-casting machines were stopped the machinist's helper, who was a young boy, pulled a small box on wheels up to one of the machines, removed the plunger from the pot and, resting one end on the box, proceeded to brush it briskly. The fine oxide of lead dust dropped partly on the floor between the box and the machine but a large cloud of it could plainly be seen rising upward, directly into the mouth of the boy bending over it. The plunger was brushed rapidly to prevent cooling it more than absolutely necessary. After removal from the metal pot of the floating dross, which was taken out with a small spoon and dumped on the floor beside the machine, the plunger was again placed in the well of the pot, and the operation repeated on the other machines. Here was, first of all, the exposure of the helper to the oxide dust—recognized by all the authorities as one of the most dangerous forms of lead—supplemented with the exposure of the operator to the pile of dust left on the floor near each machine during the entire afternoon, and which he could hardly avoid stirring up with his feet from time to time, also the similar danger from the dross skimmings left on the floor and, finally, the possible risk from

these sources to those who cleaned the floor after the day's work. Such practices can not be too strongly condemned, as there is no necessity for them.

In another newspaper establishment in the same city the plungers were also brushed by hand with a wire brush, but it was claimed that the operation was performed during the absence of the force, between shifts, by a special cleaner, who wore a sponge over the mouth while doing it, and that the dust was removed before the operators came to work. A number of newspaper plants were provided with a small mechanical cleaner, in which the plunger was inserted and which, when closed, was practically dust-proof. Turning a handle by hand revolved rotary wire brushes, which removed the coating from the plunger, collecting the dust in the bottom of the box and eliminating any possible danger. A large newspaper establishment in New York had one of these machines stationed in a separate room, which was provided with an exhaust fan in the transom over the door, and another newspaper plant in Chicago was equipped with a somewhat similar but larger cleaner, which was piped to a flue, but the majority of the cleaners were portable and were moved from one machine to the next during the cleaning process. In two large newspaper plants, one in New York and one in Chicago, a different method was used, which effectually eliminated all dust. The plunger was taken out of the metal pot and dipped quickly into a pail, partly filled with water, where the accumulated oxide was instantly removed from the plunger by the contact. As the dip was only of short duration the plunger was not chilled and the remaining heat prevented any water from clinging to it. In one establishment precaution was taken to wipe the plunger roughly with a rag. This method was also used in a large trade composition establishment in Chicago and in a few smaller establishments in various localities, and all declared it to be the fastest way, as well as the most hygienic. A pail which had been used without changing the water for two days in an establishment equipped with over 20 line-casting machines, and where the plungers were cleaned daily, contained over one-fourth inch of lead dust in the bottom. Inquiry was made of several machinists why this method was not used in preference to others, as it seemed the most practical one. The usual answer was that the water would cling to the plunger and cause an explosion when it was returned to the hot metal pot, even though these machinists had seen it done without any such effect, such as in one periodical printing plant which contained two machine composition departments, located on separate floors, one of which used the dip method effectively, while the other declared it could not be done safely.

Some authorities dwell considerably on other classes of lead dust in the composing rooms. Thorough observation indicates that there would not be sufficient quantity of this present seriously to affect the health of the compositors in an establishment which was kept in a sanitary condition. Methods have changed considerably with the passing of the years. The elimination of distribution of used type has reduced the accumulation of oxide dust in the type cases, previously one of the chief factors. The vacuum cleaning used for absorbing the dust from the cases when necessary has removed the

danger formerly encountered by blowing out the cases with bellows or with compressed air. It is regrettable that the vacuum system is not more generally used for this purpose and that a number of establishments still employ the bellows or compressed air. It is never a good plan to scatter possible injurious dust when this can be absorbed and localized just as easily. There is at times considerable metallic lead around line-casting machines or unit-casting machines, but this is usually coarse metallic scraps and does not appear to cause any appreciable damage. Some fine metallic dust is created by the saws and mitering machines used for cutting slugs to required special sizes. They are, as a rule, used only intermittently, but there is really no excuse for not providing these machines with some device that will remove the dust right at the source. In a number of establishments they were not provided with any arrangement at all, just left open in the room, permitting the dust to scatter all around. In others they were inclosed in small booths, mostly to prevent the particles dislodged by the saw or the mitering machine from being propelled against other work located close by, such as line-casting machines. In the majority of such cases the sides of the booths came only to 4 or 6 inches above the floor, and the metal cuttings were scattered all around the booth as well as tracked still further outside by workers in the room. Only a few plants were found that used a cabinet reaching the floor or had suction applied to remove the cuttings, though such could easily be arranged. The cuttings are unsightly, whether they are dangerous to the health or not, and should be got rid of instead of kicked around and scattered all over. A new style of metal feeder was seen, by means of which the old metal slugs, scraps, or other material were fed directly back into the metal pot instead of being remelted first. In this case there was dead metal piled in small boxes near to the type-casting machines and running over on the floor, producing a very unsanitary appearance and the possibility of scattering dust over the floors from tramping around in it. In one establishment the machinist was found rubbing the space bands from a line-casting machine on a large pad placed on a bench. Considerable fine dust was noticed on the surface of the pad around the edges, and, as the machinist leaned right over it, such a method seemed rather careless. He claimed there were no ill effects from the operation, which was performed right along at intervals, but here, as with the other possible dangers from dust, the hazard could not be absolutely determined without analysis of the air.

The examination of composing rooms in printing trade plants revealed that, in spite of constant improvements, there were still a number of undesirable conditions existing in some establishments, which could be remedied with advantage to both employers and workers. The latter are interested from a standpoint of personal health, and the former additionally from a question of production. There is no valid reason for polluting the atmosphere with either fumes, gases, or dust, and a composing room can be filled with just as good, clean, wholesome air as an office.

Photo-engraving establishments, whether independent plants or departments of combination establishments, are exposed to fumes and gases developed by the chemicals used in the process or liberated

by heating equipment, as well as by dust from chemicals or from the materials of which the plates are made. Ventilation equipment was used in a number of the establishments or departments surveyed, to eliminate the fumes, gases, and dust. The summary of tabulation (p. 229), under head of "Ventilation of equipment" and subhead "Photo-engraving," shows that out of the 142 establishments the provision was good in 29.6 per cent, fair in 47.9 per cent, and bad in 22.5 per cent. The relative terms good, fair, and bad are used in the same manner as they were applied for ventilation of composing-room equipment.

Fumes and gases are liberated to a great extent by the various chemicals used in the dark rooms, aggravated at times by the heat developed in these rooms when not properly ventilated, and by additional heat from the exposure lamps in the galleries or, in summer time, by the rays of the sun on large glass walls and skylights in the galleries. Ventilation of the dark rooms, which was included in the tabulation of ventilation for buildings, is an item that had not been properly taken care of in a number of the establishments visited. Dark rooms often consisted of box structures located in the center of the room, some with a natural draft ventilator to the gallery and others with ventilation only through the doors which had to be closed during the operations. Other establishments had the dark rooms placed by the outside wall, where window ventilation could be obtained, and in some they were provided with ventilating ducts. One large plant in Boston, which had moved, about a year previous, to a new building erected for the purpose, had the dark rooms arranged along the outside wall, but separated from this by a 2-foot space, in which the drain pipes were located for easy access, at the same time giving ample facilities for ventilation.

Another establishment, located in a modern building in Cleveland, also had dark rooms and stripping placed in a similar manner, with windows in these directly opposite those in the outside wall. A newspaper establishment, located in an old inside building in New York, with the photo-engraving department on the fifth floor, had provided the dark rooms with a good exhaust duct leading out through the wall and supplied with a fan. In addition there were also hoods over the silver bath and acetic acid tray, to remove fumes from these, and over the exposure lamps. A photo service department, placed on the fourth floor, was provided with hoods over a gas fuel photo printer, piped together with pipe from a gas fuel drying oven to an exhaust duct with a fan. The dark room of the staff photographers, located on the second floor, was also provided with an exhaust duct. The air felt good in spite of the fumes developed and the unfavorable conditions of the building itself, showing that even with such handicaps a photo-engraving gallery, with dark rooms, can be turned into a comfortable place to work. Another establishment was in part located on the top floor of an eight-story building in Chicago. The room was provided with a high ceiling and skylights, used for ventilation, together with the natural draft turrets through the ceiling in the printing and coating departments, adjoining the gallery. The dark rooms, ranged along one wall, had been provided with an exhaust duct with individual pipes from each booth, extending out through the roof. It

was claimed it had not proved satisfactory and it was being removed at time of the visit. The reason for failure to work was probably that it had been attempted to operate it by natural draft instead of applying a fan. One of the dark-room booths, in which sulphite of sodium was handled, was provided with a small exhaust fan in the wall and the coating room had been supplied with an exhaust fan in one window. In spite of the high ceiling and the open skylights there was a decided odor of chemicals in the gallery. A photo-engraving department of a newspaper establishment in Pittsburgh was located on the fourth floor of a five-story building. The gallery was an inside room with the dark rooms along one side and ventilated to the hall of the building only, where fumes were strong. Two small bracket fans had been placed in a window between gallery and hall, but one of them had been borrowed for the etching room, which was separate and was extremely hot on account of a large gas fuel baking stove, burning continuously during the visit. This room also contained an etching machine and a power rocker etching tub. The former was provided with a pipe that extended out through the wall, but the latter had no provision for carrying off the acid fumes that penetrated into the gallery and made the atmosphere feel decidedly unpleasant.

One establishment in New York was provided with fan exhaust from the dark rooms, through a duct leading out of a window, but the grates in the ceilings of the dark rooms were covered, claimed to have been done a few days previous when it was very windy, and the fan was not working. Consequently there were considerable fumes in the galleries. In another establishment in the same locality this condition also prevailed because the workers objected to the draft. In a photo-engraving department of a rotogravure establishment in Cleveland sensitizing, twirling, and printing were all performed in small dark-room boxes, placed in the center of the room, with no special ventilation, and it was very hot in the printing booth, making surroundings uncomfortable. In one establishment in New York, located on two top floors of a 17-story building, it was found that each worker was supplied with a window for his station. The dark rooms were furnished with windows, and only very slight odors were noticed. One offset printing establishment in Milwaukee was equipped with electrically heated plenum for its photo-engraving department and exhaust grates in ceilings of transfer and proofing rooms, which kept the air in good condition. Sinks and twirler were provided with special hoods connected by pipes with main exhaust duct. Several large color printing establishments in Chicago were furnished with good systems of exhaust by means of hoods over the various equipment in the photo-engraving departments, eliminating fumes and heat. In one of these the direct gallery contained a large southern exposure of glass, which ordinarily would render it very hot and uncomfortable in summer, but this condition had been ameliorated by installation of pipes on the sides of the glass, through which cold water was circulated. In contrast to these establishments was one in Milwaukee, located on the second floor of an old three-story office building, with windows on one side, in front, and in rear. The front of the building contained the office, separated from the gallery, in which were located the cameras, dark rooms, printing, and

copper etching, while zinc etching, routing and blocking, hand-tooting, and proving, also the art department, were each in a separate room. The dark rooms were boxlike structures, with ventilation only through the doors into the gallery. Fumes were very noticeable in spite of an exhaust fan, installed in the outside wall of the gallery by order of the factory inspector and against the protest of the firm, which declared at time of the visit that the window ventilation along one side of the room ought to have been quite sufficient. The inspection of the plant was in June, and the outside temperature ranged around 85° F. Even with the windows open and the fan in operation the room was far from comfortable.

In the majority of places the sinks, where clearing the lines of the negative, or so-called cutting, with cyanide of potassium was performed, were placed in the often poorly ventilated dark rooms. A few plants among those visited had them located near windows to admit all possible fresh air and to minimize the danger in handling this extremely poisonous material. In some establishments the fumes created in preparing the nitrate of silver bath for developing the negatives were very noticeable. One plant in New York had the bath cooking on a small gas heater in the stripping room, another had it placed similarly in the gallery, and a third had it in the copper etching room, none of the plants having made any provision to eliminate the fumes. In another establishment it was provided with a hood piped out of the window, but the steam from the pipe had caused complaints from other tenants of the building and a change was considered. In one plant the bath was placed in the chemical store room and equipped with a hood piped to the flue with a small fan exhaust, which effectually eliminated the steam. In another it was located in the gallery but inclosed in a cabinet, also piped out, with similar result. Glass washing often creates undesirable fumes when the old negatives are left to soak in a strong solution of acid to remove the film, sometimes in a room where other operations are being performed and in an uncovered soaking tray. In some shops this operation was done in a separate room, and in some the glass was soaked in covered tanks provided with an exhaust pipe—undoubtedly the best method. In one establishment a gas mask was provided and was worn during the cleaning operation—something seldom met with on account of the aversion of the workers to use such appendage.

Ventilation on equipment is especially required in the zinc etching department, where diluted nitric acid is used to dissolve the metal around the designs on the plates. Most of the plants inspected were equipped with one or more of the various styles of etching machines, consisting of tanks in which the plates are placed and subjected to the corroding effect of the acid. In one of these the acid is splashed against the face of the plate with a revolving paddle. In another it is forced against the face in sprays by compressed air. In a different machine the plate is driven vertically in and out of the acid, face down, and another kind is equipped with a tray having a corrugated bottom and moving with a rocking motion which forces the acid up into the plate, held face down. Machines of similar styles are also used for copper etching, but, as the etching fluid used for

that metal consists of a perchloride of iron solution, there are no dangerous fumes emitted and, consequently, no need for special ventilating equipment. A different method was also used for etching copper in some plants by means of an electrolytic machine in which the copper is etched electrically, the opposite of electroplating. In the majority of cases the zinc etching machines were piped, either to a main exhaust duct or separately out through the wall or a window. Those provided with fan motion were seldom found equipped with additional exhaust fans, and the pipes seemed to carry the fumes off well. The other machines were sometimes equipped with pipes provided with fan exhaust or natural draft, or occasionally not even piped. It is a natural condition that constant familiarity and daily contact with dangerous elements in the trade develops a natural contempt for these in the minds of both workers and employers. Nitric acid is a very powerful destructive agent, but the workers get so used to the fumes that they ignore the danger, and consequently conditions are found at times that by no means should be allowed to exist. In two of the large color printing establishments in Chicago the exhaust pipes from the etching machines were badly corroded, permitting fumes to escape into the rooms. Lids provided for the machines, to prevent distribution of fumes during agitation of the acid while operating the machines, were often left off. In one large establishment in Philadelphia four machines were observed in this condition. These were piped and the room was provided with an exhaust duct, but the air was full of acid fumes. The foreman pointed to the covers, lying under the machines, and claimed that the men did not want the covers on. Similar experiences were met with in other plants. In one establishment in Detroit the original covers had been replaced by others, home-made ones, that did not fit well and permitted fumes to pollute the air around the workers.

A newspaper establishment in New York, previously mentioned as handicapped by an old building but with installation of devices to make working conditions tolerable, furnished a decided contrast. The etching room was equipped with two etching machines, each with a pipe extending out through the wall, and in addition was provided with a large hood, extending over these machines, and a power-driven rocking tub placed between them, through which all fumes were eliminated. Some smaller establishments were equipped with etching tubs in place of machines. These are given a rocking motion, by hand or by power drive, which dashes the acid back and forth over the face of the plate, deposited in the bottom. When rocked by hand, the old-fashioned way, the operator is usually stationed by the side of the tub with one hand on each end of it so as to press it down alternately, subjecting him to inhalation of the fumes. When the tub is propelled by power he can walk away from the immediate locality but, even then, is often required to bend over the tub to insert the plate, to take it out, or to assist the action of the acid by brushing the plate. Where no method is provided for direct exhaust of the fumes, these naturally spread around in the room and create an undesirable condition, such as was observed in some establishments where the tubs had been placed by the windows. Instead of the fumes floating out through the open window, they

are blown into the room by the draft through it, polluting the atmosphere not alone on the same floor but often throughout the whole building. This may also happen even where hoods are provided and exhaust applied with a fan, such as in one large establishment in Chicago, located on the fifth and sixth floors of a six-story building, where the odor of the chemicals was strongly noticeable near the elevator shaft in the entrance hall on the first floor of the building. The hood and exhaust appliance localizes the fumes, but even in such cases whenever the operator bends over the tub he is more or less subjected to inhalation of the fumes as they ascend to the exhaust. Rocking tubs were found in some of the larger establishments also, in addition to the etching machines, and these were usually provided with power drive and with exhaust for the fumes. In one establishment in New York a power-driven rocking tub was observed that had been inclosed in a glass-topped cabinet, which was piped out of the building and with fan exhaust, but in other places such inclosure was declared to be impracticable for the operation involved.

One of the sources of fumes in the etching room, or other parts of the establishment where it may be located, is the carboy containing the concentrated nitric acid. The carboy itself does not allow the fumes to escape, but the carelessness of the workers, who pour the acid from it into their receptacles and then leave the stopper out instead of replacing it in the carboy, permits the fumes to spread through the room and pollute the air. This condition was found in several of the plants visited. In one of these, located in New York, the attention of the etcher was directed to the circumstance. He claimed that it had been left out by the night shift, but, as the survey of the establishment did not start until 11 o'clock a. m., he evinced a personal disregard of his own health by not stopping up the carboy himself before then, even though some one else might have left it open. No attempt was made to do so, even after attention had been called to it. In another New York establishment a sign had been placed above the carboy, reading "Keep top on." This plant was inspected twice to observe working conditions for both day and night shifts, and in both instances the carboy was found open. In cases such as these the workers have only themselves to blame if other conditions are not of the best, because the employers can hardly be expected to make improvements which are slighted or ignored by those who would benefit by them. There is a danger of breakage of the carboys containing nitric acid or other acids used in the process, in spite of the wooden case which protects the large glass vessel. This would liberate a great quantity of fumes, the inhaling of which under similar circumstances have proved fatal or, even where the exposure appeared to have been light, developed severe after-effects many hours later. A number of the establishments were provided with special hangers in individual frames for holding the carboys and to permit easy tipping to pour the fluid. Some kept the supply of carboys on concrete stands provided with a projecting edge to prevent escape of acid in case of breakage, and a number of them were supplied with large quantities of bicarbonate of soda or soda ash and ammonia to neutralize the acid and prevent fumes in such event. In two places the storage stand was located on the roof, outside the door of the etching room, for additional safety.

Chemical fumes are also spread throughout the etching room or the entire plant by drains from etching tubs, etching machines, or sinks. In some establishments the drains consisted of open gutters, molded in the concrete floors, which allowed the fumes to escape freely from the fluids flowing to the main drains for the building. Metal pipes can not be used successfully, on account of the corroding effect of the acid, and terra cotta drains have a tendency to become loosened in the joints whenever there is any vibration in the building, letting the fumes escape through the cracks, as observed in some instances during inspections. In plants that were using hard rubber drains there were no fumes noticeable from this source, and consequently it seemed to be the ideal method. There may also be other causes for fumes, such as in one establishment in New York, where a sink in the etching department contained one open tray with acid and another with phenoid cleaner. The sink was placed right against a window, partly open, in the top part of which a small exhaust fan was located. The fan was not in running order and there was considerable complaint from the workers about the fumes distributed by the acid and the cleaner. That chemical fumes can be entirely eliminated by proper exhaust and by cooperation of the workers was successfully demonstrated in a number of establishments, both large and small, where the air was good and wholesome, no taint of fumes being noticeable.

There is still another source of fumes, especially in the etching department, but also existing in other parts of the plants, which ordinarily is completely ignored by the workers. During etching the designs on the plates are protected from the acid by an acid-resisting coat of ink and a resinous powder. To fix this latter it is necessary to melt it by heating the plate, which in the majority of cases was done by holding it over a stove, usually consisting of several tubes, provided with perforations and supplied with gas by opening a valve. The gas is lighted from a pilot light, left burning, while the stove is supposed to be extinguished except when actually in use. In a number of cases the stoves were found burning continually, consuming the oxygen of the air and polluting the room by fumes and gases. Whirlers, which are used in the galleries for turning the plates during drying operations in sensitizing them, are ordinarily suspended over gas stoves. Drying ovens, used for drying negative glass after washing, are also ordinarily supplied with gas fuel, though a few were found that were heated by steam. Some of the plants were well provided with hoods and exhausts for the gas stoves, but in several others the odor of gas was noticeable over the chemical fumes in the establishments, and these were quite strong.

In a few plants electrically heated whirlers and drying ovens were used, and one establishment even used an electric stove for baking the acid resist on the plates. Electrical equipment is ideal from a health standpoint and, according to those who were using it, performed the work in a satisfactory manner, but is objected to mainly on account of the comparatively high cost. Gas fuel can be made safe by proper ventilation, which should in all cases be applied to it to prevent contamination of the atmosphere, no matter where or how it is used. The undesirability of it under other circumstances was emphasized in one photo-engraving establishment in Philadelphia,

which was visited during the end of January, when the outside temperature was about 15° Fahrenheit. The ceilings were low and only natural ventilation was provided for the rooms. As the day was cold the windows and the ventilation pipes in the roof were closed, keeping the gas fumes from whirlers and baking stoves and the chemical fumes in the building. The dark rooms were, with one exception, provided with ventilation to the galleries only and two rocking tubs in the etching room had no provision at all. The heating system for the building was insufficient and it had been necessary to augment it by the use of coal stoves and gas fuel stoves. These latter distributed considerable fumes also, and altogether the atmosphere in the plant was far from desirable. A number of the workers complained of headaches and nervousness—not surprising under the circumstances.

The dust proposition in the zinc etching department is also objectionable, on account of the fine resinous powder, called dragon's blood, which is brushed over the face of the plate to cover the design and protect it from the action of the acid. In some of the establishments this was kept in open trays, in others in cabinets with open fronts, while several used better arrangements, though none of those observed were ideal and the old-fashioned method of hand brushing was used in all except one of the plants inspected. The operator holds the plate in the box or cabinet with one hand and brushes the fine powder over the face of it in four different directions so as to cover all edges, then bakes the powder by heating the plate over a stove and inserts it in the acid bath. As the plate usually receives three separate immersions in the acid this means that it must be powdered at least three times.

The dragon's blood is a very fine powder and is distributed through the air by the agitation and brushing of the plate. It is an organic dust, and as such not classed by authorities among those that cause pulmonary lesions. There is, however, no question that a large amount of it is inhaled, as in a number of plants the hair and clothing of the workers were thickly coated with the fine, red dust, and all projections in the room, in some cases even the perpendicular walls, were similarly covered. In one establishment in Richmond the departments were separated by galvanized-iron partitions. The partition dividing the etching room from the gallery was covered with dragon's blood, which had also drifted through imperfect-fitting joints and was visible in streaks on the other side in the gallery. One establishment in New York had installed cabinets with slide fronts for the dragon's blood, but these fronts had been raised or nailed up, probably to save the exertion of opening them, and dust was scattered all over the room. Several plants were found that had open-front cabinets, with pipes extending from the top out through the walls, equipped with small fans or piped to exhaust systems. Other cabinets were provided with hoods, extending over the boxes, and piped out in a similar manner. Equipment with fan systems does not always mean that this is used, and in several of the establishments the men neglected to start the fans when powdering the plates, with the result that the dust was scattered throughout the room. In places which used the ventilating system there was a noticeable decrease in the powder apparent in the room

as well as on the men. In Detroit a special design cabinet was observed, which was equipped with a roller front door, a small exhaust fan, and a hopper for collecting the dust expelled by the fan. No dust was observed in the room. One establishment in Nashville was provided with the usual open tray for small work, but in addition had a cabinet for large plates, which was not in operation at the time. It was explained that the plate was inserted in this cabinet, the door closed, and the dust forced against the face of the plate by a fan. It is understood that since the field survey ended a new machine has been placed on the market which automatically powders the plate, driving the powder against the face by a fan blast through a narrow orifice. The plate carriage is propelled into a stove compartment by turning a handwheel, which ignites the gas burners and drives the heat against the top of the plate, baking the powder. Turning the handwheel again propels the plate—which meanwhile is being turned one-fourth way around—into another chamber, where it is cooled by a blast of cold air. As soon as cooled, the operation is repeated until the plate has been powdered on all four sides. It is claimed that no powder can escape from the machine, so, if correct, this would solve the problem effectually and enable the etchers to breathe unpolluted air.

The problem of the finishing departments is mostly metallic dust, zinc or copper, created by the use of the various machines, such as saws, trimmers, bevelers, mortising machines, and routing machines, as well as by hand tools. Though it is seldom done, the dust created by the saws, trimmers, and bevelers could easily be collected at the source by exhaust pipes and conveyed to a receptacle. The bases of the machines are ordinarily hollow and intended to catch the majority of the cuttings. It is a question if there is sufficient danger in the dust created by the operations to justify exhaust equipment. The same holds good with the chips from the routing machines. Information has been received that in one establishment in Chicago an experiment is being made with an exhaust system for these, but the result is not known. Two of the plants inspected were equipped with exhaust on the trimming machinery, such as one in New York, which had applied it to a small circular saw and a jig saw. It was claimed that it paid from a standpoint of cleanliness, even if there were no dangerous features in the dust. The dust was collected in a box, from which it was removed at intervals. The wood-trimming machines in several places were provided with exhaust, but as wood dust is declared not detrimental to the health, such equipment was considered under sanitation. The exhaust system could have been put to good use in the two brass-engraving and die-sinking establishments inspected, where the cuttings from the lathes, saws, trimmers, and routers were scattered all over the floors. These seemed to be quite coarse and, as the amount of work was small, were probably not so detrimental to health as to looks.

The photo-engraving work for offset printing presents additional factors, together with some of those in the ordinary branch. The provisions for the gallery apply equally to either, but as the operations differ materially from there on the ventilation problem would naturally apply also. The only two factors in the offset method that seemed to require special ventilation in the plants inspected were

the drying of the grained plates by open gas flames, as found in some instances, and the fumes from the turpentine in the transfer room, which were strong enough to cause headaches and irritation of the mucous membranes of the nose in two of the plants visited. The majority of places used air for drying the plates, and most of the transfer rooms were so well ventilated that the fumes from the turpentine were carried off.

In photo-engraving work for the rotogravure method the questions of ventilation are practically the same as for the others, but to this is added the preparation of the cylinders, consisting in grinding and polishing. These are operations which always create a fine dust and, as the material is copper, would prove dangerous if not properly taken care of. The grinding is performed wet, which disposes of the danger in that operation, but the polishing material usually consists of emery or crocus cloth, fastened on a block, which rests on the revolving and automatically oscillating cylinder. The operator, as a rule, inserts the polishing block and starts the machine, which works automatically, and then leaves the immediate vicinity to do other work until the operation is finished. The fine copper dust, liberated through the action of the crocus cloth, flies all through the room, polluting the atmosphere, and is consequently inhaled by the workers, even though quite a distance from the work. In some of the plants surveyed there was sufficient dust to irritate the mucous membranes of the nose and cause sneezing. In one establishment in Chicago the operator wore a handkerchief over mouth and nose during the polishing operation. A worse condition was seen in another plant, located in Boston, where the operator was seated bending over the cylinder and holding the block with the emery cloth on the revolving cylinder. Being located so close to the source of the dust he was naturally inhaling considerable of it, as his face was unprotected. One establishment in New York claimed to have eliminated the dangerous feature by using polishing paste, spread on a felt pad, in place of the crocus cloth on the automatic polishing machines. It seemed to prevent the distribution of dust through the air, judging from observation, though the degree of absence could not be determined without analysis of the air.

Some fine metallic dust is created in steel and copper plate or die engraving, but the relative quantity is very small, and establishments where this was done were usually well ventilated. The operation of hardening the plates and dies involves some special ventilation if done on a large scale, such as in one establishment surveyed, located in Washington. It was performed in a special room, which contained tanks with cyanide of potassium, heated with gas fuel and forced draft to 400° or 500° F., in which the plates were dipped. These, as well as the accompanying cooling tanks with oil and water, were provided with hoods that were connected by large pipes with an exhaust duct up through the building and roof, and all fumes were carried off by the fan.

Considerable smoke and fumes are developed by the stereotyping process. The metal used is an alloy consisting of lead, antimony, and tin, and, similar to that for type casting, ordinarily contains about 15 per cent of antimony and 6 per cent of tin. It is kept molten in huge kettles during the casting operations. Scraps, dust,

and sweepings are thrown into the kettles and remelted, together with plates which have been used or, occasionally, with new metal. When the metal is heated to the melting point or, above, and the surface is exposed to the action of the oxygen in the air, it becomes covered with a thin film of oxide, commonly called dross. The higher the temperature the more dross is formed, and this is also affected by agitation or stirring, which presents fresh surfaces to the air. Impurities in the material rise to the top, part of them working into the dross, floating on the surface, and part of them rising in the air as smoke or fumes. The metal is stirred to facilitate rising and the dross is skimmed off, leaving the metal surface clear and bright. The subsequent action of the air forms another film of oxide, which is often carried into the air when disturbed by stirring the metal or by mechanical agitation. Coupled with the large amount of heat distributed from the equipment and the fact that a great many of the establishments are partly located in basements, the provisions for ventilating both rooms and equipment are of vast importance to the workers. That part of the summary of tabulation (p. 229) headed "Ventilation of equipment" with subhead "Stereotyping," shows that of the 103 establishments 39.8 per cent were good, 31.1 per cent fair, and 29.1 per cent bad, with the terms used relatively as for equipment of the composing room.

The molding department, where the paper matrices are made, is often located in one side of the composing room and has been referred to in connection with this. There are no fumes developed, as a rule, by the operations in the work, but in several cases the odor of gas fuel, used on boilers for the steam tables, was very noticeable. Excessive heat is created, seldom with any provision for carrying it off. Humidity is also developed through the drying process on the steam tables, making the heat more noticeable. Where the flat casting department is located in, or adjoining, the molding department there is the addition of metal fumes, together with acrolein fumes, from the kettles and usually also from the ingot metal furnace or the kettle used for that metal. The majority of stereotype flat casting kettles are provided with hoods and with curtains extending from the hoods to the edges of the kettles, but it is necessary to have doors in the curtains for feeding in the old metal and dipping out the new metal with a ladle. Consequently the doors are open part of the time, leaving a chance for the fumes to escape into the room. In several places they were found to be open at all times, except just at the beginning of melting down the metal, when the clouds of smoke often were so dense that even a strong exhaust had difficulty in removing them. In some shops the kettles were not provided with curtains, depending on the exhausts being strong enough to draw the fumes up through the hoods. In others the curtains were provided with slots to accommodate the handles of the force pumps used in place of ladles to pour the molten metal into the flat casting boxes. The hoods and the fuel exhausts were ordinarily provided with separate pipes leading to exhaust ducts, as the oil and dirt in the metal has a tendency to create soot in the pipes and this might catch fire from the fuel exhaust. Considerable heat is created by the metal kettles, and in a number of plants these were found covered with asbestos, applied in some also to the curtains and part of the

pipes, which helped to protect the workers from the radiation. The kettles often have a capacity of 5,000 pounds or more of metal, which is usually kept at a temperature of 650° F.

The largest amount of fumes is developed in the foundry, where even larger metal kettles are used. The kettle on the ordinary double junior autoplate has a capacity of 8 tons of metal and, as it is usually kept filled, constitutes also a source of considerable heat, even though its sides are covered with asbestos. The operation of the casting units at each end requires considerable muscular effort, because these will each produce three plates per minute, which must be removed and transferred to the shaving and cooling machine, and a stereotype plate for a newspaper press usually weighs about 60 pounds. Old plates, to be remelted, must also be fed into the metal kettle to replace the amount removed and to keep the rest at the required temperature. The dross is often allowed to accumulate on the top of the metal in the autoplates to about 1 inch in depth, instead of skimming it continually, as is necessary in metal kettles where ladles are used. The covering of dross protects the metal from the air, retarding oxidation, and consequently there is less contamination of the air by actual lead fumes. Plain metal kettles are substituted in some plants for the autoplates, either provided with force pumps or, in smaller newspaper establishments, intended for the use of a ladle to remove the metal. Both kinds are ordinarily supplied with hoods and curtains, though the latter are often removed after the metal has been melted. Where force pumps are used, a gas burner is placed under the mouthpiece or spout, situated above the casting box, so the metal will not be cooled before reaching the box. As this flame burns in the open and there is no provision for removing the fumes, the operators are subject to any detrimental influences that may come from it.

Several methods are used to exhaust the fumes from the autoplates, as there is no equipment for such purpose turned out by the manufacturers and a variety of opinions regarding the most efficient manner prevail. The most common arrangement consisted of a side curtain, fitting tight around the kettle but with vertical slots at each end, permitting free movement of the levers controlling the feeding pump, with a tight-fitting hood, which was piped, together with a pipe for fuel exhaust, to a duct with a fan. The curtain was supplied with a trapdoor, through which old plates and cut-off ends could be returned to the supply of metal in the kettle, but as the curtain retarded operations to a certain extent and prevented a free view of the interior, it had been removed in the majority of cases. The hood was of the same circumference as the kettle, and with this arrangement it was necessary to place it up high enough to prevent interference with the levers, about 2 or 3 feet above the kettle. The fumes naturally spread out as they rose from the surface of the metal, even where the pipe from the hood was provided with a good exhaust, and consequently were escaping outside the edges of the hood. This condition was especially bad when the ink-covered plates were melted down, liberating dense acrolein fumes.

In one establishment in Chicago one of the autoplates had been placed in a small inside room and the side curtain removed. The ceiling was low and the small room was filled with fumes that were

escaping from under the hood, as well as through an opening in the pipe, intended for additional connection and which was not capped. Failure to keep equipment in proper order was also at times a cause of undesirable conditions. A newspaper establishment in Cleveland was equipped with two autoplates, located on a 4-foot-high platform in one corner of the pressroom in the basement. These were provided with hoods of the same circumference as the kettles, piped to a main duct, with separate pipes for the fuel to the duct. The exhaust fan was not working on account of a fire in the pipes three months previous and fumes were escaping in large quantities outside the hoods, vitiating the air in the stereotype foundry and also in the pressroom, making it especially bad for the workers on the top decks of the tall presses used. The basement was supplied with plenum and exhaust which helped the condition somewhat. The management claimed continual trouble with the pipes from the autoplate exhaust, no doubt due to the fact that the fan was located directly in the duct, and also to neglect of burning out the soot in the pipes at regular intervals to prevent accumulation of a large deposit, which would create a very hot fire. Difficulty from similar cause was encountered in other plants, especially where small pipes were used, which rapidly became filled with the soot from the acrolein fumes. An establishment in Chicago, where the equipment was provided with large exhaust pipes and a fan which was situated by the side of the main duct so the fan could be shut off from the duct, took the precaution of burning out the pipes regularly every three weeks—an excellent method. The fuel was piped separately in this plant, as well as in a number of others. Other ventilating conditions in the building also affected the system. One establishment in Denver had two autoplates, provided with hoods of the same size as the kettles, around which considerable fumes escaped, though they were piped with exhaust to the flue. The gas fuel was piped separately to the flue, but with natural draft only. A separate room had been inclosed in the center of one end of the stereotyping room, leaving a 4-foot-wide space at one side between this inclosure and the side wall for a paper-roll chute. An exhaust fan was located in the end of this chute, near the ceiling of the foundry, about 4 feet above the level of the alley, which drew out some of the fumes, but a considerable portion spread through the rest of the room and into the pressroom in front, which had no wall separation. The superintendent claimed this was partly due to the open windows in the side wall, which prevented the fan from exhausting properly, but it seemed largely due to improper location of the fan, to no separation of rooms, which left too large an air space for the exhaust, and especially to the small size of the hoods. If these had been extended about 2 feet all around and raised high enough to permit the free working of the casting levers on the machines, a strong suction in the pipes from the hoods might have prevented any escape of fumes whatever. One establishment in Indianapolis was equipped with two autoplates, one double and one single. The hood over the double junior autoplate was about 3 feet higher than the top of the kettle and, as it was only slightly larger in circumference, the fumes were not completely absorbed. Escape outside the edges was accelerated by draft from

the open windows in the department, which was located on the third floor and equipped with both plenum and exhaust. The gas fuel on the drying tables and fumes from gas on the matrix roaster were also piped to the exhaust. The washed air from the plenum system made conditions fairly good but they would have been even better if the exhaust for the autoplate had been perfect. An establishment in Washington was equipped with one junior autoplate, which was supplied with a hood of the same size as the kettle but no curtains. This was piped, together with pipe for the gas fuel, to a duct leading to a flue, but provided with natural draft only. The fumes spread outside of the hood and were, in addition, drawn from under it by the action of an exhaust fan located in a rear window of the room on the first floor, the window being 3 feet above the street level in front though 4 feet below it in the rear. An exhaust fan applied to the duct would have cleared the room more effectively of fumes.

A newspaper establishment in Pittsburgh was equipped with two junior autoplates, located on the fourth floor. These were provided with hoods, each piped out through the roof, with a fan. The hood over an ordinary kettle for flat casting metal was piped to one exhaust and the hood over a similar kettle for ingot metal was piped to the other. The fuel on a small dross refining furnace was piped to one of the exhausts, but there was no hood over the kettle part. The gas fuel on a boiler, supplying steam to a steam table on floor above, was piped to a flue. The room was provided with a plenum fan in a window at one end and an exhaust fan in a window at the other end. These drew the smoke and fumes out from under the hoods, scattering them all around. A large amount drifted through a stairway and a descending pole shaft to the floor above, on which the stereotype molding department and the composing room were situated, polluting the air of these also. It felt very warm in the room, in spite of asbestos covering on the autoplates and metal kettles and pipes from these and the boiler. The condition was very undesirable. Windows and walls were dirty from smoke, and even the light bulbs were grimy from it. In some plants the autoplates were provided with covers or flat lids extending a foot or two above the top of the kettles, provided with trapdoors for return of the cut-off ends or of old plates, such as in one establishment in New York, where the stereotype foundry was located on the third floor and separated from the pressroom by a plaster curtain partition hung from the ceiling to about 8 feet from the floor. The two junior autoplates were each provided with two pipes from the lids over the metal to the main fuel pipe which was covered with asbestos up to about nine feet above the floor and was provided with a fan on the roof. The sides of the autoplates were also covered with asbestos. In addition, large hoods had been placed up near the ceiling, connected with the exhaust duct, and fresh air was supplied by a plenum system through four large funnels, extending part way down in the room by the wall. In spite of basement location, the air was good. In another establishment in New York, where four junior autoplates were located on the second floor, these were equipped with flat tops in the same manner, but there were several holes in the lids through which fumes could be seen escaping. An exhaust fan in

the window removed them, but they were polluting the air between the kettles and the window. In a different plant, where four senior autoplates, located in the basement and in a crowded space, were piped to a duct with a fan exhaust, the flat lids were partly open and the presence of fumes in the room from that source were quite noticeable. A metal kettle in one end of the room, equipped with one force pump to a double-page casting box, and another to a flat casting box, did not have any ventilating attachment and fumes were expected to be eliminated by a fan placed in the window above it. It was used only for special occasions, but would naturally be a source of contamination whenever that happened.

In other plants no special equipment was provided on the autoplates, exhaust fans being placed close to them for the removal of the fumes. This was the case in one establishment in Pittsburgh, where the foundry was located on the seventh floor and contained two junior autoplates. The fuel was piped to a large flue, provided with a fan on the roof, and the fuel from two ordinary metal kettles in the room was piped to the same. An exhaust fan had been placed in the window in the rear of the room. Considerable smoke and fumes were in evidence, as it was quite a distance from the kettles to the windows. The fumes at one time penetrated through a sliding pole shaft to the stereotype molding department and composing room on the floor above, so the top of this had been covered with a cabinet. In Philadelphia a somewhat similar condition was noted in one establishment, which had two junior autoplates located on the eighth floor and one additional on the seventh floor, together with a metal kettle for double-page casting and one for flat casting or ingot metal. The fuel was piped out through the roof on all, but the flat casting and ingot metal kettle was the only one provided with a hood, also piped. Some fumes and smoke were evident, in spite of exhaust system with duct applied to the room. An establishment in Cleveland presented considerable difference. The foundry, located together with the molding department on the sixth floor, was equipped with one junior autoplate, one kettle with three force pumps for plate casting, one kettle for flat casting metal, and one kettle for ingot metal. The three kettles were provided with large hoods, piped to a main duct out through the roof, with natural draft only. The autoplates were not provided with hoods, but the fumes seemed to rise straight up to three turrets in the high ceiling above, leading out through the roof and supplied with a suction fan. The fuel was piped separately out through the roof.

Ordinary metal kettles were found equipped in different ways, as well as the autoplates, and with comparatively the same results. They had smaller surfaces to create metal fumes, there was not so much fuel used, consequently less radiation of heat, but the air space of the foundries using them was ordinarily also less, so the proportionate pollution may be just as large under unfavorable circumstances. One establishment in Cincinnati was equipped with two kettles, each with two force pumps to casting boxes. These were located on the first floor, together with the pressroom, and were placed under a large hood, reaching from the ceiling to about 7 feet from the floor, with a 42-inch exhaust fan near the top, which pulled the fumes out of the building. In a plant in Atlanta the

stereotyping department, which was only partially separated from the composing room, was located on the fifth floor. The metal kettle, on which coal was used for fuel, was equipped with two force pumps and had been provided with a curtained hood piped out of the building, but the pipe was partially disconnected and the curtain had a large opening in front. The room was full of fumes, which were also drawn into the composing room by two suction fans in the ceiling. Strong gas fumes were also emitted by the matrix roaster, especially noticeable when it was opened. A new system for equipment ventilation had just been installed in one stereotyping department visited in Detroit. The department was situated on the tenth floor, separated from the composing room by a glass-top partition with sliding doors. The equipment consisted of one kettle with three force pumps, one kettle with two force pumps, both for plate casting, one kettle with a force pump and double-page casting box, and one kettle for ingot metal with molding attachment. The gas fuel on all four kettles was piped to the flue and each kettle had been provided with a hood, piped separately out through the roof, with a strong fan. No fumes were noticeable, and the workers were well pleased with the improvement, as the former system had been inadequate and filled both the stereotyping and composing rooms with smoke. A bad condition was found in an auxiliary stereotype foundry in Detroit, located, together with the pressroom, in a basement with a high ceiling. It was used only on Friday and Saturday, but during the rest of the week a slow fire was kept under the metal in an ordinary kettle equipped with three force pumps and heated by gas. The kettle was provided with a hood and with a curtain in the back but was open in front. It was piped out into a small court with fan exhaust, but the fan did not work well and the entire room was full of smoke and fumes. The following night the fan was found entirely out of commission.

Besides the metal fumes there was often considerable odor from gas noticeable in the stereotyping departments of newspapers. A great many of the steam tables were provided with steam from individual gas fuel boilers. The majority of the autoplates and metal kettles were heated by gas and the matrix roasters, used in practically every foundry visited, were nearly all heated by gas. It is of course the same as in any other department where gas is used. Improper combustion is sure to produce fumes and gases among the surroundings, and it is extremely difficult to secure complete combustion. One establishment in Boston had been experimenting for quite a while, in cooperation with the local gas company, to secure proper automatic control on the gas fuel for its autoplates.

The stereotyping departments in book and job and periodical printing plants were on a minor scale and were usually equipped with small kettles, provided with hoods on collapsible pipes, to be raised or lowered at will, and piped out of the buildings.

The dust problem in the stereotyping process is greatly ignored by the workers. The dross, which is skimmed off the top of the metal in the kettles, is probably the most dangerous form. This was often thrown on the floor in a heap by the side of the kettle, but in the majority of larger plants it was commonly placed in drums or other receptacles to be shipped to the refineries. Only a few of the

plants do their own dross refining at the present time, considering it a better financial policy to sell it. It is certainly better for the health of the workers, as it is bad enough to handle the dross in removing it from the kettle into the receptacle for it. Routing machines for curved plates were commonly located in the foundry, and were inclosed in booths provided with wire screen sides to prevent the chips from scattering. At times the floors of these booths were covered with metal chips, most of which were too coarse to be dangerous. It is possible that some fine dust is liberated and inhaled through the process of routing, but to determine this would require a thorough analysis of the air. There are usually considerable scraps, cuttings, and dust around the flat finishing department, where the saws and trimmers are located and where additional hand tooling may be performed. The workers in a job stereotyping plant are exposed to practically the same problems as those in the flat casting and finishing department of a newspaper. The establishments of that class which were surveyed did not present any unusual features. There was often considerable dust around the saws and trimming machines, due to the carelessness of the workers in pushing aside the receptacles that were placed by the spouts on the machines or letting them fill to overflowing.

Aluminotypes were used besides stereotypes in one of the newspaper and periodical printing establishments. The plaster composition used for molding requires considerable heat for drying, and it was kept in the specially designed oven for about one hour and a half under a temperature of 180° to 190° F., supplied by a steam radiator inside with the hot air circulated by a motor. The fusing point of aluminum is high, 1,218° F., and the alloy of aluminum and copper used in the plates was melted in special kettles, heated by forced draft gas fuel to 1,900° F., throwing out considerable heat. Some dust was scattered by the removal of the mold from the cast, but this consisted principally of gypsum, clay, and asbestos, and the quantity was small. This special method was also found in a large electrotyping plant in Cincinnati, where it was used on a more extensive scale. The additional heat was taken care of in that place by good window ventilation and did not seem annoying.

Electrotyping is another process in which metal fumes are created, but additional conditions also require ventilation for the equipment used in some of the other operations to make the workrooms comfortable. This is often neglected, especially in the smaller establishments, as shown by the figures of the summary of tabulation (p. 229), under head of "Ventilation of equipment" and subhead "Electrotyping." Only 16.1 per cent of the 62 establishments surveyed were found to be good, while 53.2 per cent were judged fair and 30.7 per cent bad. Good, fair, and bad were used in the same relative terms as for the other processes.

The most important source of fumes is the kettle for the backing metal, which is also an alloy of lead, antimony, and copper, but with a smaller percentage of antimony than metal for type casting, usually only about 2 to 3.5 per cent, with the tin varying from 1.75 to 5 per cent. It is kept at about 650° F., though sometimes a considerably higher temperature is reached. The kettles are ordinarily smaller than those used for stereotyping, and ladles are used for

dipping out the metal and pouring it into the flat, open backing pans. The majority of the kettles in the establishments surveyed were provided with hoods, fitting down close and arranged with collapsible pipes that can be let down on top of the kettles while the metal is melted, and then raised to permit ladling. As in stereotyping, the scraps, cuttings, and sweepings are remelted with the metal, thus creating acrolein fumes as well as metal fumes during the operation. Where the hood was let down tight over the kettle and a good exhaust provided for the pipe the fumes were insignificant during the melting operation. This was not always the case, such as in a periodical printing establishment in New York, where the electrotype foundry contained two metal kettles. The edges of the hoods were about 6 inches above the tops of the kettles on account of the scraps and cuttings heaped in the latter for melting. The exhaust pipes were provided with only natural draft, which permitted escape of fumes all around the edges. After the metal was melted the hoods were pulled up to permit skimming and ladling, leaving the surface of the metal free to distribute fumes whenever agitated by the ladle. Other establishments were provided with stationary hoods, at times supplied with curtains similar to those used on stereotype metal kettles, but often the curtains had been removed, leaving a hood of the same size as the kettle suspended up too high to catch all of the fumes, even with a fair exhaust in the pipe leading from it. One book and job printing establishment in Cincinnati, whose electrotype foundry was equipped with two kettles, was provided with only one small hood that was shifted from one kettle to the other, according to which one was in use, and connected with a pipe leading to the flue. It was hanging over the kettle containing molten metal, but there was no fan exhaust and, in addition, the pipe leading to the flue was disconnected, leaving all fumes a chance to be distributed in the atmosphere of the room.

An electrotyping establishment in Richmond had only one metal kettle, with the gas fuel piped out through the wall. A removable hood was used over the metal, but only while this was being melted. The gas fuel pipe had a large opening for the connection from the hood, which was not capped when the hood was removed, and the fumes from the fuel were ejected partly into the room through this. As the establishment was small all of the operations were performed in one room and all the workers in it were subject to the fumes and gases from the metal kettle and its fuel, as well as to the fumes from the wax and the electroplating tanks. All of these fumes were especially noticeable as the windows were closed on account of cold weather and there was no artificial ventilation provided. The inspection was in December and the temperature outside was only 30° F. In one book and job printing plant in New York City the electrotyping department was located on the top floor of a seven-story building, separated by a partition from the composing room. The metal kettle was provided with a hood, which was piped out of the window, but fumes were escaping around the edges and mingled through the room with the fumes from the wax kettles and the stop-off, together with fumes from an open vat in which kerosene was kept for hand scrubbing of the electrotypes. In spite of the windows being open, the atmosphere was decidedly unpleasant. A large periodical

and job printing establishment in New York had the foundry located on the seventh floor of an eight-story building. The two metal kettles were originally provided with hoods and curtains, but the curtains had been removed and the fumes escaped outside the edges of the small hoods in spite of the exhaust fan in the duct. Hoods over the backing pans and over the wax kettles with tables were also piped to the same exhaust, and the fumes were carried off effectively. If the curtains had been left on the metal pots, the equipment would have been well provided with ventilation. The removal of these was probably due to carelessness of the workmen on the metal. Further carelessness was shown by large piles of dross, spoiled shells, and other scraps that were thrown back of the metal kettles and which emitted considerable smoke, in that way further contaminating the air, a condition for which there was no excuse. An electrotyping establishment in New York had a large hood over the two metal kettles with pans, piped out with a 15-horsepower exhaust fan, that effectually removed the fumes from the room. The fuel was piped separately, together with fuel from a large gas-fired boiler and from a stove for burning rubbish. Another similar plant in the same city also had a large hood, placed high up over the two kettles with backing pans, ending against the wall, where a large fan placed in the window eliminated the fumes from the metal, while the fuel was piped separately. In a large electrotyping establishment in Philadelphia the two metal kettles and the pans were provided with hoods, piped to a special exhaust duct for the plant, together with hoods over the wax kettles. One metal kettle was equipped with a spout to the backing pans and the other with a spout to a casting box, eliminating the use of a ladle. The room was provided with a plenum system, and the effective disposal of fumes from the casting operation was not so noticeable as it might have been otherwise. The problem presented by these fumes is practically the same as in a small stereotype foundry, where the metal is poured by a ladle. It is necessary to have free access to the surface of the metal so the ladle can be dipped in it, and there is consequently a possibility of distribution of fumes in the room, at least whenever the metal is agitated by dipping of the ladle. The kettle should in all cases be provided with a hood and a sufficiently strong exhaust to localize the fumes and to prevent them from spreading. Even then the operator is liable to come in contact with them when bending over the kettle, and the attachment of a spout from the bottom of the kettle seems to be a better solution of the difficulty. A more elaborate arrangement was seen in a large electrotyping establishment in Cincinnati, which was using an automatic casting table of its own special design. This consisted of an inclosed metal kettle, around which a rotary casting table with 10 pans was revolving, stopping each pan under a spout from the bottom of the kettle until the pan was automatically flooded with the metal, then turning to bring the next pan under the spout. By the time the circuit had been completed the first cast was cooled sufficiently by air blast to allow its removal to the scrubbing machine. Fumes from the metal container were carried off in a large pipe. The backing pans with the ordinary metal kettles were sometimes an additional source of fumes, as hoods were not always provided for them.

In the largest book and job printing establishment in Washington the metal kettle in the electrotype foundry was provided with a stationary, curtained hood with removable front, piped out of the building with fan exhaust. The backing pans were taken from the kettle by a pneumatic lift and carried on rollers under the pan table to the far end of the table for cooling. At the time of inspection a breeze, coming through the open windows near by, was blowing the fumes from the hot metal in the backing pans into the room. Provision for exhausting these fumes through a hood was contemplated, and a long hood extending over the pan table has since been installed, which prevents scattering of fumes. In a large book and periodical printing establishment in New York the electrotype foundry contained two metal kettles provided with hoods extending over the accompanying backing pans and piped to a flue. An additional pan, heated by gas burners and not equipped with a hood, had been placed on a stand between the two kettles. Fumes were noticeable from this pan, and the odor of gas from the heating device was also apparent. An exhaust fan in the wall had a tendency to draw the fumes out from under the hoods and pollute the intervening air. A similar condition was observed in one electrotyping establishment in Chicago located on the top floor of a six-story building. A large hood had been placed over the two kettles and the backing pans, but it was placed high up on account of a high crane for moving the pans and was provided only with natural draft exhaust. A large exhaust fan in a window near by drew the majority of the fumes from under the hood. Other windows in the room were open, and at the time of the visit a strong breeze was blowing part of the exhaust fumes back into the room through these. As a rule, there were considerable fumes in the rooms where metal kettles were not provided with hoods, even though exhaust was used, but such was not the case with one electrotyping establishment near Boston. It was housed in a single-story building and was provided with strong exhaust fans in the ceiling. The scrap metal kettle was equipped with a hood, but the backing kettle was not, and no fumes were noticeable, as they were absorbed by the exhaust. It was different in another establishment, located in Indianapolis, where the two metal kettles had been placed on the third floor of a five-story building. The coal fuel on these had been piped out of the room, which was provided with natural ventilation only, and the windows were closed on account of the cold weather, as the inspection was made in February when the outside temperature was only 30° F. The room was filled with smoke and fumes from the kettles and from gas fuel used on the backing pans. The smoke and fumes drifted through on open stairway up into the finishing department on the floor above, polluting the atmosphere there also. The backing pans were usually cooled by a blower and air-pipe system against the bottom of the stand, but in one establishment this was accomplished by dashing cold water on the cast with a short-handled, stubby broom, dipped in a pail. Considerable humidity was added to the room by the vapors generated.

In some places, especially where the windows were closed, vapors were noticeable from the electroplating tanks but the detrimental

effect could not be determined without analysis of the air, and very little information could be obtained about possible danger. None of the establishments visited had hoods over the tanks, though one plant in Cleveland had attempted to install them at one time. This plant was equipped with two metal kettles, one with gas fuel and one with oil fuel, six plating tanks, a small gas fuel boiler for the wax department, and a gas-heated oven for wax plates. Hoods had been placed over these, with pipes to a large duct out of the buildings, but the exhaust fan proved too small to handle the system, so the equipment was taken down. The fuel on the metal kettles was piped out through the window at time of the visit and the firm stated that a contract had been let for an exhaust fan in the ceiling above the metal kettles, which was the roof of the five-story building. The windows were open, but fumes from the metal and from the wax department were strong in the room, as well as in the hall outside the plant. The majority of plating tanks seen were about 5 feet long, 25 feet wide, and 2 feet deep, containing approximately 200 gallons each. As many as 16 tanks were found grouped in one room. The solution used for copper plating baths usually consists of 2 to 8 per cent of sulphuric acid and 10 to 20 per cent of sulphate of copper, mixed with water, kept at about 65° to 75° F. and, in a number of cases, agitated by an air pump. The solution used for nickel plating baths ordinarily contains about 10 per cent of double sulphate of nickel and ammonia, with 8 to 10 per cent of salt. There did not seem to be any vapor from these to affect the system at all, or to warrant any complaints about them having a bad effect on the electrotype workers.

One of the main sources of fumes in the small electrotyping establishments was the wax department where the ozokerite was melted, mixed with plumbago, and spread on the cases. Dense smoke, consisting mainly of acrolein fumes, was often found drifting from the kettles, which hold about 20 to 30 gallons of wax, through the rooms and out at some window located in the opposite wall. Considerable smoke was also created by the builder and the stop-off in some plants. In one electrotype foundry in Deteroit, an exhaust fan had been placed in a pipe through the roof above the wax kettles, eliminating the fumes from these, but heavy fumes from the stop-off were carried all over the room by drafts from the windows. Exhaust fan equipment does not always mean that the fumes are removed. One book and periodical printing establishment in New York had a fan in the window by the wax kettles in its electrotyping department but the fan was not in operation at time of the visit and the fumes were consequently drifting around. An electrotyping establishment in the same city had the wax department located in one corner. Adjoining it, but separated by a partition projecting out into the room, was a gas fuel boiler and a washstand by a window in which an exhaust fan had been placed. This fan drew the smoke from the kettles by the wall around the end of the partition and back to the wall on the other side before expelling it. A large book and job printing establishment in Washington was well provided with hoods over wax kettles and tables, gas flash, wax cutting machines, molding press, and steam for removing wax from molds. These hoods were piped to the main exhaust for the foundry and carried off all fumes.

The question of gases and fumes distributed by illuminating or fuel gas is also brought to the front in this process. Gas is seldom used directly on wax kettles but often on a boiler to supply steam for melting wax and other operations. It is used in every wax molding plant for the flash, to remove bubbles from the surface of wax cases, often on wax shaving machines, on molding tables or ovens, on builder's knife or flame, on builder's iron, on stopping out. The majority of metal kettles are heated by gas fuel. It is also used on soldering irons for finishers, sometimes for smoking the face of the plate, and on some plate curving machines. A number of these operations were not provided with exhausts in many of the plants surveyed and, consequently, there was often considerable odor of gas. In one electrotyping establishment in New York each plate correcting station was provided with a tube connection on a gas pipe, equipped with a gas jet on the other end, which was kept burning continuously during working hours, vitiating the atmosphere. Electrically heated wax kettles and ovens were observed, and these were claimed by the users to work splendidly. Among additional sources of fumes are vats or scrubbing machines containing kerosene for scrubbing the plates. The fumes from wood alcohol, sometimes used for the same purpose, were complained about by the electrotypers in one periodical and job printing establishment in New York, the workers saying that it affected the vision of those using it and of others in the vicinity.

The metal kettles in the electrotyping departments do not ordinarily distribute as much heat as the kettles used in the stereotyping process, because they are smaller, but some of the equipment for other operations tended to increase the temperature of the workrooms, especially the live steam used in some establishments to separate the copper shell from the mold or to clean it, which created excessive humidity. Some plants use cold water and compressed air for the separation which, regardless of the efficiency, maintained a better temperature.

Dust is considerably more of a problem in the electrotyping process than in some of the other processes, for in addition to that from the backing metal, which is present in large quantities, there is also the copper dust and, although it may be harmless, the so-called black lead or graphite dust. The finishing rooms contain a number of machines for planing down the backs of plates, trimming the edges, routing out the high spots, and mortising the plates. A great deal of the lead alloy scraps consisted of large pieces, and many of the trimming machines were provided with hollow pedestals, intended to catch the trimmings, but the emptying of these was often neglected and the contents had run out on the floor, where the workers stepped on them and possibly distributed some of the finer particles in the air. Other machines were supplied with spouts, under which portable trucks were supposed to be placed to catch the cuttings, but these had often been pushed aside through carelessness, or had not been placed under the spouts, so the cuttings fell on the floor beside them. At other places they were found full and running over. Such conditions can only be charged up to carelessness among the workers themselves and are entirely unnecessary. A few excellent plants were seen that were kept very free from cuttings and scraps,

such as in the largest book and job printing establishment in Washington, as well as some in New York, Chicago, Philadelphia, St. Louis, Boston, and other cities. An excellent system was seen in a large electrotyping establishment in Cincinnati, where the trimming machines were located on the second floor and had been supplied with suction attachments. One set, for wood alone, were piped to a large metal receptacle on the first floor near the boiler, where the trimmings were used for fuel and for packing in shipping cases. The other set, for combination wood and metal, were piped to a resmelting room, also on the first floor, where the cuttings were run through a separator, dividing the metal from the wood. Straight metal was conveyed to the resmelting room by a chute from the second floor. There was very little dust visible in the finishing room but the amount contained in the atmosphere was, of course, problematical.

Routing machines are a continual source of cuttings and dust, just as in the same operation in photo-engraving and stereotyping. They were usually inclosed in booths, either of close mesh wire netting or of wood with glass tops to prevent the chips from flying into the other work. The floor inside the booths was in most cases covered with the cuttings and in a number of places these were being tracked over the floor for quite a distance outside. The larger establishments were, as a rule, cleaned well but in a number of small ones a great deal of dust, partly copper, was observed on the tables by which the finishers were seated and on the window ledges near them. This dust was easily dislodged by blowing the breath and was invariably found to irritate the mucous membrane of the nose, producing heavy sneezing. The workmen may be more immune, due to continual and prolonged exposure, but the accumulation of dust is a menace to the health and should not be permitted. Some of the smaller plants were also found to be very careless regarding the dross skimmed off the metal kettle, throwing it on the floor and leaving it there for a considerable length of time—another practice that should not be tolerated. Preparation of wood bases is similar to that operation in the photo-engraving process. In some of the establishments the blocking and woodworking department was separated from the rest, such as in the large book and job printing establishment in Washington, previously mentioned, where it had been placed behind a glass top partition at one end of the finishing room, to localize the wood dust produced. Since the survey was made in this plant, suction equipment has been placed on the machines, carrying all the wood dust out of the room. The dust is not dangerous to the system, but detracts considerably from the appearance of a plant and should, consequently, be carried out by exhaust wherever produced.

Most of the dust in an electrotype foundry is liberated in the molding operations. In spite of its common name, black lead, this dust does not contain any lead but consists of graphite, a metallic variety of carbon, which is very light and scatters easily through the air. The wet black-leading method, which is now used in the majority of the plants, has eliminated a great deal of the dust, though some polishing with dry graphite follows the wet-leading operation. The wax mold is inserted in a machine, containing black

lead suspended in water, where its face is covered with a fine deposit of the graphite by constant agitation of the mixture against it. After it has been removed from the machine a small amount of dry black lead is ordinarily applied by hand with a soft brush. As a rule, there was not a great deal of the graphite dust scattered by this operation, except by careless workers. A few plants were using combination machines, in which brushing with dry black lead was performed automatically after the wet leading was completed, which seemed to distribute less dust than the hand method. With the old-fashioned dry-leading machine, found in over 11 per cent of the establishments inspected, there was a decided difference. The mold was polished with the fine dry graphite by badger-hair brushes, which traveled back and forth at a rate of 600 to 800 movements a minute. This was done in a box, in which the door and other parts of the machine were supposedly dust tight, but in reality were not, and the room was full of the dust, which settled upon everything in it. Both employers and workers declared that the dust was harmless and could be chewed or swallowed without ill effects. It can be understood that a minimum quantity, such as distributed in the wet-leading method, would not be more harmful to the system than the small amount of ordinary dust inhaled on the street. It does not, however, seem reasonable that the workers would not be affected to a certain extent whenever the quantity became excessive. Black lead, or graphite, belongs to the insoluble inorganic dusts and, while it may be merely obstructive, the breathing of large quantities can not be deemed beneficial to the system. It is probable that, on account of its nonpoisonous qualities when compared with lead dust, its effect has not been thoroughly and scientifically investigated. In some establishments a large amount was seen, covering every projection in the room, walls, and even ceilings. It was also observed on the floors and in the type cases of adjoining composing rooms, where the type used for electrotyping was kept. There is no necessity for having a plant full of dust, just because such dust is not poisonous, and the fact that conditions in such respect are better than they used to be is not justifiable excuse for failure to improve them more. The wet-leading method has accomplished a great deal in reduction of the dust but there is still room for further improvement. The use of sheet lead for molds, in place of wax, eliminated the dust entirely in the molding operation and is, of course, preferable from a sanitary, if not from a health standpoint, but where certain reasons demand the use of wax and black-lead molding, this should be carried on with some regard to less scattering of dust. In listing electrotyping establishments for ventilation of equipment the question of black-lead dust was not taken into consideration, as it was decided to be more of a sanitary problem.

It was found that, as a rule, there was scant provision for ventilating molding departments except by windows, outside of a few that were equipped with either plenum or exhaust for the building. One electrotyping establishment in New York, where the molding department was separated from the finishing department, had installed two natural draft ducts for fresh air in the former. These extended along the ceiling from the windows for about 15 feet into the room. Two exhaust fans had also been placed in the windows

near the molding presses, while an additional exhaust fan was located in the other end of the room close to the wax kettle, making a decided improvement in the atmosphere of the plant.

While there are two other principal processes, presswork and bindery work, besides additional minor operations not strictly belonging to them but still related, the equipment used in them was of too varied a character to be considered individually for tabulation. Consequently these were listed jointly under the head of "Ventilation of equipment" and subhead "Other equipment" in the summary of tabulation. This classification includes 147 establishments, which contained equipment that was, or should have been, provided with ventilating devices outside of that used for either of the other four processes previously described. Some plants did not have any equipment requiring special ventilation. Only 15 per cent of the 147 were found good, while 37.4 per cent were judged fair, and 47.6 per cent bad. Good, fair, and bad were used with similar meaning as for ventilation of the preceding equipment.

The pressroom of a printing-trade plant has its own special problems of ventilation that differ from those of the other processes and some of which have been touched upon in mention of building ventilation, as the tabulation for that subject covered the pressrooms themselves. Many pressrooms were heated to 80° or 90° F. in winter, or whenever the outside temperature was less. This is claimed by some to be necessary, especially for color work, to insure proper distribution and drying of ink. In addition the air is often kept stagnant for the same reason, creating an extremely bad condition of the atmosphere. Observations showed that these conditions were not at all necessary and there was no valid reason to compel workers to toil in such unhealthy air or high temperature. The question was found to hinge more on the degree of humidity, coupled with a reasonable temperature, not over 70° F., and that fresh air at such temperature dried the ink far better, especially where this depended on oxidation. The modern plants were usually equipped with ventilating systems to provide fresh air of proper temperature and humidity for the entire building or certain parts of it, several of which have been referred to. Others had installed air conditioning plants, or humidifiers, for the pressroom only, maintaining steady temperature and movement of the air.

Artificial ventilating systems are not always satisfactory and even good systems may create some unpleasant conditions. A plenum and exhaust system used for the pressroom and stereotype foundry in the basement of a newspaper establishment in Cleveland looked ostensibly good. The intake for fresh air and the fan were located on the roof of the 14-story building, and the air was distributed through grates in the walls. It was found that large areas around the grates in the pressroom were covered with soot and dirt and, judging from the looks of the walls, the air drawn in must have been very dirty or was contaminated after entering the building. In winter steam is used for heating the air before distributing it. The workers complained that the air supplied seemed lacking in oxygen. The atmosphere was polluted considerably by fumes from the two autoplates in the stereotype foundry located in one corner, as the fan in the exhaust from these was out of commission and fumes were

drifting from under the hoods. A corner in the other end was used as a storeroom for composition rollers and oil tanks. This was not provided with any ventilation, and the air inside of it felt nauseating when the door was opened. The ventilation of this plant was not perfect when examined closely, but was better than that of another newspaper pressroom in the same city, which was located in a basement. In this the ceiling was high, reaching to the top of the first story, except in one rear corner which was occupied on the first floor by the stereotype foundry. The presses were three decks high, about 21 feet, and reached close to the ceiling. The only ventilation was through the windows on the first floor in the front part of the building and some in one side, which was bounded by a covered driveway and loading station. These were all closed at time of the visit, although the outside temperature ranged between 71° and 84° F., and the air in the room felt very stagnant. It was claimed that new equipment had been ordered and that improvements in ventilation would be made when this arrived. It is often difficult to maintain correct temperatures in all parts of the rooms where tall presses are located. An instance of this was observed in one newspaper establishment in Philadelphia, located in a basement, which was supplied with a plenum system, cold in summer and hot in winter. The ceiling was high, but some of the presses were four decks high and reached close to the top. The visit was made during the middle of January when the outside temperature was 29° to 39° F. The distributors in the plenum ducts on the ceiling were closed, and the temperature at the bottom deck stood at 76° F. The top deck, however, showed 93°, altogether too warm, and it was not surprising that electric bracket fans were necessary on the top decks to prevent the composition rollers from melting. One thing which sometimes contributes to unpleasant conditions in pressrooms is installation of additional equipment to meet expansion of business. This was exemplified in a newspaper and periodical printing establishment in Boston, which erected a building consisting of two stories and basement in 1907 and added two more stories three years later, that gave ample facilities for all departments in the upper parts. The basement, containing the newspaper pressroom and stereotype foundry, was originally built to accommodate one sextuple web press. At time of the visit it contained three of these, crowding the space and hampering ventilation in that part of the building which did not permit of extension.

Rotary and cylinder pressrooms were found provided with humidifiers in some plants that did not have plenum systems for the entire building. Several different styles were observed, most of them consisting of inclosed boxes and blowers, with ducts through which correctly moistened air was supplied to the room. In one establishment steam was liberated in the pressroom through perforated pipes extending from a small water tank with gas fuel. In another place the steam-heating pipes for the room had been tapped in three places and water containers with open tops about 1 foot in diameter were attached with a valve connection to permit heating water in the containers and liberating steam from them to moisten the atmosphere. The pressroom was kept at about 78° F., dry bulb, and sufficient steam was liberated to make about 10° difference for the wet bulb,

Change in the humidity of the atmosphere causes a corresponding change in the paper stock, expansion or shrinkage, which seriously affects color printing, as the colors must be registered over each other. This also affects the drying of the ink and the presence of static electricity in the paper, making it important to keep the humidity as uniform as possible.

Also, special drying attachments are used on cylinder presses and on some rotary presses. One style of these consists of a tube, containing a number of perforations, placed across the full width of the press. It is supplied with gas, producing a low continuous flame over which the freshly printed sheets pass to the delivery. Some of these so-called neutralizers or burners are attached to the carriage delivery, in which case the sheet first passes over the burner, which next passes ahead of and backwards over the sheet after it is deposited on the delivery board, heating both sides. Others are stationary, placed near the delivery end or up close to the front part of the cylinder. The latter position is where they are usually found on small hand-fed cylinder presses, often burning continually and with long flames. It is possible that their presence in that location may be an explanation for the abnormally high percentage of tuberculosis among press feeders, who are stationed almost directly above the gas burners and are compelled to inhale a large quantity of fumes and gas rising from them. They may not be a direct cause but, at least, would have a tendency to affect the throat and lungs by weakening their power of resistance to the disease. Accurate statistics are not available on this point but general observation indicates that the largest proportion of tubercular cases come from places where this condition exists. It may also explain why pressmen working in rooms where gas burners or neutralizers are used on the presses are less subject to tuberculosis, even though these are placed on the deliveries. The pressmen are not compelled to stand continually over the gas burners, as are the feeders, but ordinarily just walk up to the deliveries to remove a sheet for inspection and then turn away. When burners are placed on the delivery end the flames are usually not so strong, because a great many of these are equipped with automatic control, which shuts off the flow of gas when a sheet is passed and then turns on the gas and relights it from a pilot light. A number of the pressrooms visited were filled with a strong odor of gas from these attachments, perhaps from leaky conveyor tubes. The largest book and job printing establishment in Washington, for example, was discovered to have this odor, especially in one corner of the cylinder pressroom, during the inspection. Experiments had been conducted to eliminate it, such as installing a fan with spray system in a large duct, but this did not prove entirely satisfactory. The fan and spray have since been removed and measures taken to install a humidity system. Artificial ventilation overcomes the bad condition to a certain extent. This was especially noted in a book and job printing establishment in New York that was equipped with 39 cylinder presses, 24 of which were provided with both gas and electric neutralizers, while 2 others had gas burners only. They were located on separate floors, one of which contained 14 presses and had only natural ventilation, while the others were

supplied with fresh air by a plenum system with intake on the roof, fan in the basement, and ducts in the floors. The odor of gas was far more pronounced on the floor provided with natural ventilation only.

In other plants the presses were equipped with additional electric neutralizers, while in still others these were used alone. Some claimed that the work could not be done satisfactorily without gas burners, but establishments working under similar conditions in the same locality and provided with electric neutralizers only, seemed to perform the work just as well. One large plant, equipped with 40 cylinder presses, had no gas in the building and used electric neutralizers exclusively. The building was supplied with washed-air plenum and with exhaust. The windows of the pressroom were kept closed and the temperature held at 75° F. It felt a little warm, but the constant circulation of the air ameliorated the condition somewhat. Another establishment, some distance from a city, where no gas was available on account of location, was provided with natural ventilation only in the pressroom. Electric neutralizers were used on the cylinder presses, and in addition a large circular shield had been placed on each press, extending clear across the bed back of the cylinder, inside of which was located an electric heater, consisting of eight Simplex units. Some of the small job cylinder presses were equipped with gas burners, in some instances distributing a strong odor of gas, while others used electric neutralizers only. In smaller establishments hand presses for copperplate printing were found provided with gas burners. The large plate and die printing establishment in Washington, however, had made a decided change, after first motorizing these presses, by changing the individual gas heaters to electric heaters, eliminating the noxious gas fumes and creating a better atmosphere. The question of gas burners on presses was not taken into consideration in tabulating equipment ventilation, as no direct appliance was seen for eliminating the fumes or gases.

The odor of ink was noticeable in practically all pressrooms, differing according to the chemical contents. Considerable has been said at times about printing ink as a direct agent in contracting tuberculosis. The ordinary vehicle of ink used for printing on flat-bed and rotary presses is linseed oil. This class of ink, especially that used for color printing, dries by oxidation and naturally extracts oxygen from the atmosphere of the room besides scattering small particles of pigments in the immediate surroundings. The ink used for newspaper printing usually has a paraffin or resin oil vehicle and dries by absorption, penetrating into the paper. More pigment is distributed into the air in newspaper pressrooms than in others, partly through the high speed, the consistency of the ink, and the abrupt stopping of the ductor roller which carries the ink from the fountain. A piece of white paper laid down, even a considerable distance from the newspaper press, will in a short time become covered with fine black spots, showing the high rate of pollution in the atmosphere. The new method of spraying the ink from the fountain on the ink drums and eliminating the ductor roller has reduced this considerably. There has been no successful method put into use to prevent the distribution of ink fumes for the

ordinary printing processes, outside of ventilation for the building. Supplying fresh air minimizes the relative amount of pigment in the atmosphere of newspaper pressrooms and provides an additional quantity of oxygen for drying where oxidation is required, but it is not often done artificially, and where natural ventilation is used the windows are usually not opened during cold weather. One pressroom in Milwaukee was visited in the latter part of June, when the temperature outside was about 85° F. It was located on the fourth floor of an old seven-story corner building. The windows were open at the time of the visit and the air felt good, but the workers stated that the odor of the ink was very strong, practically nauseating, when they came to work mornings after the windows had been closed all night. Similar cases were found in all other cities on account of the supposedly necessary high temperature maintained. In some establishments the windows were found nailed down to prevent opening them.

The odor of ink for planographic printing was less noticeable and that for intaglio plate printing was almost imperceptible, but the ink used for rotogravure printing was decidedly different. The vehicle used for it, either naphtha or xylol, is extremely volatile and requires special exhaust devices to absorb the fumes distributed from the presses. These were consequently included among equipment which should be provided with ventilation. Different methods were found, some plants depending upon room ventilation only. One establishment, which had the pressroom located on the first floor of a four-story corner building, was equipped with five presses, arranged side by side, facing the outside wall. A large hood had been placed over each press, close over it, and provided with a large exhaust pipe leading out of the building above the windows with a strong exhaust fan. A small ventilation duct had been placed in the adjoining ink-mixing room and connected with one of the exhaust pipes from the presses. This had been carried down a column from the ceiling and provided with an intake near the floor, as it was stated the solvents were heavier than the air when cold. The fumes were only slightly noticeable, mostly from the printed product, in which they linger for a considerable period, but the exhausts, approximately 10 feet above the street level, were discharging thick fumes along the sidewalk, eliminating them successfully from the pressroom, but making it very unpleasant for anyone to pass the building. One rotogravure pressroom located on the second floor of a seven-story corner building was equipped with two presses. A hood, piped out of the window with an exhaust fan, had been placed over one press, and the hood for the other one was said to be on the way. Some fumes from the solvents were noticeable in the room, which was provided with natural draft only. Another pressroom situated on the twelfth floor of a 14-story corner building contained three presses. Each was equipped with a double hood piped out through a window with an exhaust fan, and two additional exhaust fans had been installed in other windows for ventilation of the room. Only a slight odor could be detected.

Another pressroom containing five presses was located on the seventh floor of a 14-story inside building. There was no special ventilation equipment for the presses but the room was provided

with both plenum and exhaust through grates in the walls, which changed the air every 20 seconds. In spite of that and the windows on three sides of the room, which were open, the fumes were quite noticeable, even in the entrance hall and clear up on the thirteenth floor. Several others were visited that were equipped with exhaust fans in the windows, which, of course, disposed of the fumes but compelled them to travel from the source to the ejection point first, polluting the air on the way. A special dispersing method for the fumes was observed in one plant containing a large rotogravure press on the top floor of a three-story building. The exhaust fan in the wall expelled the fumes through a short duct in which burlap had been hung with the bottom in water pans. These seemed to kill the odor effectually at the end of the exhaust, but some fumes were noticeable around the press, as well as between it and the exhaust. Two rotogravure presses in another establishment located on the fifth floor of an eight-story corner building were provided with special exhaust systems above the fountains. These consisted of tubes placed about 2 feet higher than the uncovered tops of the fountains with a number of small perforations and supplied with a strong exhaust, about 2,500 cubic feet per minute. The fumes from the solvents were heavier than the air when cold, but as they were heated through the action of steam dryers on the presses they rose and the exhaust in the tubes seemed to absorb them well. There was a noticeable odor around the presses, but probably from the printed product. The room was provided with additional exhaust. A similar arrangement was seen on a rotogravure color press, which carried the fumes off well. The ordinary rotogravure presses in that plant were not provided with such attachments, but the air was kept in good condition by a plenum and exhaust system. There was also more space than ordinarily found, as the pressroom was high and provided with a saw-tooth roof. In one establishment visited some fumes from the solvents in the ink were noticed, but these did not seem nearly so strong as the fumes from wood alcohol used for washing the printing cylinders in an adjoining and only partly separated room. The floor was provided with both plenum and exhaust, but these did not seem adequate to overcome the condition.

The fumes from the solvent used on varnishing machines were found strong enough to be classed among those for which special ventilation should be provided. Wood alcohol or denatured alcohol is ordinarily used and the main danger consists in inhaling the fumes, together with rebreathed air, in a confined space. It would be a very simple matter to equip the varnishing machines with a tube exhaust system, similar to that mentioned for rotogravure presses, just above the fountains, but no attempt to do so was discovered. In one large establishment in Baltimore the varnishing machine was located in a right-angle narrow projection about 100 feet long, through which the fumes were drifting. In St. Louis a varnishing machine with steam-heated drying oven was seen, which occupied the entire space by the side of the wall, 180 feet long. The atmosphere around the machine and in the rest of the room, which was 36 feet wide and was used for a warehouse, was strongly charged with the odor of the denatured alcohol used in the varnish. The condition was possibly at its worst because windows and venti-

lators in the saw-tooth skylights were closed on account of the cold day. The plant was visited in March, with outside temperature of 44° F. In one establishment in Chicago the varnishing machine was placed in the room with ink grinding and one rotary press. The oven was heated by hot air. The odor of alcohol was very strong in the room, though the windows were partly open, and it must have been extremely bad when they were closed. Only a few of these machines were found. They were ordinarily equipped with steam-heated ovens, but gas fuel was used in some establishments instead, increasing pollution of the atmosphere. One large establishment in New York was equipped with three machines, inclosed within a separate room. The gas-heated drying ovens had previously been piped to an exhaust duct with a fan, but the pipes had been closed and the ovens piped out through the windows. An exhaust fan had been installed in one window for ventilation of the room and the rest of the windows were partly open. In spite of that the odor of the alcohol in the fountains and of the gas on the ovens was quite noticeable.

In newspaper pressrooms the tension men are often affected by acrolein fumes from the tension blocks on which oil is used. The wood blocks, which are clamped around the friction pulley on one end of the roll shaft to act as a brake, becomes heated by the constant rubbing of the pulley against it. In some cases oil is poured directly on the brake blocks; in others a pad is placed over the top block and saturated with oil. The heating of the pulley through friction decomposes the oil and causes considerable smoke, which irritates the throats of the tension men, who must bend over the attachment at intervals to adjust it. This condition was eliminated where the presses had been equipped with magazine paper reels provided with belted braking devices.

Fumes were also encountered in the pressrooms from the solvents used for washing composition rollers or ink-distributing systems and fountains on the presses. The solvents commonly used were kerosene, benzine, a mixture of the two or a mixture of either with machine oil. In changing from one color to another on flat-bed or rotary presses it is often necessary to remove carefully all traces of the previous color, to prevent tainting the new one, but on daily newspapers the rollers and ink-distributing mechanisms are merely cleaned to remove paper dust and grit accumulated on them. Roller-cleaning machines were used in a few places, but as a rule the work was performed by hand. The solvent was applied by rubbing the surface with a saturated rag and the softened ink was removed by brisk rubbing with clean wiping rags. Special roller washes are placed on the market, but no reliable information could be obtained regarding their effect on the health. Several newspaper establishments were using special rubber rollers, a comparatively recent substitute for composition, which it was claimed did not need wash up and consequently would eliminate fumes from that source.

The question of the dangerous quality of the common dust in the pressrooms has never been definitely settled. There is often quite a quantity present, though not comparable with that created in paper, asbestos, or cement factories. Most of this dust is organic from the paper fibers, mixed with a mineral dust from the clay or

enamel used in filling or coating the paper. The dust is scattered through the air by the movement of the paper in its passage through the machines, and can often be seen accumulated by the presses or observed as a fine white dust in the air, when pierced by a ray of sunlight, but the quantity and character seem to indicate that it has been very much overrated as a hazard in the past. There is, however, one dust that is distributed by a special operation in pressrooms, which is a serious menace to the health of the workers. This is so-called bronze dust, consisting of fine particles ordinarily composed of copper, zinc, and aluminum. This dust is very fine and is scattered through the air during the operation of bronzing. It also sticks to the surface of the sheets outside of the designs that have been printed with size or ink to retain a coating of the dust, and the freshly powdered sheets must not be brushed, as this would have a tendency to remove part of the bronze dust from the design. Consequently more or less of the bronze is conveyed by the product through succeeding operations, most of it being gradually eliminated from the sheets by these, and a trail of bronze dust is usually scattered all along by the machines used subsequently and by the paper cutters, and is even in the waste. Bronzing is a specialty operation and was performed in only 50 of the establishments surveyed. The hazards from the dust had been reduced in most of the plants by use of covered machines with vacuum attachments for collecting the superfluous dust, but not entirely eliminated. In several establishments the bronzing machines were additionally kept in separate rooms, in others they were inclosed with curtains, which localized the dust somewhat. This operation was included among those in which the machines should be provided with ventilating equipment, and establishments in which they were operated were consequently included in the summary.

Various conditions were observed. In one establishment in Richmond there were several bronzing machines attached to cylinder presses. These were located in one side of the building, separated from the rest of the plant by glass-top partitions, and the air inside the inclosure was filled with dust. In another plant in the same city one new large bronzing machine was placed on the first floor and was provided with a large duct extending to the top of the four-story building and back down, through which the superfluous dust was removed and returned to the machine. Very little dust was noticeable around the machine. A large establishment in Chicago was equipped with a number of bronzing machines, all located on one floor but divided into two separate sets at different ends. Five of these, placed together, were previously piped with the vacuum system to two small structures outside the main building, where the waste dust was collected, but the pipes on four of the machines had been detached and caps placed on the outlet pipes, so that the dust was returned to small boxes near the machines. Considerable dust was floating through the air quite a distance from the machines and settled on the clothing in walking around them. This was also the case in the other end of the plant where the rest of the bronzing machines were located, one of which was connected to a cylinder press. A great deal of bronze dust was observed in other parts of the plant, especially near the baler in the basement and in

the bronze storage room also in the basement. This condition was far from desirable as the dust contaminated the air in a large portion of the plant, subjecting other workers to inhalation of the dust also. In one establishment in St. Louis, equipped with several bronzing machines that were provided with vacuum attachments and piped outside of the building additionally, one machine was observed which had been in constant operation for three months. There was considerable dust scattered around it, and this was stirred up by the movements of the workers and sent flying through the air, together with additional dust liberated by the machine. In Baltimore several machines were found in the pressrooms of one establishment. These were attached to the presses and provided with vacuum attachments, as well as piped to an exhaust duct, but a great deal of the dust was floating in the air. The plant was equipped with plenum system with a central vertical duct through the floors and four radiating distributing pipes, about 12 feet in length, on each floor.

One establishment in Detroit was using several large portable bronzing machines in a pressroom on the second floor. A large duct with exhaust fan had been placed on the ceiling back of the delivery end of the presses, clear across the room and out of the building. This was provided with a fitting behind each press to accommodate the vacuum pipes from the bronzing machines, which were attached to the presses as required. One stationary machine on the third floor was placed in a separate room, being connected by a tape conveyor through an opening in the partition with a press in the main room. It was provided with vacuum attachment and piped out of the window, as was a detached one on the second floor. One additional detached machine on the third floor was supplied with a vacuum attachment also, but was piped to a small box only. There was not much dust noticeable, though the amount contained in the atmosphere was problematical. The plant was provided with good, natural ventilation from the windows on both sides of the room, which were open except right by the presses as the outside temperature ranged from 75° to 85° Fahrenheit during the visit. One establishment in Milwaukee was equipped with four large bronzing machines in part of the pressroom, all with vacuum attachments. One of the machines was piped to a flue, while the other three were piped to a large duct leading out of the window. There was only a slight amount of dust noticed near the machines, but more was visible around the cutting machines and die-stamping presses on the floor below. The pressroom was supplied with air-conditioning equipment, improving the atmosphere considerably. In a large establishment in New York it was very clean around the bronzing machines, but the machines themselves were covered with dust. A large amount was observed around the embossing machines and die presses, as well as around the cutters and creasers. Another large establishment in New York was equipped with bronzing machines on three floors. One machine was attached to a cylinder press by tape delivery, but inclosed in glass-top partitions. An exhaust fan had been placed in the window of the inclosure. A portable machine was located in the main room on the same floor. Two machines on another floor were provided with vacuum attachments and placed

in a separate room, provided with a fan, and three machines on another floor were similarly equipped, the rest being located in the pressrooms and not piped. The largest amount of bronze dust was observed around the embossing press, though evidence of its use was seen all over the plant.

As a rule there is not much heat generated in the operations in presswork, outside of the motors used for driving newspaper presses, but the atmosphere was often found uncomfortably warm through artificial heating of the room. This was mostly the case where makeshift heating was employed, as in one printing plant in Washington, which had installed one hot-air furnace in the bindery on the third floor of the building occupied by it and another on the first floor for heating the pressroom, located there, as well as the office, composing room, and job pressroom, all on the second floor. The pressroom was not provided with ventilation, except through large doors in the front of the building, and the furnace in one of the rear corners made work very uncomfortable in winter. Lack of space may also have considerable influence in that regard, such as in one newspaper establishment in Chicago, where the back ends of part of the presses were close against the front end of the boilers, making it uncomfortably hot in spite of the four exhaust fans located in the wall beside the boiler.

There are also several machines used in the binding operations that require special ventilating devices for the removal of either fumes or dust. The principal operation in which fumes are liberated is spraying of artificial leather book covers. The vehicle used in the ink for that purpose, commonly known as banana oil on account of its bananalike odor, consists mainly of amyl acetate. This is very volatile, and the inhalation of even a small quantity will produce a headache, giddiness, and nausea. The ink is usually sprayed by means of an air brush and stencils on the cover, which is held under a low hood that is provided with a large exhaust pipe and a strong exhaust fan. The hoods are made in different sizes to accommodate two or more operators, who are seated facing the table under the hood. In recent years several plants had installed one of these machines and sometimes did not quite figure on the toxicity of the fumes liberated by the operation. A large bindery in Detroit installed a three-station spraying machine in one corner of a floor occupied by ruling, perforating, punching, and embossing machinery—the fourth floor of a five-story corner building. The health department decided that the operation should be isolated and better ventilated. A hollow tile wall was consequently placed around the other two sides, separating it from the main room, and on one side a small additional room was added for a buffing machine and air compressor. When the plant was inspected the three stations were used by four operators and the hood seemed too small. Fumes were escaping around it and drifting through the open doors and the buffing room into the main room, probably assisted by a draft through the open windows of the spraying room. Fresh air was supposed to be distributed in the room by a small fan, through an intake on the floor below, also ordered by the health department, but did not seem noticeable. The air in the spraying room was heavy with the odor of banana oil, both from the spraying machine and from the finished products on tables.

Another bindery in Detroit had installed two single station machines of a different construction. These were also equipped with fans and exhaust pipes, but the hoods, instead of being horizontal and placed low over the table, were arranged vertically and just covered the back, extending up in the air with a curved end over the top. They were not in operation, but the proprietor stated that the fumes were bad and that he was going to change the ventilating system on them. In one book and job printing establishment in New York an air-brush machine had been placed in the edition bindery near windows. The hood was piped out through a window and the other windows were open, but the fumes were strong in the vicinity. At the request of the assistant director, who was acting as guide, the operator put on a gas mask furnished for him but which he does not ordinarily wear. In this establishment the covers were subsequently baked in a steam-heated oven, located close by, which was piped out through the wall. It was claimed that this proceeding would successfully eliminate all lingering fumes from the product. The tables between the oven and spraying machine were provided with suction—piped to the main duct from the spraying machine—which removed a great deal of the fumes. A different spraying machine in the same establishment had only a hood over the back and a bracket fan placed in a hole in the same toward the window. This machine was used for spraying book edges only, which was done with aniline dissolved in water, and no fumes were produced. An establishment in Chicago, which produced a large number of artificial leather covers for the trade, had 45 double station spraying machines, each 15 piped individually to a large exhaust duct leading out through the wall and with a strong fan. The machines were located in a light, airy room, recently added to the building and, as far as could be observed, the ventilation system was ample for removal of the banana-oil fumes. In an adjoining room was located a case-drying oven, with steam coil and blower for the hot air, in which the covers were baked, and a buffing machine. The building was supplied with a plenum system, and in addition six ozone generators had been installed, some connected directly with the plenum system and others, independent portable cabinets, to be used where necessary for freshening the air. The machines were small, about 12-cylinder capacity, of the same type as used in connection with the ventilating system for the United States Capitol Building in Washington. During the survey the electric current was turned off on one of the generators located near the drying oven, and after the odor from the banana oil had become very noticeable and offensive in the vicinity the current was again turned on, starting the machine. The odor was destroyed in a very short time, resulting in a more invigorating atmosphere. This was the first and only establishment where the ozone generators were seen applied to the printing processes, but from what could be learned about them they seemed to be a very desirable addition to any ventilating system for purifying the air where obnoxious odors exist. In one printing establishment, surveyed later, one of the generators had been installed to ozonize the air of the office.

In another large establishment, also located in Chicago, coloring of pictures was performed by means of air brushes through stencils. This was done over open tables in a light, airy room, and the colors

used appeared to be weak solutions of aniline dyes. No fumes were observed and the only noticeable effect was the staining of the left hands of the operators, who used these to hold the stencils while spraying. In a book and job printing establishment in Boston the edges and borders of greeting cards were gilded by means of spraying. The operator was standing in front of a table provided with a hood over the back and extending out over the table. A pipe with exhaust fan led from the hood out of the building, but the fan was not strong enough and allowed the fumes of the banana oil to escape. The operation was separated from the rest of the shop by a partition, the door in which was standing open, and the fumes were strong in the main room as well as in the inclosure for the spraying operation. Air-brush stations were seen in several other places, though not in use at the time of the visits. A great deal depends, of course, on the vehicle used in the spray, but if banana oil, benzene, or a similar liquid is used, great care should be taken to provide sufficient ventilation on the equipment.

A number of gas-heated appliances were found on binding machinery. Gas was used extensively on the older style of machines for heating glue containers, but on the newer machines gas has been practically replaced by electricity. There was always more or less odor of gas where it was employed, partly due to improper combustion and partly to leaky tubes or pipes. The latter were often found in smaller establishments, such as in one bindery in New Orleans which employed only five workers and was all together on one floor. An exceptionally strong odor of gas was noticed. When traced it was found to come from leaking rubber tube connections leading to a small gas stove used for cooking glue and to a small hot die embossing press. Gas fuel was used in a number of plants for glue cooking and for hot-die embossing presses, but in the larger and more modern binderies were found electrically heated glue cookers and glue pots, and die-heating devices on the embossing presses, and a far better and healthier atmosphere was maintained in the rooms. Although the odor of gas was bad in some establishments, this feature was not considered under the tabulation of ventilation for equipment.

Drying ovens, such as are referred to under artificial leather book covers, were also found in some binderies and in plate-printing establishments for drying the product. A large plate-printing establishment in Washington had several drying rooms located in various parts of the building, but especially in the wetting division. These were provided with drying cabinets, where air was forced through perforated pipes at one side, over the racks on which the product was spread and, with the moisture, out through the other side to ducts. Two large ducts with exhaust fans carried the moisture-laden air up above the roof. The rooms were rather warm, about 90° F., though not when compared with the ovens, which had a temperature of 180° inside. Gumming machines with drying ovens were also used in this establishment. The gummed sheets were carried by grippers on an endless chain through a long box, in which air was forced between steam coils, and which registered 140° F. at time of the visit. The surroundings were somewhat warm but

ameliorated by the plenum system for the building, which supplied fresh washed air and made a complete change once per minute, as well as by an exhaust fan in the window. Gumming machines were also observed in label-printing establishments, ordinarily with steam driers but sometimes with gas-heating devices. These naturally gave off some heat but were not sufficient factors to render conditions uncomfortable except in a minor degree. The same was the case with paper seasoning machines, of which a few were also found, heated by steam pipes or electricity. The effect from these was principally local, and insignificant where proper ventilation of the building was provided.

Paraffin-coating machines are sometimes the source of disagreeable and nauseating acrolein fumes, but no provisions were observed for carrying off the vapors in case these were developed. The paraffin is heated, so that a thin coating can be applied to the paper as it passes through the machine. When too much heat is used the paraffin is decomposed by the heat and acrolein vapors are produced. One establishment in Kansas City, where several paraffin machines were used in the production of wrapping paper, claimed to have solved the difficulty by a special process, but, as this was a trade secret, information on the method could not be obtained. Another plant in Denver also claimed to have eliminated the smoke problem by melting the paraffin before placing it in the machine, and was equipped with a special (own design) melting tank system. Paraffin machines are seldom found in any quantity in printing trade plants, one or two machines usually being sufficient for even a large quantity of work, and then are ordinarily operated intermittently. They are used mostly in specialty work.

The dust problem in the binding process is principally a sanitary question, as most of the dust created by the operations and the material is paper dust, and only a few establishments develop sufficient of this to make it a menace to the health where the room is properly ventilated and cleaned regularly. Several of the larger plants were using suction attachments on cutting machines or trimming machines for removing the waste cuttings, or on covering machines for eliminating the dust from scoring saws. These attachments are, however, an aid to ventilation, as they are often provided with good-sized openings and consequently exhaust considerable of the air in the rooms, disposing of foul odors and keeping the atmosphere circulating. Suction attachments of this class were considered in the tabulation for other equipment, but only where they existed, and were then included as good, fair, or bad, according to their influence and condition.

Two of the bindery operations created dust that would prove harmful to the health if not properly provided for, but were unusual and not general operations. One of these was grinding the edges of books, playing cards, or other products, to smooth them thoroughly before gilding. A very fine dust was liberated by holding the edges against rapidly revolving emery wheels, but the grinding or polishing machines were provided with suction, which absorbed the dust well. In one binding establishment, which was engaged only in repairing books, a similiar operation was employed for removing old glue from the backs of books. Two special double

grinders were used, against which the operators held the backs. The grinders were provided with small hoods and suction, but this did not remove all the glue dust and the operators were covered with it. Naturally a quantity was inhaled, though the extent or possible damage could be ascertained only by analysis of the air and physical examination of the operators. The other operation is the removal of superfluous gold, bronze, or other metallic leaf from book covers or other material after it has been applied. This was ordinarily performed by rubbing the surface by hand with cotton or brushing it with soft brushes. Where gold leaf was used, precaution was taken to save this on account of its monetary value and the work was usually done on tables provided with screens in the center, through which the particles of gold leaf dropped. Some tables were provided with suction pipes through which the particles were carried to large hoppers suspended above the tables. In one establishment a small machine was observed which performed this operation automatically. The saving of the gold leaf eliminated danger of dust from the operation, but where cheap imitation leaf, ordinarily bronze, is used it is merely brushed off and scattered all around, distributing a fine dust. Pieces dropping on the floor are ground up by the feet of the workers and add to the dust in the air—an undesirable condition. It is not found in many establishments, so affects only a small number of workers, but could be eliminated by use of brushing machines, one of which was seen in use for bronze leaf also.

Among other equipment was included that of two specialty establishments, type foundries, though the fumes and dust hazards in these resemble those of the composing rooms so much that they could well be considered together. Type-casting machines, used for the production of the type, were equipped with metal kettles, in which the metal was heated by gas. The composition of metal used for foundry type varies slightly from that used in the composing machines. It usually consists of 55 to 60 per cent of lead, 25 per cent of antimony, 10 to 15 per cent of tin, and 5 per cent of copper. The high percentage of antimony and the addition of copper, which has a melting point of 1,981° F., require considerably more heat and the alloy is kept at temperatures varying from 600° to 850° F.

Different designs of casting machines are used. One style produces the type entirely finished and ready for use, while type cast in the other style requires considerable handwork before assembling, which produces some dust. In one of the establishments hoods had been placed over the casting machines, piped to ducts leading out of the building, and provided with fans. No fumes were noticeable in one room, which contained a number of small-size casting machines and where an exhaust fan had been placed in one of the windows. There were several small ventilating turrets in the roof, and, in addition, the windows and ventilators in the saw-tooth skylights were partly open. The large-size type-casting machines were located in an adjoining room, with similar natural ventilating facilities, but no fan. Some of these machines had not been provided with hoods, claimed due to recent installation, and there was considerable odor of gas around these, as well as around some which had been temporarily swung out from position under the hoods for change of

matrices. Large die-casting machines with force pumps were located in a separate room on the floor below, with natural ventilation from the windows only, but the machines had been provided with hoods that were piped to a duct with a fan, leading out of the building. In the other establishment the type-casting machines were, with exception of two large hand type casters, not equipped with hoods, but there did not seem to be any strong odor of gas. The majority of the machines were located in several bays with very high ceilings. One of these was provided with two exhaust fans in each end of the gable in the monitor skylight. A few hand casting machines were also used in both establishments, with gas fuel on the metal, none of the machines being provided with hoods.

Both plants mixed their own metal, but did not refine the dross. One plant was equipped with a large metal-mixing kettle, located in a separate room in the basement. It was provided with a tight-fitting hood, piped to an exhaust duct with a fan. A long pipe was used for conveying the molten metal from the tap in the bottom of the kettle to the molding pans, which had been placed on the floor in a semicircle. The doors of the hood were open and the pans were being filled, but no fumes were noticeable. A large metal kettle was also used for slug casting in a separate room, also provided with a hood and piped out to a duct, with artificial exhaust. The slugs were cast in continuous strips, passing over a long conveyor to a reel on which they were wound to be cut up and trimmed later. In addition, there were several kettles for metal used for printers' furniture that were provided with similar exhaust. The fans seemed to carry the fumes off well throughout, and with the windows partly open the air felt very good. The plant was visited in May, with an outside temperature of 74° to 77° F., which would naturally make inside conditions better than if it had been inspected during cold weather that would necessitate closing of the windows. The other establishment was equipped with two large metal-mixing kettles provided with pump drive agitators for the metal and with spouts with screw stoppers near the bottom. The kettles were covered with good hoods and curtains, with exhaust pipes to a large hopper placed between the two. The gas fuel was piped separately out of the building. A separate, special container, for shipping the dross, was provided with a hood and piped to the hopper also. An old dross refining furnace with charcoal fuel, placed in one corner, was piped only to the flue, but it was stated that it was not used any more, all dross being sent away for refining. It was explained that the hopper had been installed to collect antimony from the fumes of dross in the metal kettles, and that about one-half of 1 per cent had been saved since installation. The air in the metal-mixing room, which was located at the end of the foundry, seemed very good, partly due to the high ceiling and window ventilation and partly to the hood over the kettle in use being closed tightly during inspection of the room. The visit was in May, with an outside temperature of 53° to 64° F., and the heat from the metal kettle did not seem excessive. Hand casting furnaces for brass type, located on the top floor of the two-story part of the establishment, were provided with large hoods and curtains but were open in front. The hoods were piped with exhaust fan out through a flue. The rooms on the second floor were supplied

with grates in the ceilings to turrets on the roofs and felt well ventilated.

Some type-metal dust was produced in both establishments through hand finishing. One style of casting machine turns out the types all finished and ready for assembling, breaking off the jet, grooving the foot, and leaving the edges smooth. In one establishment the jets, which are small projections on the ends of the types, were broken off in the machines and fell into small, removable pans placed under the machines for catching them. When the jets were not removed by the machines it was necessary to break them off afterwards, smooth the broken surfaces or edges of the type, and nick it, which naturally distributed some dust. In one establishment the dressers, who smoothed the ends of type and nicked or grooved it with a hand plane, removed the dust at intervals by a swipe with a soft flat brush, intending to deposit it in a box at the end of the bench. The box caught most of the dust, but not all. The burs on the edges were removed by hand rubbing on three large flat stones, around which the operators were seated, bending over the work. Some were using special files laid on the stones in addition to the stone surfaces. The fine dust from the edges clung mostly to the stones and files, but some stuck to the hands or to the pads where used, while no doubt some was inhaled by the workers. Special trimming machines were also used for overhang type. Additional dust was created by all of these operations, but none of it was visibly oxidized, and it looked to be mostly metallic particles, too heavy to rise in the air. The dust in the sorting room and type-dividing department was probably more dangerous, as the type had been exposed to the air for a longer period and it would be more likely to consist of oxide of lead rubbed from the type by contact. Brass rules were also finished by hand planing and hand rubbing in similar manner, though part were finished by power trimming machines, which were provided with vacuum attachments for removal of dust. In either case this would also be metallic dust, consisting of proportionately heavy particles. In the other establishment two large stones were similarly used for hand smoothing of type; also grooving of the partly finished type was done by hand planing. A number of small kerning machines were used for cutting down special sizes of type, and these were provided with drawers under the benches for catching the cuttings. Brass type was also finished by hand in a similar manner, but brass rules were finished in a special, own design machine, which was equipped with a vacuum attachment for dust. The dust in the assembling and dividing departments was similar to that found in the first plant, but was very slight in both of the plants. The same thing holds good for die engraving and finishing.

The manufacture of ink produces more or less fumes and dust, but very little is definitely known regarding the possible injurious effects of the fumes. Considerable complaint was heard in departments adjoining ink-grinding equipment where it was not entirely separated from these, but no ill effects were actually proved. It seemed to be merely a question of disagreeable odors, and where proper ventilation existed these were not apparent. The dust was ordinarily a local problem and very few of the printing-trade estab-

lishments used dry colors, most of the ink grinding consisting of reduction, mixing of colors, or regrinding ink left in the fountains. The two separate ink factories visited did not require any special ventilation provisions, and those located in the larger establishments were provided with sufficient ventilation. Occasionally an ink-grinding department was seen which needed better ventilation, such as an auxiliary one in Chicago—located in the basement of a six-story building—engaged in coating carbon paper. This department contained several hopper mills for grinding, a mixer, a retainer, and a coating machine with fan-blast cooling. All were provided with steam heat from the boilers in an adjoining room. There was no ventilation to speak of, so the air felt decidedly close and unpleasant.

Factors outside of the establishments themselves may also be responsible for unpleasant conditions in the workrooms, such as in one plant in New York, where considerable painting was being performed in adjoining rooms, not well separated from the printing operations. The air in the shop was laden with fumes of turpentine, and complaints were heard of headache from this cause. Another establishment in New York, which occupied part of a six-story factory building, was well provided with ventilation for the plant itself, but the workers were subjected to strong fumes from banana oil, used by a special process plant located in the same building, which penetrated through the halls and elevator shafts, tainting the atmosphere. The agencies that distribute unpleasant conditions are not always industrial. A variation was observed in a newspaper establishment in Cleveland, part of which was located in a basement which had some small windows in the rear end of the building, facing on a concourse in the alley used for delivery vehicles. Most of these vehicles were small wagons drawn by horses, which stood quite a while waiting for papers, and the place was in a filthy condition. Stench from it penetrated into the basement and polluted the air. Such a situation was, of course, absolutely unnecessary and could have been easily remedied.

Observations showed that adequate ventilation is one of the most important factors in health conditions of the workers in printing-trade establishments. The effect of insufficient provision could not be accurately and scientifically determined without thorough physical examination of the workers, which was out of the question. One examination would give only a basis and would have to be followed through a period of years with other examinations of the same subjects, to readily establish accurate data by comparison.

SANITATION

The importance of keeping the working rooms clean is not always recognized, neither by employers nor by workers. Even though the actual constituents of dirt may not be dangerous to the health, a workroom filled with it encourages unhygienic habits and practices. Dirt not only looks unsightly, but, in addition, has a tendency to render the workers careless in habits and in the execution of work. When compared with the conditions of past years, still fresh in the memory of former printing workers, now owners of establishments,

the sanitary conditions of printing plants show a vast improvement. But former conditions can not be accepted as a standard, and improvements in sanitation are of importance to the workers from a health standpoint. Incidentally they are of importance to the employers, because better working conditions create additional production. Sanitation includes several subjects and merges to a certain extent with provisions for ventilating devices on equipment, because some of these devices either carry off the dust, which otherwise would litter the floors and cover the objects in the rooms, or eliminate the fumes that assist in producing unsanitary conditions. Some of the work is of a dirty nature, but even the worst phases of it were found in buildings that were kept clean all through and furnished pleasant surroundings for the workers. This means more than appears on the surface, because the environment in which the worker spends approximately one-third of his or her life has a marked influence on both physical and mental development. Dark and dirty work-rooms naturally foster a depressing feeling which affects health, contentment, and efficiency.

The main subject considered under sanitation was the "state of cleanliness" in the workrooms. Under that head the summary of tabulation (p. 229) gives the condition as observed in the various plants for the important features. In the 536 establishments it was found that the condition of cleanliness for the floors was good in 40.9 per cent, fair in 34.9 per cent, and bad in 24.2 per cent. "Good" means that the floors of the plants were clean at the time of the visit, though the method of cleaning was not always taken into consideration. "Fair" means that the majority of the floors were clean at the time or showed evidence of regular and reasonable cleaning. "Bad" means that cleaning was generally neglected, the floors littered with rubbish or accumulations of dirt. The state of cleanliness for the equipment ordinarily goes hand in hand with the condition of floors but was found to be even better, as shown in the tabulation. In 65.9 per cent of the establishments it was good, in 22.4 per cent fair, and bad in only 11.7 per cent. Good, fair, and bad were applied in the same general terms as for the floors.

Information was sought regarding the use of vacuum cleaning for factories. This was found in use for that purpose in 33 of the establishments surveyed—only a little over 6 per cent—and not exclusively in all of these. A few were equipped with vacuum systems in the walls of the buildings, but the majority used portable cleaners. These seemed to work well, whether the establishment was engaged in book and job or periodical or newspaper printing, in photo-engraving or electrotyping, or in bindery work. Comparison of the places where it was used with those where it was not gave a feeling of regret that vacuum cleaning was not more commonly employed. It is certainly an application of the correct principle, because it removes the dust altogether from the workroom instead of scattering it, as invariably is done in sweeping. In 6 other plants vacuum cleaning was used for the equipment only, and 4 additional establishments stated that the system was used in the building for the offices but not for the workrooms.

One newspaper establishment in Cincinnati was equipped with vacuum tubes in the walls and turbine attachment in the basement,

but used sweeping mostly. Another newspaper plant, located in Cleveland, also had vacuum tubes in the walls, with a stationary pump in the basement, but the system was used only for the offices. It was claimed that it would not work well in the workrooms. At the same time there was a considerable amount of dust visible on some ledges and sloping parts of walls in the pressroom which could easily have been removed by the vacuum system, and similar conditions were found in other departments. When attention was called to this fact, the real reason for not using the system was disclosed by the statement that it would require extra janitor service. The floors of the plant were swept well in the easily accessible places, but not thoroughly all over. A different view of vacuum cleaning was held by a large book and job printing establishment in Louisville, which had just completed a new addition to its 8-year-old, four-story-and-basement building and had installed vacuum tubes in the walls, convinced that it was the best method of cleaning. A large book and job printing establishment near Chicago, which was housed in a single-story building, was provided with vacuum tubes, through which waste paper was taken during working hours to a waste room in the rear of the building. The room was separated by glass-top partitions from the main room, and the interior, where the waste was being sorted by girls, was full of dust from the waste. The plant was cleaned thoroughly by vacuum every Saturday afternoon and Sunday. Another large book and job printing establishment, located near New York City in a two-story and basement building, was also provided with a vacuum tube system in the walls, with outlets every 75 feet. The rooms were kept well cleaned. Some firms were skeptical on the subject. One label-printing plant in St. Louis stated that it had tried vacuum cleaning, but did not find it suitable. A book and job printing plant located in Nashville also explained that vacuum cleaning had been tried there and found not satisfactory. On further inquiry it was learned that the attempt had been made with a small hand-propelled suction sweeper, intended for housework and not for an industrial establishment.

Vacuum was also used in some establishments for removal of paper dust and trimmings directly from the sources, as well as for all paper waste. One large periodical printing plant in Chicago has applied suction attachments to the paper-trimming machines, so that one sweep of the arm by the operator would bring the trimmings close to the opening of the tube. The tubes extended through the floor to a duct close to the ceiling of the story below and down through the six stories of the building, with additional pipes and ducts on other floors from trimming or covering machines, or for other waste paper, to the baling room in the basement. The system seemed to work excellently, so that both floor and equipment were kept comparatively clean. A large book and job printing establishment near New York was also provided with a vacuum system, on trimming and covering machines, etc., that was piped outside the main building to a separate structure, in which the waste was baled. Both of these plants were cleaned by sweeping, and compressed air was used for blowing dust out of various machines. Compressed air blowers are objectionable because of distributing

the dust instead of eliminating it. They were commonly used in newspaper establishments for removing dust from the type-casting machines, from around stereotype steam tables, from the folding mechanisms of the presses, and from other places difficult to clean.

In the ordinary printing establishment the main article to be removed from the rooms is paper waste. The cuttings and dust from this can not be considered a direct menace to health, but large quantities scattered over the floors have an indirect influence by creating disorderly workrooms and encouraging unsanitary habits. The ordinary method for disposing of it was to place it in containers and to convey these to the waste baler. In small plants, located on one floor, the baler was usually placed at one side, away from the actual working machinery, though in some plants it was seen located right alongside the trimming machines. In large multistory buildings the baling machine was ordinarily placed in the basement, by the end of a large gravity duct that extended up through the building, with doors on each floor for admittance of the waste. Cuttings from trimming machines were sometimes thrown into bins, from which they were removed at intervals, though in some places they were just pushed off the machine to the floor and swept away from time to time. A few establishments used sacks for containers, and in one establishment these were taken to the basement when full, where they were piled until sufficient had accumulated to dispose of. This is a very hazardous proceeding when fire risk is considered. Other plants were supplied with metal containers for the paper waste. Metal containers, some open and some with covers, were usually employed for other waste in the pressroom, such as rags filled with oil or ink. The largest book and job printing establishment in Washington used sanitary containers with hinged lids.

The problem of metal waste in composing, photo-engraving, stereotyping, and electrotyping establishments is noted under "ventilation of equipment." Such material constitutes an actual danger on account of possible harm to the health of the workers, and it seemed strange that the employees were often so careless in that respect. In one book and job printing establishment in Pittsburgh a small saw was used in the composing room for trimming line slugs. It was inclosed on three sides by low partitions, inside of which the cuttings were heaped up nearly one foot high. As these did not accumulate very fast this meant that the metal had been lying there for a considerable time and had probably formed a quantity of oxide of lead, which would be distributed by stirring up. In the composing room of a newspaper establishment in the same city, where several saws were used for trimming line slugs, the cuttings were collected within the hollow pedestals and ejected through spouts near the bottoms into small receptacles, placed under them. The spout was missing on one of these and the cuttings were scattered over the floor outside the receptacle, and later kicked around by the workers passing by, but no attention was paid to it. Corresponding cases were found in the other cities visited, but there were also a number of establishments that were kept spick and span, where the employers took an interest in having the plant clean and where the workers cooperated. Several establishments

were provided with gravity chutes, for dead slugs or type from the composing room, to bins or boxes near the ingot casting furnaces on a floor below. Others merely conveyed such material in containers on wheels to the ingot furnace and dumped it in a heap nearby, from which it was later shoveled into the kettle.

The majority of plants depended on sweeping for cleaning the floors. Some used sweeping compounds, some used wet sawdust, and others used oiled sawdust; in several establishments dry sweeping was practiced altogether, at times during working hours. This should never be allowed in the workrooms, and especially not while work is being performed, on account of raising unnecessary dust and filling the air with it. In a number of places, where the floor surfaces were wood, these were kept oiled to prevent raising dust. In addition, some sprinkled with disinfectants. Thorough cleaning of floors depends on several conditions. A workroom crowded with equipment, product, or material is extremely difficult to clean. An old wood floor, perhaps broken in several places, presents additional difficulties, and a concrete floor with broken surfaces creates trouble also. One or more of these conditions as well as some mistaken ideas about sweeping were found in different localities. In one photo-engraving establishment in Chicago the manager stated that the floors were swept three times a day. This would have involved sweeping at least twice during working hours—not a healthful proposition, as it was performed dry. The statement was not quite commensurate with the looks of the plant, as there was considerable dust visible in the etching room as well as in the routing and blocking room. In the pressroom of one book and job printing establishment in Philadelphia a sign was noticed, "Floor swept at 1.30 and 4.30 p. m." The place was very crowded, and the floor was littered with paper, said to have been left over from an emergency shift on the previous night. Several of the plants during the inspection, and probably brought about by it, were cleaning the floors and the equipment. In one large periodical printing plant in New York attempt was made to sweep the worst part of a lower floor while the upper ones were being looked over. The place was very untidy and was crowded, making sweeping difficult. In another large periodical printing plant in the same city the electrotype foundry was being swept during the visit to it, and the foreman frankly admitted that it would have been cleaned previously if he had known about the inspection beforehand. He stated that it was cleaned twice a week, but judging from the looks of it and the large heaps of metal scraps this seemed doubtful. Electrotyping establishments are, as a rule, difficult to keep clean, unless it is done right along and thoroughly. A great many of them were just cleaned superficially and contained large deposits of dirt under the tables and benches or under the raised platforms between the plating tanks. The surface of the floor plays a very important part in the cleaning process. If broken or full of cracks it naturally retains more or less dirt, a condition noted in several old wooden floors. Concrete floors have a tendency to give off a fine dust from the surface unless coated with a finishing material, due to the improper combination of the cement with the other ingredients. This was especially noticeable where the surface had become chipped or cracked by heavy trucking or by material falling on it. Such condi-

tions sometimes prohibited thorough cleaning, and each attempt stirred up quantities of dust which was of an unquestionably detrimental character.

Large plants maintain a regular force for cleaning the floors and some also have special help for cleaning the equipment. In these the cleaning was, as a rule, done well. In very small establishments there is not a great amount of dirt produced, and the majority of these places were found in good condition. While many of the medium sized plants were clean and orderly, this group presented the most unsanitary appearance, often due to the fact that where separate help was employed to do the cleaning the force was either too occupied at other tasks to devote sufficient time to the work or was too careless to do it correctly. An example of the latter was, for instance, seen in a printing establishment in Louisville employing about 135 workers. The various departments were full of accumulated dust and dirt, and during inspection of the plant several of the porters were found asleep in various nooks. The blame in such a case belongs principally to poor supervision. In distinct contrast to this was the largest establishment in Washington, where cleanliness was apparent all around and where the janitor service was probably better than in any other plant of similar nature. Where the cleaning is left to the craftsmen, as was the case in several instances, the operation is likely to be slighted because a great deal of time can not be devoted to it. Exceptions were found, such as in a type foundry where the type-casting machines were stopped at 11 a. m. on Saturdays and the operators cleaned thoroughly around the machines. In the larger establishments the floors were scrubbed regularly, daily in some and at varying intervals in the others, mostly weekly. Tables, also, in the binding departments were scrubbed at regular intervals in some of the plants, commonly by those using them. In establishments which are operated continuously it is, of course, difficult to clean up, but some of them were remarkably well kept. Certain processes develop considerable dirt which, if left for any length of time, is difficult to remove.

An example of this was observed in a small ink-grinding establishment where the ink had caked on the concrete floor. It was being cleaned during the visit there and probably on account of the visit. The deposit of ink was so solid that it was necessary to scrape the floor with sharp-edged bars to remove it. The majority of ink-grinding departments were supplied with iron or steel plate floors, which were usually scrubbed regularly with chemical cleaning compounds dissolved in hot water. These compounds were used in some color printing establishments also, to remove accumulations of ink from patent bases or other furniture in the forms. The furniture was placed in a perforated cylinder, which was revolved slowly in a vat containing the hot solution. Shelves or other projections on the walls are naturally dirt catchers, especially where dry sweeping is employed, and are generally absent in modern, sanitary plants. The walls in these plants were usually smooth and covered with some material which could be washed and kept clean, such as in the large printing establishment in Washington, previously referred to, where the bottom parts consisted of enameled brick and were washed at regular intervals. Where counter shafting and overhead belts were

used for operating the machines there was considerable dirt accumulation on the overhead hangers. The walls and ceilings were ordinarily covered with dark streaks in line with the belts from oil projected by them and covered later with dust that had been stirred up by the belts. Shelving, where necessary, was often isolated from the main workrooms, and in modern plants was usually of steel. Steel bins were also found, either on wheels or stationary, and so constructed as to give access for cleaning the floors. The equipment is usually cleaned by wiping it with rags to remove the oil or grease and the dirt which has settled on this. The wiping rags are sometimes a source of danger when they are bought indiscriminately and no attention is paid to sterilizing them before handling. In several cities the use of any but sterilized rags has been prohibited, and in New York several of the large firms were using sanitary towels furnished and recleaned by a special service company instead of rags. Compressed air was utilized in a number of establishments to assist in cleaning the equipment, especially for freeing it of paper dust, and in a few places vacuum cleaning was used for the same purpose. The latter is gradually coming into use as the benefits of the system are being realized.

In a few plants it had been found necessary to protect the work against dust dropping through the floor above, scaling of paint, particles of concrete loosened by vibration, or falling plaster, and makeshifts had been employed, such as paper or beaver board nailed on the ceilings, or canvas stretched under it, presenting a very unsightly appearance. Such conditions were not the fault of the trade but due to inadequate construction or maintenance of the building, just as were other conditions which created unpleasant and unsanitary environments from time to time in basements. Quite a few basements had been dug below the level of the sewer systems, and were flooded during heavy rains by backing up of the sewers, adding considerably to the other discomforts attending basement locations.

Cleaning of windows is a very important factor because when these become dirty the daylight is retarded, causing eyestrain for the workers or waste of artificial light, which affects the pocket-book of the employer. In the larger plants the windows and skylights are washed regularly, to admit the maximum of daylight. The outside conditions and the weather naturally have considerable influence on the state of cleanliness, but sometimes it is affected by inside conditions also. In some establishments the windows were thickly coated with smoke and dust, developed inside the building, which interfered greatly with the light. For "state of cleanliness" of windows, the summary of tabulation (p. 229) shows that the condition of these was found good in 61.2 per cent of the plants inspected, fair in 15 per cent, and bad in 23.8 per cent. Good, fair, and bad were used with the same general meaning as for previous items. It was noticed that some establishments overlooked the importance of keeping the artificial lighting equipment clean. The original installation may be above reproach, but, unless properly maintained, may soon become practically worthless. Bulbs and other appliances should be kept clean.

The condition of type cases was considered separately from other equipment on account of the special character, as well as on account of the nature, of the dust found at times in these. For them the summary of tabulation shows that in 67.6 per cent of the plants inspected the state of cleanliness was judged good, while in 32.4 per cent it was considered bad. "Good" means that no appreciable amount of dust was observed in the cases, and "bad" that these contained a noticeable quantity. No intermediate term could be conceived for these, because even a small amount of oxide dust might prove dangerous. One establishment was included which was not listed as performing hand composition, as it was a trade composition plant that supplied the product to printing establishments, but used containers for this up to delivery. Type cases formerly constituted a great menace to the health of compositors on account of the oxide of lead dust which was rubbed off the type and deposited in the compartments. At the present time the majority of the type is produced on machines right in the plants and dumped into the compartments for use but not distributed into the cases after using. Consequently it does not get a chance to form any quantity of oxide on the surface, and in the majority of places the lead dust observed in the type cases was mostly small metallic particles, too heavy to float in the air. A great many of the establishments were equipped with either wood or metal cabinets containing the type cases, though older plants still used the open frames which allows dust to settle freely among the type in the compartments. Most of the cabinets extended to the floor and did not leave any space under them for accumulation of dirt. The cleaning of the cases may prove a danger unless precautions are taken. It is, however, not necessary now so often as before nondistribution came into general use, and the hazard from the dust can be entirely eliminated by the use of vacuum cleaning. This was used in some places with good results, according to the foremen, though it was not actually seen. There is no reason to subject any workers to the possibility of lead poisoning by allowing them to blow the dust out of the cases, either by means of bellows or with compressed air. The sensible method is to absorb the dust by vacuum cleaning instead of scattering it. A fine-mesh wire screen laid over the type case will prevent the suction from pulling the type into the vacuum cleaner, an argument given against the use of it in several instances. A great deal of dust formerly found in type cases was not actual dust from the type itself but dust from the sweeping or other outside sources, which had settled there and mixed with the dust from the type. This is practically eliminated where cabinets, or so-called Tracy-style cases, are used, which close tightly and do not admit outside dust unless left open through carelessness of the workers.

The state of cleanliness of the toilet rooms was deemed of sufficient importance to be referred to. The sanitary codes of the various States usually provide for a certain number of fixtures to a certain number of employees, separation for sexes, and ventilation of rooms, but do not always include cleanliness as one of the requisites. The summary of tabulation (p. 229) shows that 3 of the establishments inspected did not have any toilet rooms and that 67 per cent of the remaining 533 were found good and 33 per cent bad, as re-

lating to cleanliness. The classification is, similar to that for the preceding subject, divided only into good and bad, because no intermediate term was judged fitting, and this part of the inspection pertained to general cleanliness of the toilet rooms and fixtures only. No attempt was made to pass on the adequacy of facilities, desirability of fixtures, quality of plumbing, condition of ventilation, or sufficiency of lighting, though some unusual features were noted in passing through. Large establishments occupying single-story buildings were provided with toilet rooms all around the buildings, convenient to the different departments. In older multistory buildings the toilet rooms for males and females were usually located on alternate floors, but in the newer structures separate installations for the sexes were often found on the same floor. Many of the toilet rooms seen were of excellent construction, finished with tile or marble, supplied with doors for the separated fixtures, and cleaned regularly. Others were observed that had not been provided with doors, as well as some where the doors had been partly or entirely broken by the workers. A few were found that were not even provided with separating partitions, such as in the pressroom of a newspaper establishment in Chicago, where the toilet fixtures were placed side by side in the washroom without screening provision from one another or from the rest of the room. Complaints were heard in several plants about the carelessness of the help in maintaining sanitary conditions in the toilets and this seemed to be one of the main difficulties. There was evidence of this in some of the best plants, where the toilet rooms were equal in style to those of first-class hotels and where regular janitor service was supplied, but pieces of toilet paper, matches, cigarette stubs, and even excretions were observed on the floors of the stalls, although cuspidors were also provided. Several rooms were found in which the bowls had not been flushed and which showed other evidences of disregard for the comfort of fellow workers or of sanitary surroundings. In one place, where part of the plant was located on the tenth floor and the toilets were on a balcony in the room, the bowls could not be flushed at all times on account of low-water pressure, creating extremely undesirable conditions. Automatic flush was found in several other instances, which effectually remedied oversights.

In one large establishment in New York glue cooking was being performed in part of one toilet room for males and a cutting-knife grinder was located in part of another, while in another large plant in the same city part of one toilet room for males was used for storage of acid and part of another for storage of oils, an arrangement that could not be considered sanitary. In one large electrotyping establishment, also in New York, the floor in the toilet room was covered with a thick deposit of graphite dust, probably due to insufficient or careless janitor service, making it so slippery that it was dangerous to walk on it. The worst feature encountered was a noticeable insufficiency of fixtures in several plants, a condition which affects the health of the workers through tendency to induce constipation with attendant complications. In one newspaper printing establishment in Cleveland it was found that there were often 50 men employed at one time in the pressroom, but only two fixtures

had been provided for that department, hardly a sufficient number. In another newspaper plant located in Detroit there was also an inadequate number of fixtures for the men employed in the press-room Saturday nights, though sufficient at other times. In this place the toilet facilities were bad at the time of the visit, due to temporary backing up of the sewer. Similar conditions of insufficient toilet arrangements were observed in a newspaper pressroom in Indianapolis, while in a newspaper plant in Pittsburgh the accommodations for the stereotypers and photo-engravers on the fourth floor were too scant, and a single urinal for the pressroom was stopped up, overflowing, and distributing unpleasant odors. In one photo-engraving establishment in New York there were no toilet rooms in the three stories occupied in the five-story factory building. About 100 workers were employed in two shifts and use was made of the toilet rooms in a connecting building in which the offices and the art department were located. A small trade-composition plant in Richmond, which occupied the first floor of an old store building, had a toilet fixture located in a small, dirty basement with access only through a trapdoor in the floor. The majority of the toilet rooms were provided with outside ventilation. Once in a while inside water-closet compartments were seen, such as in one job-printing establishment in Detroit, which occupied the first floor and basement of a four-story building. The toilet facilities for the male workers on the first floor consisted of a stool inclosed in a small cupboard under the stairway ventilated by a stovepipe to the flue, while in the basement a small space was partitioned off around another stool with ventilation to the main room only. Both of these were dirty, as was the one for the female employees located in a makeshift dressing room on the first floor. A few outdoor toilets were found in connection with very small shops, usually when these were housed in old dwellings, but they were ordinarily in good sanitary condition. One small job-printing establishment in Charleston, S. C., was housed on the first floor of an old dilapidated store building, which had no toilet facilities on that floor. The plant had been located there for four years under other ownership but had been purchased by the present manager about two months previous to inspection. Installation of toilet facilities had been demanded of the owner, who refused to make any changes, and new quarters were looked for.

Another of the items under sanitation was the provision for dressing rooms and lockers. The summary of tabulation (p. 229) shows for that subject that 41 per cent of the establishments inspected were provided with dressing rooms for both sexes, while 8.4 per cent additional were provided with dressing rooms for female employees only. The remaining 50.6 per cent did not have any dressing rooms. Individual lockers for clothes were furnished in 55 per cent of the plants, collective lockers in 5.2 per cent, but none in 39.8 per cent of them. The number given for plants provided with individual lockers includes five in which the majority were individual but some were collective, while in the number containing collective lockers two were provided with some individual lockers also. In the processes which involve dirty or heavy work the workers usually change their street clothes for overalls and other special

garments. In a few of the plants special working clothes were furnished, but the workers usually provided their own. Oftentimes all of the wearing apparel was changed, including underwear and shoes. Suitable dressing rooms are consequently required, and the majority of the State sanitary codes have regulations concerning dressing rooms where more than a certain number of workers are employed. Some of the larger establishments had adequate facilities, large and well-kept rooms, furnished with individual and well-ventilated steel lockers or with overhead hangers for the clothing, free from any fumes or dust that might be present in the factory rooms, and kept clean and tidy. In other plants the dressing rooms were located on balconies in the different departments, sometimes entirely inclosed. At other times they were partly open, and clothes hanging in them were subjected to fumes or gases liberated in the rooms below. In some of the smaller shops makeshift affairs had been installed by inclosing a small place with partitions that did not extend clear to the ceiling and, consequently, gave free access to dust. A few of the older plants were supplied with wooden lockers, not very desirable from a sanitary point of view, and in several places half-length steel lockers were observed. These were entirely inadequate, and it had been necessary to hang outside wraps around in available places without any protection, as they were too long for the lockers. A number of plants were provided with good, full-sized steel lockers, often with sloping tops to prevent piling stuff on top of them and detracting from the sanitary surroundings. In several locker rooms the lockers had been placed on composition bases with concave floor joints for easy cleaning.

In some of the newspaper establishments special locker rooms were maintained for the compositors, photo-engravers, and perhaps for the stereotypers, but in several of the pressrooms the lockers were found stuck in available nooks, wherever space could be found. In others regular rooms were provided for the purpose. These were often littered with paper, as the floors usually were of concrete and the workers in pressrooms commonly change all their wearing apparel, so object to standing with bare feet on the concrete floors. The rooms are often swept in a haphazard manner, as they are not seen much by the public. In small establishments clothes were usually hung on the walls without any protection, though in some places the workers had covered them with sheets of paper to keep the dust away from them. It seemed strange to see lockers provided in some of these plants for the wraps of the office help, placed in rooms that were clean in themselves, while the other workers were compelled to dispose of their wearing apparel in rooms containing considerable dust, and without any protection whatever.

Several of the processes in the printing trades are clean but others are extremely dirty, and in some of them the workers are brought into contact with possible poisonous material. This makes washing facilities one of the important items of sanitation in the trade, and one which was found sadly neglected in a number of instances. The accumulations of lead, ink, and grease can not be removed properly with cold water, and hot water should always be provided for that purpose. This is, of course, usually furnished in winter in shops located where heating is necessary at that time of

year, but several of these were supplied only with cold water during the summer season, and in the South it was not uncommon to find cold water provided throughout the year. The summary of tabulation (p. 229) shows that 61.4 per cent of the establishments inspected were equipped with hot water for washing purposes, while 38.6 per cent were supplied with cold water only. Among the establishments which were provided with hot water it was found that in 9 of them only part of the plant was supplied and in at least 21 others it was furnished in winter only. The summary shows that 21.5 per cent of the plants were equipped with shower baths. These are seldom supplied for bindery workers, and in some plants they were installed for special departments alone, such as in three of the establishments where they were located only in the pressrooms and in five others, where the electrotyping departments only were provided. The importance of washing up has been very much underrated in the past and the lack of facilities was probably largely responsible for considerable of the illness attending work in the printing trades. Managers of some of the large establishments pointed with justifiable pride to the arrangements existing in their plants, ample space and adequate facilities in nicely finished rooms that were kept clean. Some were equipped with individual bowls, such as one large establishment in Cincinnati, where one of its washrooms contained 148 of these, all filled by the porter just before lunch time and quitting time, ready for the workers.

In some modern plants spray faucets were used instead of individual basins, a more sanitary way. The main objection in the South to providing hot water was on account of the heat generated in preparing it, but it has been learned that some establishments which were not previously equipped have installed hot-water facilities for washing since the plants were surveyed. A possible solution of that problem might be found through the electrically heated water faucet, such as is allowed by the New York State Department of Labor to be used in small plants that have no general hot-water heating system. These do not distribute any heat and would be well adapted for a warm climate, although the operating cost might prove too great. Some buildings use special water heaters, separate from the heating system for the plant, all the year round while others use these only in summer. Makeshift arrangements were also found, such as in one establishment in Cleveland, where hand and machine composition, electrotyping, presswork, book and pamphlet binding are all performed in the plant. An individual gas fuel boiler was used in the electrotyping department to furnish steam for the work there, and the workers in that department drew hot water from it for washing purposes. The other departments used cold water only. In two establishments, located, respectively, on the tenth and the eleventh floors of the same building in New York, only cold water was supplied, but this was heated by the workers, a bucketful at a time, with live steam. The free end of a steam pipe, which was kept inclosed in a small cupboard on each floor, was inserted in the water and the steam turned on. These pipes were probably installed originally for cooking paste in a similar manner, a method still used in some small establishments, where it also serves

for heating water for washing. Some establishments seemed to disregard sanitation in washing facilities. In one job-printing plant in Detroit, employing about 23 male and 12 female workers, the only provision for the compositors and job pressmen was an old dirty sink, placed by one wall in the composing room on the first floor and supplied with cold water only. The washstand for the female workers, located in a makeshift dressing room in the adjoining bindery, was likewise dirty. In the basement, containing the cylinder pressroom, was found a pail, two-thirds full of dirty water, placed on a box, the arrangement used for the workers in that department. A few employers seemed to think that hot water was not a necessity. In one newspaper establishment in Cincinnati the composing room was located on the third floor. There was no hot water above the first floor, and the management stated repeatedly that it did not want to install a system, as a new building was contemplated. In a contract finally entered into with the compositors it was agreed to install hot water above the first floor, but the original intention was partly evaded by installation of one faucet in the washroom on the third floor, entirely inadequate for the workers employed there.

A newspaper establishment in Baltimore was not supplied with hot water. The workers had requested it and the manager stated that he had offered to run steampipes from the boilers for the steam tables in an adjoining room into the washroom for the compositors, but the proposal had been rejected as unsatisfactory. The manager explained that the firm would be in the building only a short time, but the workers stated that the building was leased for five years and only one year of this had expired. It looked rather unreasonable to expect them to continue for four years more without hot-water provisions. In one of the type foundries visited there was no hot water at the time, as the heater for that purpose was being equipped with oil burners. The same condition was found in two of the printing establishments. In a few newspaper plants the equipment for washing was sufficient for ordinary purposes but not for the additional force employed Saturday nights, though the majority were prepared for the emergency. In a number of photo-engraving establishments the workers were observed to wash at the sinks provided for the work, usually without soap, and many of these plants were not provided with any other facilities for washing. This should not be permitted, especially where poisonous chemicals are handled, and proper washrooms should be supplied in all establishments of that kind. An undesirable condition was observed in several binderies, in which the sinks were used during the making of paste, for the cleaning of implements as well as for washing, and were found filled with lumps of paste. Soap was furnished in a number of the establishments. In some, liquid soap had been provided and in others bar soap was furnished to the workers. Some plants provided paper towels, while others supplied individual cotton towels. The workers in a few plants were using roller towels, a practice which should never be allowed, as it is a possible source of infection. In a large binding establishment in Detroit, employing over a hundred workers, the firm supplied roller towels, hung by the washstands. A sign on the wall by these read: "Individual face towels will be fur-

nished by — Towel Co. for 35 cents per week." In a book and job printing establishment in Philadelphia containing about 50 employees the help also paid for the use of individual towels. These were the only two instances where that condition was noticed, though there may possibly have been others.

In one private printing plant, owned by a large life-insurance company in Boston, electric hot-air blowers were used instead of towels. These were also found installed in a newspaper establishment of the same city. Some of the installations for shower baths were excellent. A few were the reverse, such as in one newspaper establishment in Detroit. The composing room on the tenth floor was supplied with a shower bath which could not be used because the water pressure was too low. The pressroom in the basement was also supplied with one shower bath, entirely insufficient for the 50 men employed regularly, and especially so when 25 men additional are employed Friday and Saturday nights. In a large newspaper establishment in Chicago the pressroom was the only department supplied with shower baths, and one of these was used as a storehouse for dirty ink taken out of the fountains. Electrotyping establishments of any size, as a rule, were equipped with shower baths on account of the dirty nature of the graphite dust employed in electrotyping. A few fair-sized ones were found that had failed to install baths. One of these, located in Cleveland and employing about 30 men, had been occupying the same quarters for about 18 years. Recent changes were made in the arrangement of the plant, and the blue prints showed installation of shower baths. A space had been partitioned off for these but no plumbing had been installed, and the inclosure was used for storage of stock. In a large printing establishment in St. Louis, employing about 400 workers, no shower baths were provided, although electrotyping and bronzing were being done in the plant, as well as stereotyping and ordinary presswork. The firm claimed the men would not use them if they were installed, an assertion that seemed completely refuted by observation in other places. Good use was made of shower baths where they were installed in plants, especially in electrotyping establishments, and in spite of the dust accumulated during working hours the majority of the workers in the manufacturing processes were found to be as clean as the office workers. In fact, many of them were cleaner, because the work compelled them to bathe daily, something all office workers do not indulge in. For all workers that handle lead thorough washing is very essential, not alone when stopping work but also at lunch time before eating, as this prevents what seemed to be the greatest hazard connected with lead or antimony in the printing industry—the accumulation of lead on the hands and conveying it into the mouth. Adequate facilities should always be provided, and shower baths should be installed in all departments where the workers are exposed to lead dust, to excessive dust, or to excessive heat.

WELFARE

Under this head were considered the provisions for lunch rooms, either separate rooms where the workers could eat the lunches brought with them or restaurants provided in the plants, provisions for

drinking water, provisions for medical attention, and other provisions for the comfort of the employees. The summary (p. 229) shows that separate lunch rooms had been provided in only 4.9 per cent of the establishments inspected and that 6.5 per cent additional maintained restaurants with lunch rooms, where food was served to employees. Aside from these, lunch counters were established in eight plants, where food could be purchased, but no place was provided to eat it. A few plants had installed automatic candy sellers. The restaurants consisted of 7 with table service and 26 cafeterias. Two other restaurants were for employers only. Some of the cafeterias were elaborate and in a few of the large establishments separate service was maintained for the sexes. In one of these, maintained by a large periodical printing plant in Philadelphia, luncheon was served at cost to over 2,400 people daily. A splendid large four-way cafeteria was seen in a lithographic printing establishment in Cincinnati. A newspaper establishment in New York maintained a large restaurant, with a seating capacity of about 200 in the main room, and table service or self service, besides large executive dining rooms. About 3,000 people per day were fed in this restaurant, which was operated by two shifts and was open up to 2 o'clock a. m. A private printing plant, operated by an insurance company in New York, maintained a nice cafeteria in which lunch was furnished free to 370 employees.

Another insurance company, which was located in Boston and operated a small private printing plant in its headquarters, with about 40 trade workers, maintained a good cafeteria in which a substantial lunch was served to all employees at 10 cents each. The trade workers, of course, were only a small percentage of the total. Among the cafeterias none were found better than one conducted by the largest printing plant in Washington—the Government Printing Office—a full description of which was printed in the May, 1923, issue of the Monthly Labor Review, published by the Bureau of Labor Statistics, United States Department of Labor. A nice cafeteria was also seen in the large die and plate printing establishment in Washington—the Bureau of Engraving and Printing—though it was not quite so modern as that of the Government Printing Office, because it had been installed eight years previous. It was a necessity in this building, as the workers were not permitted to leave the plant during the lunch hour. A large newspaper establishment in Washington maintained a cafeteria, serving food at cost to employees and tenants of the building, but the workers in the stereotyping department and the pressroom seldom ate there, as they were not admitted in working clothes, consequently they either ate in restaurants outside the building or brought their lunches and ate in the workrooms. Two large printing establishments, one in Louisville and one in Atlanta, stated that they had established cafeterias at one time but discontinued them on account of poor patronage. While restaurant service in the plant is desirable it is not necessary in a business district where it is surrounded by eating places, but the relative importance of good food to health is well known and it is a business policy for employers to keep the workers in good health, which goes hand in hand with efficiency. There is no question that a substantial hot lunch, properly balanced, is better for the

system than cold, unappetizing food in the majority of cases, and that the change of environment from the workroom during the lunch period benefits and invigorates the workers. Where no restaurant is maintained a separate lunch room should be furnished, giving a change from the working surroundings and providing freedom from fumes or dust created by the industrial processes. Attempts on the part of employers to do so were sometimes met with rebuffs, such as in one book and job printing establishment in Milwaukee, where a small lunch room had been installed in the bindery department, equipped with gas plates and porcelain tables. It was stated that offers had been made to install similar ones for other departments, but that the help did not care for it.

Sometimes the arrangements were not of the best. In one newspaper establishment in Philadelphia a small temporary table was found placed in the stereotyping room close to the elevator during the night lunch period, and several compositors and stereotypers were served there with food cooked on a small stove near by. The main stereotyping room was full of fumes and such a place was altogether unfit for eating purposes. A large printing establishment in Baltimore had separated a small space in one corner of the main pressroom with iron pipe hand railing and used this space for a lunch room and kitchen. The pressroom was located in a one-story part of the plant and was equipped with two exhaust fans on each side of the building, in the skylights, but there was considerable odor in the pressroom from the ink and gas burners on the cylinder presses. In addition there were eight bronzing machines located in the room, and the open corner for a lunch room certainly could not be considered as a proper place for eating. In a number of places the help was found eating in the workrooms. It seemed to be a customary proceeding in the binderies, several of which were equipped with small gas stoves for cooking coffee. In others the gas plates for paste cooking were used for that purpose. It was bad enough in the binderies, but the eating of lunch was also observed in composing rooms, in photo-engraving, stereotyping, or electrotyping departments, and in pressrooms, something that should never be allowed. In one large periodical printing plant in New York it was stated that eating was prohibited in the composing room and in the engraving department, but was permitted elsewhere. One electrotyping establishment in the same city had a sign on the wall prohibiting eating in the workroom. There could not be a worse practice than eating in workrooms contaminated with lead in some form, and often without washing the hands. Even though the workers themselves are willing to disregard all warnings regarding the dangers of such habits, the employers ought not to allow it and should provide separate lunch rooms, as well as insist on the help leaving the workrooms during the lunch period.

Drinking water, a very essential item in connection with health, still received only scant attention in the smaller plants. The large modern establishments were usually equipped with filtering and cooling systems for drinking water, piped to the various rooms and supplied through bubbling fountains. These fountains were presumed to be sanitary but did not all prove so, as quite a few were seen which were not provided with guards to prevent the lips from

touching the waterspout. In most of them the water was discharged vertically, though in a few places oblique discharge was found, considered the superior method. The common arrangement for summer consisted of tank coolers, filled with water from the hydrant and with a piece of ice inserted directly in the water. In some instances the ice was not in contact with the water, and bottle coolers were also observed. These latter were in the majority of cases supplied with hydrant water in the workrooms, but it was not unusual in the same plant to find that the drinking water furnished for use in the office was bottled spring water or distilled water, though no logical reason for the distinction could be seen. In a few places bottled water was furnished and in others it was purchased by the workers of certain departments themselves in preference to using the hydrant water. In one printing establishment in Richmond, which employed about 100 workers, one-fourth of whom were females, ice water was supplied by the firm but the help was charged 10 cents a week each for the use of it. Hydrant water is not always desirable, as was noticed during inspections in Milwaukee in the latter part of June. The city water supply had been contaminated and public warning was issued by the commissioner of health to boil the water before using. The commissioner claimed that a bacteriological test showed the presence of 1,500 disease-bearing organisms in each cubic centimeter, which under ordinary circumstances contained only 10 or 12. Most of the printing-trade plants in the city were using drinking water direct from the hydrant, a dangerous practice under the circumstances. In winter cooling tanks were usually discarded and water was secured from the hydrants, either from bubble fountains or individual glasses or cups, though in a very few instances cups were still used in common. In two small establishments the requirements of bubble fountains, ordered by the authorities, had been met by turning an ordinary faucet upside down so the water would be propelled vertically, clearly an evasion of the issue. A sufficient supply of pure, cool drinking water should always be furnished for the workers, especially as some of the operations require severe physical labor and the workers consequently find relief and comfort in good drinking water.

Health supervision of the workers is growing more common each year as it is realized that healthy employees mean additional production. The summary of tabulation (p. 229), under head of "Medical attention," shows that 10.8 per cent of the establishments inspected were provided with emergency hospital rooms, sometimes under the supervision of one of the bindery women, but in 38 cases having a regular trained nurse in attendance. A few of these emergency hospitals had the service of visiting physicians, while five of them had regular physicians stationed there and four others had dental clinics. Of the plants surveyed, 60.8 per cent additional were equipped with first-aid kits, and among these 49 contained also female rest rooms, in most instances supplied with cots. While hospital departments were seen that were excellently equipped, some supplied with as many as six beds, none were found that excelled the emergency hospital in the large book and job printing establishment in Washington—the Government Printing Office—operated with a staff of two physicians and three nurses. A complete write-up of this was included in the

article on the welfare work for the plant in the May, 1923, issue of the Monthly Labor Review, published by the Bureau of Labor Statistics, United States Department of Labor. It was claimed by the establishments which were provided with emergency service that the firms had been more than repaid by the reduction in absences from work. Emergency treatments for minor illnesses had often prevented development into severe sickness, just as treatments of slight wounds prevented serious infections. The importance of dental clinics in the health program had also been recognized and the medical attention included dental infirmaries in three of the New York establishments and one in Washington. Two of these were attended by nurses during working hours, with a dentist half of the time. In the other two the dentist was present all day. One provided free cleaning and an examination of the teeth every six months for all employees. In another, prophylactic treatment and X-ray service was free, with reduced rates for special work. In the others the dental service was optional.

A number of the establishments were located adjoining or close to one or more hospitals, and the firms had not seen any use for individual emergency rooms. Some plants called near-by physicians in cases of emergency, while others sent the patients direct to the physicians selected by the insurance companies. In one large periodical printing plant in New York it was found that the emergency hospital room had been eliminated during recent changes, but it was stated that it would be installed again. In one novelty printing establishment in Cincinnati an emergency room had been provided, equipped with a cot, but it was used at the time of the visit as part of a laboratory and would not be readily accessible in case it were needed. The large establishments ordinarily were examined from time to time by safety committees, selected by the workers from among themselves. These submitted to the management plans for necessary improvements regarding either sanitation or safety. It was found that, in addition to emergency treatments especially good work was often rendered by the medical staffs, physicians, or nurses, through instructing the workers in the fundamentals of public health, personal hygiene, and preventive medicine—great factors in the reduction of illness. These are very important subjects and some which the workers often ignore thoughtlessly. An instance of this was observed, among others, while visiting a small printing establishment in Atlanta. The floor in the bindery department was littered with paper cuttings from the machines and was also dirty, as the crowded condition prevented thorough cleaning. The foreman of the bindery was emphasizing that the plant was nice and hygienic to work in, and punctuated his remarks by vigorous exhortation on a large pile of paper, a proceeding in direct contradiction to his words. The first-aid kits in the various plants equipped with them were usually in good order and kept well filled. Once in a while some were found, mostly in binding departments, that had not been kept up, such as in one job printing establishment in Richmond, where the cabinet was in charge of the forewoman in the bindery. The cabinet was hanging on the wall, but the contents were gone, and in case of accident there was nothing on hand to use in first aid.

In several establishments, notably in Chicago, the workers that were subjected to fumes from lead were examined monthly by

physicians. The same course was followed in a private printing plant operated by an insurance company in New York, and the rest of the employees in that plant were examined yearly. Other establishments required physical examination of applicants for positions in the trades, such as in the Government Printing Office in Washington, where the medical staff conducted rigid examinations, including tests for sight and hearing. It was also found that some of the trade-unions required examinations by physicians for the physical fitness of applicants before admitting them as members. This subject had unfortunately not come up until near the end of the survey, so the only ones recorded as doing so were New York Typographical Union No. 6 and the photo-engravers' unions in New York and Philadelphia. There were probably others which also demanded this safeguard for the other members and for the applicants themselves. The application blank for admission to the New York Photo-Engravers' Union contained the following subjects under the report of the physician:

Age ----- Height ----- Weight: Usual -----, present ----- Arteries ----- Blood pressure: Systole -----, diastole -----, reflexes ----- Eyes -----: Right -----, left -----, with or without glasses ----- Pupillary reactions: Light -----, distance ----- Ears -----: Right -----, left ----- Tongue ----- Teeth ----- Tonsils ----- Pharynx ----- Nasal passages ----- Lungs ----- Heart ----- Skin: Cold or warm -----, dry or moist -----, eruption ----- Abdomen ----- Tremor ----- Flat foot: Right -----, left ----- Glands ----- Varicosities ----- Hemorrhoids ----- Fistula ----- Hernia ----- General condition ----- Remarks ----- Date ----- Signature -----

Any physical condition that might menace the health of other employees, or which would prohibit the applicant from performing the work in the trade efficiently, would cause rejection of the applicant.

The welfare of the workers includes a number of miscellaneous subjects, some of which were not gone into fully, but which are all to a certain extent connected with the health of the people employed in the trade. The question of wages and hours was scrupulously avoided, although it has a great influence on health. Low wages prevent the workers from enjoying decent housing, at times even from obtaining sufficient food, and causes worry which naturally affects the health. Long hours create fatigue and do not give proper time for recuperation. This lowers the resistance of the body to disease and sometimes creates nervous disturbance of the system.

Insurance features were not tabulated. These are only mental factors as far as health is concerned, but may be almost as important in preventing worry about the future, a phase that often contributes to ill health. Several establishments furnished health insurance, accident insurance, or life insurance to their employees. In others part of the premiums was paid by the firms, the workers paying the balance. Some plants had established regular pension systems, but most of them did not have any certain methods and considered each case of aged workers individually in making provisions for them. Others again were not concerned about their employees, except from day to day. One book and job printing establishment in Nashville, employing about 160 trade workers, advised that it retired male employees at 60 years of age and female workers at 55,

and that employees with 20 years' service received a pension. This sounded very good on the face of it, but it was found that if an employee at retirement age had worked in the establishment only 19 years and 6 months, he or she was "out of luck," as the manager put it, and not entitled to a pension. A different attitude was taken in a periodical publishing establishment in Boston, which employed about 250 trade workers. None of the employees were discharged for age, only when infirm, and the ages of those on the active list ranged from 18 years to 70 years. In addition to the employees on it there were 15 others on the pension list. A book publishing establishment in Boston, employing about 600 workers in the manufacturing processes, did not discharge employees on account of age and kept several on the pay roll who did not perform any active work in the plant.

Other provisions for the welfare of the workers were found in different establishments, arrangements for recreation and amusement, all of which play an important part in the wide scope which is being adopted for conserving the health of the workers. A few were equipped with auditoriums, which were also used for social gatherings, sometimes provided with stages and arrangements for moving pictures. Some plants had roof gardens, where fresh air could be enjoyed during rest periods. Others had provided club rooms, with current periodicals or libraries, smoking rooms, or recreation features, such as bowling. In some plants a piano or a phonograph had been placed in the rest room for diversion of the workers during the lunch time. Conveniences in cases of emergency were also found provided, such as in some establishments which furnished rubbers or umbrellas at nominal cost to employees caught without these by inclement weather. One large plant, which was located quite a distance from the business center of the city, furnished free bus service for the workers to and from the same. Mutual associations were noticed in several plants, usually backed by the firms. Aside from looking after some of the features just mentioned these also at times conducted commissaries, where food or other merchandise could be purchased at less cost than outside. Some of these items may seem trivial and altogether beside the point, but they all contribute partly to the well-being of those engaged in the industry, assist in maintaining the vitality and general health of the workers and, consequently, mean increased efficiency and production to the employers.

PERSONNEL

The number of workers engaged in the trade in the 536 establishments surveyed in detail, as furnished by the managers of the various plants, totals 81,314. According to figures compiled from the Fourteenth Census of the United States this constitutes approximately 20 per cent of the number of wage earners in the various trade processes of the industry, or about 15 per cent of the total number of people engaged in the industry, the latter item including proprietors, superintendents, managers, and clerks. In small establishments the first three divisions were often actively engaged also in the trade processes of the plant. The size of the establishment regulated the proportionate number of proprietors, managers, superintendents, and

foremen to the total number of workers, which was naturally largest in the smallest establishments. In the plants inspected about 10 per cent of the total working force occupied supervisory or directive positions.

The summary of tabulation (p. 229) shows that 21.43 per cent of the workers were female. The majority of these were employed at skilled or semiskilled work in binding departments or establishments, though females were found in nearly all branches of the trade. In binding work they usually start on some of the simplest operations, such as folding or pasting, and gradually acquire practice, when opportunities arise, in the more skilled work. Some of the binding work is seasonal, with a heavy demand ordinarily from September to December, causing considerable irregularity in employment and variation in number of employees, though less than in other industries where a large number of females are employed. There is less irregularity of employment among the males. These follow, as a rule, the same vocations in which they started and seldom shift from one trade to another. The tendency of modern conditions is toward a sharper definition and limitation of work in each trade, and this has resulted in specialization of operations in the same trade. The largest group of workers in any occupation in the industry consisted of hand compositors, followed in rotation by pressmen, press feeders and assistants, machine compositors, bookbinders, electrotypers, photo-engravers, and stereotypers.

No accurate count was kept of minors employed in the industry, but the number of workers less than 16 years of age in the establishments surveyed was about 3 per cent of the total. Full information was sought about employees actively engaged in the trade that were 60 years old or over, and questionnaires were submitted to these for records of birthplace, age, number of years in the trade, occupation, present condition of health, past cases of sickness, condition of eyesight, and length of time glasses had been worn. Information from the offices in the establishments gave the number of trade workers over 60 years of age at 1,363, or 1.7 per cent of the total employees. Only 600 questionnaires were obtained, as the workers in a number of places refused to fill them out, fearing it might deprive them of work were it known they had passed that age. A foreman of a large composing room stated: "I am past 60, but I am not going to let them (the employers) know it." A different stand was taken in other places, where the men seemed proud of their ability to perform active work even though they were 60 years old or over. A tabulation of the questionnaires has not been attempted, as copies of these were furnished to Dr. Frederick L. Hoffman, of Wellesley Hills, Mass., who was cooperating, on behalf of the Joint Conference Council of the Printing Industry, with the Bureau of Labor Statistics in the survey, and had obtained additional data direct which might affect the general result of compilation.

A summary of the 600 questionnaires shows that 490 of the workers were native born and 110 were foreign born. Among these, 267 were between 60 and 65 years of age, 223 were between 65 and 70, 85 were between 70 and 75, and 19 between 75 and 80. Two of the rest were 80 years old, and one each, respectively, 81, 82, 85, and 91

years of age. Fifteen had been less than 30 years in the trade, 39 others less than 40 years, 340 others less than 50 years, and 186 others less than 60 years. Eleven had put in 60 years of trade life, three 62 years, two 63 years, two 65 years, one 68 years, and one 73 years. In the occupations the hand compositors dominated with 220. Proof readers came next with 115, all former hand compositors. Composing machine operators totaled 63, photo-engravers 35, stereotypers 18, electrotypers 12, pressmen 47, press feeders 3, bookbinders 52, bindery women 4, and workers in type foundries 31, of which 16 were casting machine operators, 2 type dressers and 1 a type rubber. Among the six oldest, all past 80, it was found that the worker who was 85 years of age was a composing machine operator, one of those who were 80 years of age was a former hand compositor engaged in proof reading, and the other four were hand compositors. The figures for trade life are probably not strictly accurate, because the numbers ending in fives and zeroes predominate so much that they indicate some workers gave these as approximate numbers.

The present condition of health was given as good by 497, fair by 95, and bad by 8. These statements are open to doubt, because in a number of places the questionnaires were received through the business offices and the workers would, in such case, want to appear in as favorable a light as possible. In several plants they were made out by one of the executives, such as in one from which 16 questionnaires were received. These all stated that the present condition of health was good, but the questionnaires were all filled out in the handwriting of one of the executives. While the statements may be accurate, there is too much chance in such a case to rely absolutely on them, especially where the firm is known to wish its workers to appear very healthy. The eight workers describing present health as bad consisted of 2 hand compositors, 4 linotype operators, 1 stereotyper, and 1 pressman. One of the hand compositors, 68 years old, was suffering from phlebitis and gave typhoid fever as the only former illness worth considering. His eyesight was good, though glasses had been used 33 years. This case was not considered due to any trade influence. The other hand compositor, aged 73, gave former sickness as bleeding of lungs, pneumonia, and bronchitis, which were also the cause of present ill health. These may have been contracted, or at least aggravated, through the trade work, though the composing room in which he was employed at the time was well ventilated and free from fumes or dust. The condition of eyesight was bad, with glasses used 39 years, and it was no doubt affected by the badly placed artificial lighting in the composing room. One of the linotype operators, 65 years old and employed in the same place, likewise complained of poor eyesight, probably also aggravated by the faulty arrangement. Glasses had been used for 22 years. In this case the bad health was not caused, so far as known, by trade work. The second linotype operator had been subjected to four severe attacks of neurasthenia, the first three one year apart and the fourth after an interval of six months. This might have been a result of trade work, which involves considerable nervous tension. His age was 63, glasses had been used for 31 years, and his eyesight was bad. The composing room in which he was employed was

crowded, badly lighted, and badly ventilated—contributory causes to bad health.

The third linotype operator, age 62, had also suffered from nervous breakdown, but was troubled especially with bronchitis, possibly produced by unhealthy working conditions and aggravated by fumes in the composing room where he was employed. Poor lighting facilities in the same were also claimed to affect the eyesight. Glasses had been used for 27 years. The fourth linotype operator was likewise afflicted with bronchitis, though complicated by liver and kidney troubles. The establishment in which he was employed was strictly modern and healthful, but up to a year previous had been housed in an old building, which was practically the reverse. The stereotyper, who was 73 years of age, gave heart trouble and rheumatism as causes of ill health, but stated that they were not due to trade work. The workroom was in a basement, where the artificial light was fair, but the ventilation was bad. Glasses were used for reading only. The pressman, 66 years old, also complained of heart trouble and rheumatism, but, in addition, was suffering from a rupture, said to have been caused by heavy lifting in connection with the work. Glasses had been used for 10 years and the eyesight was listed as bad. Records of past cases of sickness were either marked "none" or left blank in 358 of the questionnaires. Previous attacks of tuberculosis were reported by 3 hand compositors and 1 bookbinder. Cases, or alleged cases, of lead poisoning were cited by 9 compositors, 1 photo-engraver, 3 stereotypers, 2 pressmen, and 2 type foundry employees, one a type dresser and the other a type inspector. Paralysis was stated by 3 compositors, hardening of arteries by 1 compositor, stomach trouble by 15 compositors, 1 electrotyper, 1 pressman, and 2 bookbinders. Congested lungs were reported by 2 compositors, bleeding of lungs by 2 compositors and 1 stereotyper, nervous breakdowns by 7 compositors, and other nervous disorders by 2 additional compositors and 1 bookbinder. These illnesses may have been, at least partly, due to industrial causes. Five cases of blood poisoning were reported, two of which were due to occupational infections, one of a compositor and the other of a pressman. The only skin disease mentioned was erysipelas, which was given by 1 compositor and 1 pressman. Among other former illnesses reported, influenza was stated by 49, pneumonia by 44, typhoid fever by 39, rheumatism by 38, bronchitis by 15, and kidney trouble by 10.

The present condition of eyesight was reported as good by 418, fair by 152, and bad by 30. Glasses were worn by 579 of the 600 workers, but 95 of them had neglected to give the number of years they had been used. Among the rest, 73 had worn them less than 10 years, 209 less than 20 years, 114 less than 30 years, 64 less than 40 years, 20 less than 50 years, and only 4 had used glasses 50 years or more. The other 21 did not wear glasses, in spite of the age, which ranged from 61 to 67 years, with one each over 69, 73, 74, and 80 years old. The last four were all compositors and, in view of the exacting nature of this work on the eyes, these circumstances were noteworthy.

In three establishments, where no questionnaires could be obtained, the individual ages of the workers were secured from the records

in the offices. A summary of these show that among the 1,645 employees listed, 244 were 60 and less than 65 years of age, 125 were 65 and less than 70 years of age, while 9 were 70 years old or over.

HAZARDS

Trade work in the printing industry has in the past been considered extremely dangerous to the health and full of hazard, and a number of individuals engaged in the various vocations have at times suffered serious impairment of their health. This is altogether unnecessary. There is no reason why printing should not be one of the healthiest of indoor occupations, as all of the unhealthful conditions can be avoided or remedied. Ordinary work under normal conditions is not a menace to either health or life, but is in fact beneficial to the human system and has a tendency to preserve health and prolong life. The conditions under which the printing industry is usually conducted are naturally of vital importance to the health of the workers. When these conditions become abnormal in regard to the character of the working place, degree of light, purity of air, care of sanitary conditions, undue speed or duration, the work may be a source of real danger to good health and may shorten the lives of the workers.

In many of the establishments surveyed the conditions were found excellent, with full regard for the health and comfort of the workers. This has, incidentally, proved a benefit to the employers by a corresponding increase in efficiency and production. The strenuous competition in the industry is a great factor and necessitates practice of economy, but a tendency was observed at times to carry such economy too far and curtail space, light, or other requirements for the bodily welfare of the workers, a false economy for the employer as well as a peril to the well-being of the employee. A printing trade establishment is not a sanatorium, but there is no excuse for permitting absolutely detrimental conditions to prevail in the plant. Some establishments were found that were poorly lighted, badly ventilated, and with uncomfortable temperature, and were dirty or insanitary. Such neglect was at times due more to a lack of knowledge on the part of the employer about proper arrangement of the plant and possible menace of the industrial agents than to willful neglect of sanitary principles. The carelessness and ignorance which was often displayed by the workers constituted an additional, and very dangerous, factor. It was, however, also used for an excuse by some employers, who stated that when certain improvements were proposed by them, in reality to comply with the requirements of the State laws, the men had declared such installations were unnecessary and consequently they were not put in.

While the opinions of the workers may have some influence in a few plants, it was noticed that these had very little control over the conditions under which they worked, either individually or collectively, but that conditions were arranged and regulated by the employer as he saw fit. Some good work had been done by various labor and health departments of the different States in regulation of hazardous processes and insanitary conditions. Additional good work had been performed by the health campaigns of the different trade-unions and their attempted education of the members. A number

of the ailments from which the workers in the various trades suffer were directly due to their ignorance or disregard of ordinary precautions to guard against certain easily preventable dangers. A more intensive educational campaign is needed for the education of both employers and workers. The employers should be educated in their duties toward those who are actively engaged in the trade work and in the means or devices for the prevention of industrial illness, while the workers should be instructed in the common dangers of industrial life, of the special ones in their occupations, and in the conservation of health or life.

The chief occupational diseases in the printing industry are tuberculosis and lead poisoning. Other common ones are nontuberculous diseases of the respiratory system and diseases of the digestive organs. A number of the hazards of the industry are strong contributing factors to these, as well as to other diseases, just as faulty lighting, improper ventilation, extreme temperatures, vibration, and fatigue play an important part in the health of those subjected to them. It has not so far been proved to just what extent any of these latter is responsible for disturbances in the human system, and it can not justly be claimed that individual sickness is due to the work only, and not to some cause in the life outside the workroom, without complete data on this also.

Tuberculosis has been recognized for a number of years as one of the occupational diseases for the printing industry. The various trades in this industry have always ranked high among the special industries subject to that disease, resulting partly from dust created in the process, insufficient ventilation with stagnant air or abnormal temperature, and lack of personal cleanliness or regular habits of the workers. The constantly increasing reduction of these undesirable conditions has resulted in lowering the death rate from tuberculosis year by year. According to mortality statistics issued by the United States Bureau of the Census the death rate per 100,000 enumerated population had decreased from 154.6 in 1910 to 113.1 in 1920 for tuberculosis in all forms in the special area surveyed in both years and which contained more than one-half of the population of the country. The deaths from tuberculosis among the printing-trade employees in 1910 were approximately 30 per cent of deaths from all causes, but they have probably decreased in similar proportion as for the country at large. Information was requested from employers in the various establishments regarding cases appearing among their workers during the five years preceding the visits. The result was rather surprising, as seen in the summary of tabulation (p. 229) under heading "Tuberculosis." Only 29 cases were mentioned for the 536 establishments, employing 81,314 workers.

The only conclusion that can be drawn is that some of the instances were withheld, or not known to the employers, because these cases were simply attacks of the disease and not deaths, while according to statistics on the subject the deaths would ordinarily be nearly 100 annually for the 81,000 workers, or 500 for the total period of five years. The employees mentioned as afflicted consisted of 7 compositors, 3 photo-engravers, 1 electrotyper, 5 pressmen, 4 press feeders, 4 bindery girls, 1 ink grinder, and 4 other workers. One case was arrested, 2 had been cured, and 7 had died. In nearly

every instance the managers explained that the disease had been contracted in other plants or through outside influences, but in several of them the appearance of the establishments would indicate at least contributory causes. The possibility of trade origin was usually disparaged, such as in one electrotyping establishment where the proprietor claimed that in his 35 years of experience in that trade he had known of only 4 cases, and these were probably of outside origin. In one newspaper establishment, which employed about 425 trade workers and had reported 2 cases of tuberculosis within the past five years, it was claimed that only 10 cases had been found among the employees in the 48 years of its existence.

In the early part of the survey attention was attracted to the prevalence of the disease among cylinder feeders by the statement of a trade-union official, that out of 11 deaths among these during the two previous years 9 had been caused by tuberculosis. The pressrooms of that city did not seem to differ much from others seen up to that time or to show any condition at first glance which might account for such a high percentage.

Information was received from reliable authorities that this proportion was probably relatively high, but that the death rate from tuberculosis among cylinder-press feeders exceeded the rates for other trades in the industry. On further examination it was found that a number of pressrooms in that city contained several small hand-fed cylinder presses equipped with stationary gas burners, or neutralizers, located close to the cylinders on the delivery side. The majority of these were not provided with gas control, consequently were burning continuously, and on some the flames were unusually long. Considerable odor of gas was noticeable around the presses, and the feeders, who were stationed practically directly above the burners, were naturally subjected to even larger amounts of the fumes and gases liberated by these than would be present at a lower level. The contact with the gases, together with the elevation of position and the posture during the hours of labor, were the only differences observed from the hazards to which the pressmen were exposed in the same plants. The elevation might make some difference by subjecting the feeders to a higher temperature, and the posture might affect the system, but not sufficiently to cause a general increase in death rate. The only conclusion to be drawn was that the fumes and gases distributed by the burners were an important factor or at least a strong contributory cause. This would not necessarily mean that tuberculosis was contracted through inhalation of the gases, but that the respiratory organs and the system were weakened by exposure to these, so that the power of resistance was lowered against attacks of tuberculosis. The situation was closely watched in other cities subsequently and did not disclose any other differences between the hazards for the pressmen and the feeders. The correctness of this theory can, of course, be established only by tests of atmosphere and medical examination of the workers. It was the most logical reason from point of observation alone, and some cause certainly exists for the variation in death rate. Reference has previously been made to unhygienic habits of workers, which play a very important part in connection with tuberculosis, such as one incident of a foreman in a bindery expectorating in the waste paper on the floor. Such prac-

tices have been found difficult to regulate, although this seems strange when it is considered that the group of workers in the printing trades are presumed to be above the average workers in intelligence. Cities have tried to regulate expectoration in public places, but not always with success, especially one of the cities visited in which the people were expectorating all over the sidewalks, even around the city hall and on the steps of the same, in spite of the ordinance against it.

In one establishment some of the workers had formed a habit of expectorating in the corners of the hallways and staircase, where the bottom part of the walls had been painted black. A small space in each corner of the wall next to the floor was painted white, and this seemed to have helped to eliminate the practice. Signs were posted in most of the plants by the local labor or health departments prohibiting spitting on the floors. In one establishment an additional sign was found, placed by the workers, imposing a fine of 25 cents for each violation, which was claimed to have been an excellent remedy against forgetfulness. The various health committees of large establishments and of trade organizations have done some splendid work in eliminating indiscriminate expectoration, one method by which tuberculosis is frequently transmitted. The custom of having spittoons placed around the shops seemed to be gradually diminishing and in the majority of places where they were still used they were cleaned and disinfected daily. In several plants the floors were sprinkled with disinfectants, both against tuberculosis and other diseases. A superintendent of a large establishment stated that during the influenza epidemic he kept the disease down to a minimum among the workers in the plant by copious spraying with germicides. Tuberculosis may, of course, be contracted outside the workrooms, but conditions in some of the printing establishments surveyed were undoubtedly contributing factors and should be eliminated.

The other important, recognized occupational disease, lead poisoning, has been a subject of much controversy. Authorities disagree regarding the method by which it is acquired, by contact, by breathing of fumes, or by inhaling of dust. It may possibly be contracted by all three methods, but it has been proved conclusively that it can be acquired by contact. It is a disease particularly affecting compositors, stereotypers, electrotypers, pressmen, and type-foundry workers, as these are the trades in which lead is used or handled in the process. Type founders and compositors are working in old processes, though at the present time modified considerably from what they once were, eliminating a great deal of the handwork, but both have increased greatly in magnitude. As practiced at the present time, stereotyping is only about 75 years old and electrotyping about 50 years old. About 50 years ago there was considerable talk about lead poisoning among compositors and type founders, and no doubt a great deal of it existed then, as well as during a number of succeeding years. It has gradually been diminished among the compositors by the reduction in the handling of type and consequent absorption of dust from the type cases, coupled with the adoption of modern hygienic standards in the workrooms. Hygienic improvements have also eliminated many of the dangers for the type founders, stereotypers, and electrotypers, but the increase in the use

of stereotype and electrotype plates, following the constantly growing use of rotary presses, seems to have increased the hazard for pressmen in late years. Statistics are, unfortunately, not available for these different processes, but it is hoped that the report compiled by Dr. Frederick L. Hoffman for the Joint Conference Council of the Printing Industry, in cooperation with this survey, will throw some light on the subject. The statistics for the European countries, while valuable for comparison, are not applicable to conditions in the United States, as the methods of production, facilities, and hygienic standards are altogether different.

Acute and violent cases of lead poisoning were seldom found or heard of during the survey. The rarity of these cases is borne out by the mortality statistics issued by the United States Bureau of the Census, which gives the death rate for lead poisoning per 100,000 enumerated population, for the special districts surveyed in both 1910 and 1920 and which contained more than one-half of the population of the country, as 0.2 for both years. This is significant when one considers that over 100 different occupations are engaged in industrial use of lead, some of which are constantly exposed to lead in more dangerous forms, the various salts of lead, which are fairly soluble. The lead used in the printing processes is in metallic form, which is relatively insoluble, except when oxidized by exposure to the air. The danger from oxidization of type has been greatly reduced by the nondistribution system, which eliminates continued contact of the same pieces of material with the air and consequent formation of oxide, as well as by a higher standard of personal cleanliness among the workers. Only 12 cases of lead poisoning during the previous five years were reported by the employers in the establishments surveyed. Two other bona fide cases were found that had unquestionably originated in one of the newspaper establishments inspected, and these were consequently included in the summary of tabulation (p. 229), which gives a total of 14, consisting of 8 compositors, 5 stereotypers, and 1 lithograph artist. In one newspaper establishment two compositors were cited, but the manager claimed he was skeptical of the diagnosis because one of these had been an inmate of a tuberculosis sanatorium twice. A large composition establishment stated that one employee was advised by his physician to quit the trade, that no record was kept of the case, and the present whereabouts of the invalid was unknown. This was claimed to be the only case known in this plant, which had been in existence over 40 years. A compositor operating a monotype casting machine with electric metal pot, a Ludlow type caster and an Elrod slug caster, both with gas-heated pots, in a newspaper establishment, complained of stomach trouble, which had been diagnosed by some physicians as lead colic but was declared by one to be due to lack of exercise. It might have been lead poisoning, but the absence of any conclusive symptoms and the presence of strong gas odor around the machines would indicate that the fuel gas on these might be the real factor.

A linotype machinist on another newspaper was stated to have been affected by lead poisoning four or five years previous, but was apparently cured. When interviewed he claimed to still suffer

slight attacks from time to time. He was 45 years of age, 5 feet 8 inches in height, and weighed only 131 pounds. The duration of his trade life was 27 years. One workman contracted the disease, according to his own statement, when operating a small job printing establishment, through placing the type in his mouth while setting. In 1903 he was attacked by paralysis from the hips down and in the hands. After being five weeks in a hospital for observation, without result, he was moved to another hospital, where correct diagnosis was made and he was partly cured through galvanic treatments. His weight had been reduced from 145 to 87 pounds through the illness. At time of the interview he was 45 years of age, 5 feet 4 $\frac{3}{8}$ inches in height, and weighed 123 pounds. He was still suffering from partial paralysis in the lower limbs, though able to move around, and had a decided case of drop-wrist. In one large periodical printing and stereotyping establishment the manager stated that one compositor was then absent on half pay, that the claim of another had been rejected by the compensation board, and that one stereotyper had claimed stomach trouble as a result of lead poisoning. There was nothing noticeable in the plant to account for any unusual amount of this disease. The building was provided with good window ventilation, though most of the windows were closed at the time as the outside temperature was only 48° F. The top floor, on which the composing room was located, was provided with two large saw-tooth skylights, with three exhaust fans in the ends, and with natural draft ventilators. The line-casting machines were equipped with gas-heated metal pots and short pipes, extending up in large hoods that were piped to a main duct with an exhaust fan. The ingot metal caster was also piped to this duct. The type cases, which were cabinet style, showed the presence of some dust, though not an unusual quantity, and there was very little dust noticeable in the room, except some in corners and nooks. The plungers on the line-casting machines were cleaned by dipping in water, so there was no chance of lead oxide dust from that source. The only negligence noticed was that some of the workers were allowed to eat in the workroom, just as was found in a great many other establishments.

Eating in the workrooms often leads to carelessness in washing the hands and consequently conveying particles of lead into the mouth with the food. The stereotype foundry, which was located in the same room as the electrotype foundry, occupied part of the floor below. The kettles were heated with coal and provided with hoods on collapsible pipes, leading to a main duct with exhaust fan. The hoods were raised high, but the suction was good and absorbed all fumes well. The equipment in the adjoining electrotype foundry was also well provided with exhaust for fumes, but considerable carelessness was evident as far as dust was concerned, especially graphite dust, as the dry process of blackleading was used. A number of the trimming machines were provided with receptacles for the cuttings, and these were filled and running over. Eating was also indulged in here. No information was obtained in one newspaper establishment about lead poisoning among employees, but it was found that one stereotyper, who had been working there for about 20 years up to 1916, had been confined to his home since that time

and for the last two years was unable to leave his bed. The case had been diagnosed conclusively as lead poisoning, with paralysis of both legs and drop wrist. Another former employee was also said to be confined at his home with lead poisoning. One of the stereotypers working there, 66 years old and with a trade life of 45 years, claimed that his left leg was at times affected as a result of a previous stroke of paralysis from lead poisoning. Another stereotyper claimed he was affected by rheumatic pains, which some physicians had attributed to lead poisoning. He was 64 years of age and had been working at the trade for 40 years. The stereotype foundry in this establishment was located in the basement, and while the metal kettles were well provided with exhaust systems the conditions were far from desirable. One stereotyper in a different newspaper establishment stated that he had an attack of lead colic about 15 years previous, and another one about 9 or 10 years later, but effected a cure in both cases by means of castor oil. Another newspaper establishment stated that a claim had been received recently by a former employee, also a stereotyper, of lead poisoning. In one large lithographic printing establishment it was claimed that the only occupational disease originated in the plant was a case of lead poisoning contracted by a lithograph artist. He was continually placing the brush in his mouth, using the saliva for a medium, and was affected by the lead in the materials used.

In one of the two type foundries surveyed it was stated that only one case of lead poisoning had occurred, 15 years ago, and the other one stated that no case had been found during the past five years. Among the employees in one of these plants 14 trade workers were found past 60 years of age, and in the other plant, 16. All, except two, claimed they had never been afflicted with lead poisoning. One of the two, a 64-year-old type dresser, stated he had an attack of alleged lead poisoning for two weeks 44 years ago, and the only subsequent illness, two attacks of pneumonia. The other, a 62-year-old type inspector, mentioned an attack of lead colic over 40 years ago. Both of these establishments had the employees examined regularly for possible affliction. One of these establishments had conducted a private inquiry regarding the prevalence of lead poisoning among the printing trade establishments in the State where it was located, and claimed the result showed remarkably little knowledge of the disease. This corresponded with results of this survey and with a statement made by Dr. Leland E. Cofer, director division of industrial hygiene, department of labor of the State of New York. Letters had been sent to 10,200 physicians in the State, calling attention to the statutes making it compulsory to report all cases attended of poisoning by lead or various other substances as a result of employment. About two-thirds of these returned reports for the year 1923, mostly negative, showing the number of lead-poisoning cases attended by them to be only 65, an insignificant number, as it was not from the printing industry alone but from all occupations.

The existence of some cases do, however, show that the danger exists and should be safeguarded against. The various opinions by authorities regarding the source or method by which the disease is contracted complicates the manner of safeguarding the workers

against it. Some claim the fumes are the most dangerous agents, while others ignore these altogether. Some claim the dust liberated from scraps and contained in type cases is the real menace. All of them agree on one point, that it can be acquired through contact, by a deposit of oxide on the hands being conveyed into the mouth. Observation in the survey and deduction from the prevalence would indicate that the latter is the method by which the majority of cases are contracted. This can be proved conclusively only by tests, analysis, and examination, and as long as there is a possibility that other agents may be at least partly responsible, the other two factors should also be guarded against. The symptoms of the disease are sometimes obscure, or other complications may be present, such as in two cases, both compositors, where the diagnosis was at first given as lead poison but following the autopsy was changed to cancer. In another case the lead poisoning was found to be complicated by a social disease, which may have aggravated it.

The various alloys used for type casting, stereotyping, and electrotyping also contained antimony, likewise a poisonous material, and might also include some impurities of arsenic. According to information obtained, it would be exceedingly difficult to determine which of the three is the responsible factor in a case of poisoning when all three metals are found together, because the symptoms are similar in a number of respects. In searching for information on this subject it was learned that a partial examination had been made of dust accumulated in some monotype exhaust pipes in the Government Printing Office in Washington. The monotype casting machines in that place were equipped with pipes over the gas fuel exhaust on the metal kettles, supplied with an additional small pipe extending over the top of the kettle. The pipes extended vertically for 10 or 12 feet and, with a right-angle bend, horizontally to a main duct provided with an exhaust fan. In 1921 some of these had been taken down and cleaned. The accumulated dust in the horizontal part of the pipes had been analyzed for the medical director, but unfortunately for lead only. It was claimed that no trace of that metal was found in the dust. The fact that a considerable amount of antimony was collected from fumes exhausted from a metal mixing kettle in a type foundry, as previously mentioned, about one-half of 1 per cent, would indicate that some of this metal is a constituent of the fumes from the alloy, and that it might be the leading factor in so-called lead poisoning contracted from fumes, if these are detrimental. There is a very good argument against the agency of metal fumes in the disease. In establishments where metal pots on line-casting machines are heated by gas fuel, and sufficient ventilation was not provided to absorb the fumes direct from the machines, there was usually considerable complaint of ill health, dull heavy feeling, disorders of the digestive system, and other complications. When the metal pots were electrically heated no complaints of that character were heard, even though no exhaust was provided for the metal fumes, a condition found only in rare instances.

Accurate knowledge can, of course, be obtained only through analysis of the air and medical examinations, but on the face of it, the conclusion would be that the illness complained about was not

due to fumes from metal but to the fuel gas, and that the metal fumes from a line-casting machine were not dangerous. The subject has been referred to under the question of ventilation in preceding pages, where mention was made of one newspaper establishment in Charleston, S. C., which had exceedingly bad conditions in the composing room and adjoining stereotyping department. One compositor who had worked in that plant for about two years suffered from stomach trouble and loss of weight. He quit the trade for about six months, then went to work in a newspaper establishment in another city in which working conditions were all right. After being there one year he advised his friends in the former plant that he was feeling fine. A proof reader, 63 years of age, employed in the same establishment, complained especially of stomach trouble. The other compositors and the stereotyper specified also a dull, heavy feeling appearing soon after starting work, but which seemed to diminish somewhat after leaving the plant. The strong odor of gas seemed naturally to point to this as a cause of the trouble instead of the metal fumes. Similar conditions were encountered in a newspaper establishment in Atlanta, also previously described, where the fumes from several line-casting and monotype casting machines were being drawn through the room by an exhaust fan in one side. The compositors complained about stomach trouble, as did also the stereotypers, who were working in the partly separated but adjoining foundry. One stereotyper found it necessary to leave the trade after working in the shop for 12 years. In Nashville one of the photo-engravers in a newspaper establishment was similarly affected. The photo-engraving establishment was located on the floor above the composing room, with an intercommunicating open stairway, up which the fumes and gases were drifting, and the odor of gas was very noticeable in the photo-engraving department. The same complaints were encountered in practically all plants where similar conditions prevailed.

The dust feature did not seem very dangerous, as touched upon under ventilation and sanitation, where proper cleaning was effective. The metallic lead was ordinarily too coarse to be dangerous, unless left exposed to the air long enough to oxidize. The real danger from the lead seemed to lie in handling it and conveying the oxide particles into the mouth in eating. Promiscuous eating in workrooms should not be allowed. True enough, most States have laws that prohibit such practice, but they are often ignored. Hand washing is ordinarily left to the discretion of the individual workers, and in a number of establishments no attempt was made to wash clean, neither at lunch time nor at quitting time. In many cases no washing was done at all, the worker just grabbing his lunch regardless of poison or of any dust on the hands. To a certain extent the blame lies with the worker himself in such a case, but the industry should be safeguarded, and the only way to do so successfully is by compulsory washing under supervision. It may exist in some places but was not encountered, and the only place known where it was enforced is the Pullman-car shops at Pullman, Ill., which previously had a number of cases of lead poisoning among the painters employed there. Ten minutes before the noon hour a bell is rung, the workers go to central washrooms where they are pro-

vided with individual nailbrushes, soap, and towels and spend 5 to 10 minutes under supervision of the foremen. It is claimed that lead poisoning was reduced in this plant from 77 cases in 1911 to none in 1912. Just providing washbasins and hot water is not sufficient to insure a proper cleansing of the hands. In discussing the subject with Dr. C. T. Graham-Rogers, medical inspector, division of industrial hygiene, department of labor of the State of New York, it was learned that tests had been made by the division regarding removal of accumulations from contact with lead. Water used in successive washings, with the aid of various cleansing agencies, had been analyzed. The results showed that lead can not be removed by cold water and not thoroughly even with hot water, but requires a sulphate product for absolute elimination. Doctor Graham-Rogers seemed to regard both dust and fumes as very dangerous factors, but admitted that some of the principal symptoms in lead or antimony poisoning are very similar to those produced by constant exposure to carbon monoxide from illuminating or fuel gas.

Only slight attention had been paid to any cases of lead poisoning except those of the violent or extreme order, until near the end of the survey, when it was found that Dr. Louis J. Harris, director health department, city of New York, had examined approximately 10 per cent of the members of the New York Typographical Union No. 6, with a total membership of about 9,000. Doctor Harris claimed that about one-fifth of those examined had been found affected by lead poisoning in some degree, after all possible doubtful cases had been eliminated and only those in which a combination of symptoms assured the presence of lead had been accepted as positive cases. Until his report has been published it can not be determined on just what the contentions are based and whether the mere presence of a relatively small portion of lead, shown by analysis to exist, would be detrimental in any perceptible degree to the system. There is still a great deal to learn about lead poisoning in its relation to the printing industry, especially about the slow, insidious cases and the part these might take in developing other diseases. It is extremely difficult to get accurate information from either the employers or the workers. The former are apt to minimize the dangers and point to the old employees in their plants, who have worked at the trade for a long time and never suffered from lead poisoning. The latter are often unwilling to make any statements or undergo examinations, for fear that they might be afflicted and possibly lose their jobs from that cause. They do not like to appear neglectful of personal hygiene either, no matter how much they may actually evade it. Several cases were found where workers had insisted that they washed their hands thoroughly before eating; but later observations showed that they indulged only in hasty and insufficient rinsing.

In some of the large cities mention was made of an increase in recent years of paralysis among the rotary pressmen. Paralysis is one of the symptoms which is usually found in connection with lead poisoning, and the only reason seen for an increase is that more work is constantly being executed on rotary presses, instead of on flat-bed presses. This involves more handling of stereotype and electrotype plates, which often are partly oxidized, and the risk

would naturally be added to as the number of men are increased. With ordinary precautions it should not affect the situation, but when the human element is considered and the same conditions applied as mentioned previously about careless washing, it is not surprising.

Aside from tuberculosis, which is contracted through the agency of several sources, lead poisoning has long been thought the heaviest hazard in the printing trades establishments. From observations it is believed that there is another factor which is responsible for more of the illness in the industry. This is carbon monoxide gas, derived from the illuminating gas used for heating various equipment in all the departments of the industry and liberated when the combustion is not complete. Illuminating gas is so common, not alone in the printing industry but in many other industries and in domestic life, that the odor from it is considered a natural consequence by many and the potential dangers are completely ignored. Conditions seen and information received during the survey have established the conclusion that illuminating gas is the most dangerous factor in the health question of the printing trades at the present time. The odor of gas has been referred to several times in the preceding pages, though carbon monoxide has not been specifically mentioned, because this in itself can not be seen or smelled, as it is colorless, tasteless, and odorless. It is, however, safe to conclude that whenever there is any odor present in a room from illuminating gas used for heating the equipment, there is bound to be a certain amount of carbon monoxide also. The quantity contained in the illuminating gas itself varies, according to the relative mixture of coal gas and water gas, the former containing usually 4 to 10 per cent, while the latter contains 26 to 30 per cent. The extent and seriousness of carbon monoxide poisoning has not been fully determined and there has up to date been very little scientific study of it in connection with the printing industry. It has been established that carbon monoxide is very poisonous, that exposure to 4 parts in 1,000 parts of atmospheric air for one hour may kill a man, and that one-half part in 1,000 parts of air is often dangerous. No fatalities were reported and the subject of carbon monoxide poisoning was mentioned only four times by employers during inspections. These four cases are included in the summary (p. 229) under "Other occupational diseases," which shows a total of only 15, a very insignificant number. The balance consists of 9 cases of bichromate of potassium, or chromic acid, poisoning, and 2 cases of eczema. The total number of cases reported by the employers is so insignificant, when taken together with the number of workers employed in the establishments visited and the period of five years for which the information was requested, that the accuracy is extremely doubtful just as with the enumerated cases of tuberculosis and lead poisoning. Consequently the figures published for these three items can not be vouched for and should not be used to determine proportionate rates of hazards.

According to the manager of one newspaper, a compositor had an alleged case of carbon monoxide poisoning, but left without notifying the commission on compensation. It was rather strange that this one instance happened in a city where natural gas was used, which was claimed to contain only between 13 to 14 per cent of car-

bon monoxide. It did, however, seem very significant that complaints about ill health were so frequent in the establishments which had a pronounced odor of gas and that all of these were so similar. Headache, dizziness, loss of appetite, indigestion, chronic constipation, lassitude, mental dullness, insomnia, nervousness, palpitation of the heart, and occasionally nausea, were the symptoms usually described. Thorough medical examinations might reveal some other cause, but the relationship between these symptoms and the presence of gas odors seemed constant. Where proper combustion of the illuminating gas existed, or where there was sufficient exhaust to remove the fumes and gases entirely, there were no such symptoms among the workers. None were found in workrooms that used electrically heated devices instead of gas heated ones. The substitution of electrical heating equipment was seen to be getting more general, and will, of course, eliminate the danger from carbon monoxide proportionately. The use of illuminating gas is widespread, because it is the cheapest fuel, but unless proper precautions are taken it should not be countenanced. The danger can easily be overcome in the majority of cases by adequate exhaust, so that no fumes or gases are allowed to escape and pollute the atmosphere, and by provision for sufficient ventilation in the workrooms. One circumstance was encountered in one city, where natural gas was used, that was not found elsewhere, or perhaps was overlooked. In this place the workers complained that the gas sometimes hurt their eyes when not properly mixed. This was possibly due to some chemical composition of the gas, probably a local condition only.

Chromium poisoning was given most frequently by the employers among the other occupational diseases, though only nine cases were reported in all. Eight of these were bichromate of potassium poisoning among photographers in photo-engraving establishments, three of which were claimed to have contracted the disease before being employed in the respective establishments. One of the others was a part proprietor of an establishment, who stated that the ailment necessitated his quitting active work in the photographing department, as it returned whenever he came in contact with fumes from the material. Another, who was proprietor of a small establishment, stated that he was almost cured, but likewise found it necessary to remain away from the dark rooms. It manifests itself by pitlike, gangrenous ulcers, that are very painful and very difficult to heal. It is claimed that no permanent cure has been discovered for it, and while it may not show itself for a number of years it will often break out again, long after an apparent cure, with sores all over the body. It is stated that even children, which were born later on in the families, have been found afflicted by it. In some cities rubber gloves were provided for the workmen, but they seldom care to use them, assuming that previous immunity meant safety for the future also. The ninth case was chromic acid poisoning, occurring in a lithographic establishment where this material was used as an ingredient of an etch for the offset plates. In some establishments the workers refuse to use this etch for a while, but often, when the substitute material does not work just right, resort to the use of chromic acid again, regardless of the danger. The effect is similar to that caused by bichromate of potassium. The other two cases,

given as eczema, were copperplate printers, but details could not be obtained, as they had left the establishment.

The photo-engraving process involves handling of several chemicals of a dangerous nature, principally in the developing operations. The most poisonous of these is cyanide of potassium, used for fixing wet collodion on the negatives, for intensifiers, and for cutting solutions. The workers become so used to handling this that the hazard is sometimes ignored, although only three grains constitute a fatal dose when taken internally. One example was heard of where a photographer just wiped his hands casually after handling some of the crystals, took some fine-cut tobacco from a package, and placed it in his mouth. He dropped almost instantly to the floor, and it required nearly one-half day's strenuous work by physicians to bring him out of danger. Rubber gloves are furnished by many establishments and should always be worn when handling any material containing such an element of danger. Cyanide of potassium can also be absorbed through wounds or abrasions of the skin, and one skin affliction seen in a photo-engraving establishment in Chicago was claimed to have originated in that manner, but looked more like a case of bichromate poisoning instead. A large portion of the body was covered with rash, sores, and ulcers, mostly on that part covered by the clothing, but some sores were visible on the back of the neck in the hair. The affliction, which had appeared about 18 months previous, had first been diagnosed as parasitic bacteria, contracted from a dog or cat, but this did not seem reasonable as he had great aversion for these. Additional diagnosis established the cause as poisoning from chemicals and some relief was obtained from treatment, but this was hampered by continuing at work, necessary for financial reasons, and by scratching on account of the violent itching from the ulcers. He was wearing rubber gloves when seen, and would probably not have been suffering from the affection if he had done so previously.

Among other poisons commonly used are compounds of mercury, nitrate of silver, ether, used as a vehicle in collodion, ammonia, and the various acids, especially nitric acid. The latter, which throws off strong fumes that cause corrosion of the windpipe and violent inflammation, was discussed fully in connection with ventilation. Turpentine, used extensively in offset plate making, is also very volatile and unless the rooms are properly ventilated may cause headaches and irritation of the respiratory system. It may also act as a skin irritant and produce eczema. The danger from all fumes or vapors can easily be eliminated by adequate ventilation of rooms or equipment, while the hazards from contact can be prevented by using rubber gloves. The same thing holds good with other poisonous material used in printing trade plants, such as wood alcohol or denatured alcohol, ordinarily a solvent in varnishing machines. Considerable complaint was heard about the effect of this on the eyes of the workers where the ventilation was not sufficient. When the fumes were diluted with considerable fresh air the annoying effect ceased. The same condition existed in electrotpe foundries where alcohol was used for washing the shells. Kerosene, used also for the scrubbing of shells, is not so volatile but was claimed to cause dermatosis in the form of acne. In one estab-

ishment soap powder was used in place of either of these on account of those undesirable qualities. Kerosene was commonly used in newspaper pressrooms for washing composition rollers, and many of the pressmen were found affected in a minor degree with acne, claimed to be caused by the kerosene and ink penetrating the working clothes, especially when these were worn any length of time without washing. This was mostly a matter of personal hygiene, which was really up to the individual, though there is a wide difference in the susceptibilities of individuals to skin irritants. On account of the dirty nature of the work in some newspaper pressrooms there is a tendency to neglect the cleansing of working clothes, which naturally aggravates conditions, and thorough cleanliness should be observed to avoid contributory causes. No benzol was encountered, so far as known, though it might have been used in some places. A similar liquid hydrocarbon product, xylol, was used in a number of the rotogravure printing establishments as a vehicle for the ink: This liquid is extremely volatile and the pungent fumes, unless they were absorbed by a good exhaust, irritated the eyes, the membranes of noses and throats, as well as the bronchial tubes of the workers. In the absence of thorough individual medical examinations extending over a period of time, it is of course difficult to decide just what effect these various agencies may have on the systems of the workers, just how much danger there is from the constituents of the inks used, or from the materials used for type wash in composing rooms. Amyl acetate, used as a vehicle for ink sprayed on book covers, was also referred to under ventilation. The hazards for all of these poisonous substances can be avoided by sufficient ventilation whenever they exist, by thorough cleanliness on the part of the workers, both of the person and of the working clothes, and also by the use of gloves where contact is required.

Considerable trouble was found from acrolein fumes, which are very poisonous. These are developed in ingot metal furnaces or stereotype metal kettles when used type material is remelted—from the ink and oil on this material, which are decomposed by the heat and form dense clouds of smoke with a pungent, suffocating odor. They are easily confined and are exhausted from the kettles by mechanical systems but are a source of great annoyance, at least, if allowed to spread through the rooms. Some are generated at times by monotype casting machines when an excess of oil is used on them and some by the tensions on newspaper presses, both of which were mentioned under those subjects in ventilation. These are more difficult to control, but are also a question of adequate ventilation and supply of fresh air.

Another of the common hazards, which can also be taken care of by proper methods of ventilation, is the dust problem. Lead dust and other common metallic dusts have been fully dealt with. One of the worst of the rare metallic dusts is bronze dust, also described partly. There was considerable difference of opinion among the employers and the workers in regard to the detrimental effect of this dust, the employers stating that the men grow fat on it. This does not conform to the opinion of the authorities, who hold that the bronze dust irritates the respiratory system, that poisoning by inhalation causes headache and digestive disorders, such as vomiting

and diarrhea, and also anemia. That it penetrates the system was shown by the fact that the perspiration of the workers in the bronzing department turned their clothes green. Several plants were found that would not use bronze dust on account of the possible danger to the workers, and in some of the other plants the workers were furnished with milk, which is a recognized antidote. It was claimed that the result from exposure to bronze dust does not always manifest itself openly and that a number of years might elapse without any apparent results. One instance was in St. Louis where a pressman had died from heart disease shortly before this survey was made. He was 40 years of age and had worked in press-rooms since he was 15 years old, a considerable time around bronzing machines. The autopsy disclosed a very congested state of the lungs from bronze dust. Once in a while infection is derived from contact, such as one worker in Chicago who became infected with bronze through a cut on the hand when employed previously in another city. The poison caused water blisters all over the body, and the color of the skin was turned green. He claimed that a cure had been effected through the use of milk. The possibility of eliminating all bronze dust by ventilating devices does not seem feasible, as it sticks to the surface of the paper and is scattered from this all over the surroundings. A good deal of the dust can, however, be eliminated by adequate vacuum attachments on the machines, and every possible means should be employed to control the largest amount, so as to protect the workers as far as the operation will permit.

Other industrial dusts, such as dragon's blood and the so-called black lead, or graphite, seem dangerous mostly through possible congestion of the lungs. The expectorations of photo-engravers in etching rooms were continually found to contain dragon's blood, and fine particles of this material may be responsible for part of the high death rate among these trade workers from tuberculosis, especially when combined with the weakening effect of the fumes from the acids used. Electrotypers were similarly found expectorating graphite dust. One former electrotyper, encountered in New York, 82 years of age, stated that he at one time owned a good-sized electrotyping plant, but was compelled to get away from the business on account of the black lead settling in his throat and lungs, necessitating removal by a physician. A considerable quantity was taken away and he did not, apparently, show any detrimental effect but looked very healthy and robust.

The majority of trade workers seemed to be in good health and the records that were obtained in some instances were exceptionally good, considering the hazards to which they were exposed. In one city the stereotypers were found to have a local benefit association. The secretary of this association, who had occupied that position for 18 years, stated that during this period there had been no cases of tuberculosis, lead poisoning, nor other occupational diseases among the members. Illness among the members was confined solely to outside causes, such as colds, ordinary ailments, and outside accidents. No serious accidents had occurred in the same period due to the trade work, and the only things which could be charged against the industry or conditions were minor accidents, such as

burns or slight cuts on the hands, possibly resulting in short lay offs. The membership of the association was 170 and about 15 or 20 of these were 60 years of age or over and actively engaged in the trade work. All of those seen looked very healthy. Some claims were made in various localities of different ailments due to conditions in the work, but medical examinations and extended tests would be necessary to establish facts. As an example, it was stated that in one periodical printing establishment the press feeders were compelled to carry many and excessive loads of paper, causing profuse perspiration, resulting in several deaths from pneumonia. Mention was made in one city that attacks of cancer seemed to be on the increase for cylinder pressmen. But, according to information obtained, it also seemed to be on the increase for workers in general, eliminating the possible theory that some condition of the work might influence the disease.

During recent years it has been shown that there is a close relation between eyestrain and health. Most of the work in the printing industry is very exacting on the eyes, even with good lighting facilities. Attempt was made to note the approximate percentage of workers who wore glasses in the plants surveyed. While some exceptions existed, it was found that the general proportion of workers wearing glasses amounted to about 33 per cent in the composing rooms and 10 per cent in the other departments, making a total of about 15 per cent for the industry as a whole. These figures are only of slight significance regarding the influence of the trade on the vision, as the age of the worker is an important factor. The natural condition of eyesight varies for individuals, and the development of knowledge on the possible improvement of eyesight has caused a general use of glasses among the younger generation and even among children. This brings up the question of how long glasses have been worn and would require individual statistics to establish anything reliable in regard to occupational effect. There is no question but that some of the operations create considerable eyestrain, aside from any additional hazard caused by poor illumination, which subject was referred to under lighting. Many of them require continuous and close eye work, demanding the best of daylight or additional artificial illumination. When either of these are defective, eyestrain is developed, which will produce headache and contribute to neurasthenia. Neither by employers nor by employees is sufficient attention always paid to conditions which might prove of benefit. The former neglect to install artificial lighting of proper intensity and distribution, absent from glare. The latter fail at times to provide themselves with glasses which might relieve an undesirable condition, reduce eye fatigue, and regulate defective vision. In one large periodical printing establishment an inquiry was made of the physician in charge of the emergency hospital regarding the approximate number of employees wearing glasses. The answer was: "Those that do and those that should amount to about 50 per cent." This showed a lack on the part of the workers to provide adequate safeguards for themselves, a condition which affects not only the individual workers but also the employer through reduced output and a tendency to an increase in accidents.

Abnormal temperature, caused by excessive heat or humidity, was referred to at length under ventilation. It is a subject that has received a great deal of attention recently, together with other ventilation questions in the printing industry, and as a consequence is gradually being adjusted to obtain more comfortable and healthful conditions in the workrooms.

Another hazard of the printing trades is fatigue, which is far more important than is generally realized, especially for workers of a nervous and sensitive temperament. Many of the operations in the printing trades involve great nervous or mental strain, from maintained use of intelligence and observation, from constant attention upon one skilled task, or divided attention in operating several machines. Others include considerable muscular strain as well, at times combined with a demand for speed. Fatigue often results in failure of the power of concentration or in lack of coordination of the nerve centers. A slight case is easily overcome by proper rest, but accumulated results of excessive fatigue are damaging to the general health, reflected in sickness returns or lost time. The question of hours was not touched upon during the survey, as it involved a special labor question in the printing industry. Researches have been made from time to time in the correlation between hours of work and output, without any accurate results being obtained, but there is no question that long hours have a tendency to produce fatigue. In some cases complaints were received regarding the necessity for long hours, while in other cases the workers did not seem to object. In one newspaper printing establishment in Cleveland it was claimed that some of the men were compelled to work all Saturday night after working in daytime. Similar circumstances were reported for one newspaper establishment in Detroit. Such conditions are, of course, difficult to regulate when they occur spasmodically, but can easily be avoided where they can be figured to take place regularly by proper distribution of personnel during the week. They are more difficult to handle in book and job printing establishments, where a special rush may require extra work for a short period. In one plant, located in Milwaukee, the men were found to be working two hours overtime daily, starting one hour early, having a short lunch period, and working the rest at night. Some workers are somewhat anxious to obtain such extra work when possible, on account of the increased hour rate in pay and the addition to the usual salary. If it is only for a short period the results are not ordinarily sufficient to have any effect, but where long hours become a regular custom it will inevitably affect the vitality. A great deal of complaint was heard about a large periodical printing establishment in New York, in which some of the departments were operated on a 12-hour basis, producing considerable fatigue among the help.

Night work is also an active factor in fatigue, partly because night work in itself is unnatural. Deprivation of sunlight, daytime noises from the street, which disturb the sleep, and the interference with normal family or social life all have a decided tendency to produce fatigue. The additional effect of a very common occurrence, loss of sleep by the night worker, in order to be up as much as possible during the day, increases the chances through lowering the power of resistance. Night work is necessary in some of the printing trades, especially for morning newspapers. As nearly one-third of

the establishments surveyed were engaged in night work, and these were mostly large plants, a number of workers were subject to the detrimental influences from it.

Excessive noise affects the nervous system and increases fatigue. While it may be ignored by workers in perfect health, only a few are in a physical and mental condition to resist the irritation and weariness created through prolonged loud noises, such as produced by a number of the machines used in the various operations. In many establishments some of the noisiest operations were separated from the rest on that account. The clicking of line-casting machines is not loud but is very persistent and has a tendency to produce irritation and nervousness. It is claimed to be a heavy contributing factor in neurosis, a common illness among machine compositors. In one of the newspaper printing establishments in New York a sound-deadening ceiling had been placed in the composing room, which minimized the disturbing influence from the noise—the best arrangement seen for the purpose. One large printing establishment in Chicago had covered the floor of the composing room with battleship linoleum, which seemed to absorb considerable of the noise. From that point of view it is probably the most ideal floor covering, and is also waterproof, hygienic, and durable but not adaptable where considerable trucking is done or much oil is scattered around. The loud, deafening noise from large presses, especially in newspaper work, coupled with the nervous strain of incessant watching of the machines, also affects the workers considerably.

Vibration is another source of annoyance to the system and a consequent factor in fatigue. Buildings erected principally for printing are usually constructed so as to reduce vibration as much as possible, and in the modern printing buildings it has been entirely eliminated by insulation of the foundations upon which the machinery rests from the building structure. Such a method was found employed in a newspaper pressroom in New York, located on the third floor of a seven-story building, which contained four octuple presses, but did not produce any sign of vibration, even when all of these were operated at maximum speed. A coin could be stood on its edge on the press frame without disturbance. Another provision was noted in a lithographic printing establishment in Milwaukee, where a new two-story addition, about 66 by 104 feet, had just been completed. The offset presses installed in the top story had been placed in two rows, diagonally to the sides of the room, so the vibration was distributed from corner to corner of the building instead of straight across. In addition to the change in direction, the angular position of the presses also gave better distribution of the light from the windows to the different parts of the presses. This arrangement, which was the only one of the kind seen, seemed ideal. About 4 per cent of the buildings inspected were found to vibrate, at least partly from the operation of monotype casters, electrotyping machinery (especially roughers), cylinder presses or large platen presses, binding machinery (especially cutting machines and gathering machines), or ink mills. In one photo-engraving establishment in New York, located on the top floor of a 12-story garment-factory building, a very heavy swaying of the building was observed. Some of it may have been caused by the 12 platen presses used for proving

in the establishment, but it was probably accelerated by other machines in the garment factories on the floors below. The workers claimed they did not notice it much any more, but it was very annoying and disturbing for anyone not accustomed to it.

Another photo-engraving establishment, also located in New York, occupied the three top floors of an old five-story building. The second floor housed a label cutting and gluing plant, whose machinery created a distinct vibration of the entire structure. Most of the buildings where vibration existed were old, such as one in Indianapolis, consisting of five stories, occupied by a photo-engraving, stereotyping, and electrotyping plant. The building originally housed a printing plant, but this had moved because the weight of the machinery was too much for the floors. Heavy vibration was noticeable all over, partly from the machines and partly from the line shafts and belt drives used for some of these. At times vibration was also observed in newer buildings. A large establishment in New York occupied a nine-story modern building of reinforced concrete and steel construction, covering an entire block. The work consisted of relief and planographic printing, photo-engraving, electrotyping, and paper-box manufacturing. The building looked substantial, but considerable vibration was observed, probably partly due to the location of presses on some of the upper floors, especially cutting and creasing presses used in the paper-box departments. Proper construction of a building, with appropriate interior arrangement, will eliminate vibration easily and remove one possible source of fatigue.

Posture has been found through research to be a very important item in the hazard of fatigue. It is well known that maintaining a cramped, unnatural position will reduce the energies of the worker, but this fact has until recently been completely ignored by manufacturers of machinery, who had designed this exclusively for perfect mechanical operation without regard to the physical requirement of the workers who operate the machines. Continuous sitting is injurious, and continuous standing equally so, consequently work should be arranged so the position can be varied and so as to admit of good posture in either case.

Few of the machines used are provided with seats by the manufacturers, but special seats can be obtained and attached on some of them, for example, the seat for cylinder-press feeders, which rests on a bracket fastened to a pipe that is secured to the floor and to the footboard on the press. Every hand-fed cylinder press should be equipped with a seat for the press feeder, which many of the machines were unfortunately found to lack. Stools or chairs are necessary for seating of operators in a number of the occupations, such as on line-casting machines and in bindery work. As there is considerable variation in comfortable arrangements for the different individuals the best results can be procured by the use of adjustable posture chairs and these were found in actual use or on trial in several of the establishments visited. In one large bindery all the chairs used by hand folders and by work inspectors were provided with backs, and it was claimed that this simple addition to the equipment had materially reduced absence from work on account of illness among the female employees. In some establishments com-

plaints were heard of physical discomfort due to the hard surface of the floors, usually concrete, causing fatigue and, occasionally, even flat foot.

Fatigue through heavy muscular strain has been partly eliminated in many of the operations by special equipment such as form trucks, tiering machines for handling stock, paper lifts on trucks for loading feeders on cylinder or offset presses, electric motor trucks for transporting material, electric or hydraulic elevators, and conveyors or chutes. As the question of fatigue and its effect on the health is being realized, there is more effort developed to protect the workers against it, because of the increased production which follows hand in hand with better health.

ACCIDENTS

A special hazard, which exists in practically all departments in the printing industry, accidents, is closely interwoven with the previous subjects and the cause for an accident is often directly due to the condition of the building, especially insufficient lighting facilities or some insanitary conditions, while a great many can be traced to fatigue. Other important factors are the carelessness of the workers and the desire for speed. Several other occupations are more dangerous to follow than those in the printing industry, but a number of machines are used in connection with the work which endanger the safety of the workers unless carefulness is constantly exercised. The "safety first" doctrine has resulted in a constant reduction of major accidents causing death or amputation. Safety committees were found in the larger establishments, which performed good work in recommending improvements for the preservation of health of the employees and elimination of dangerous conditions, as well as in conducting educational campaigns among the workers on these subjects.

Information was requested from the employers in each of the 536 establishments, which were inspected in detail, regarding major accidents in the plants during the previous five years. A total of 139 cases were obtained, 6 of which had resulted in fatalities, but this total can not be entirely depended on, because several instances were discovered subsequently which had occurred in plants that had stated there were none. One newspaper establishment in Baltimore claimed there had been no accidents during the past five years, but it was later ascertained that one pressman had lost four fingers from one hand three years before and three from the other hand since then. In one newspaper establishment, located in Chicago, the same statement was made, but it was found that one pressman had lost a hand three years previous. The figures, as furnished by the employees, have been included in the summary of tabulation (p. 229), but should not be used for any proportionate comparison or statistical purpose. It was sometimes extremely difficult to obtain detailed information on the accidents and no attempt was made to verify the statements given. Consequently the cause for these was not ascertained, though it would have proved interesting to know whether these happened through the fault of the employer, of the workman, of both, or of fellow workmen, or through chance. The employers usually stated that the cause was carelessness of the worker and this was un-

doubtedly true in many cases, though sometimes the presumed carelessness was in reality taking a chance for the sake of speed, either required by the plant or through personal inclination. The accidents reported were roughly divided, according to their nature, as follows:

Loss of arm, 19 cases; of hand, 19 cases; of fingers, 33 cases; total, 71 cases.

Crushing of arm, 6 cases; of hand, 8 cases; of foot, 5 cases; total, 19 cases.

Fracture of leg, 5 cases; of arm, ankle, toe, and fingers, 1 case each; not specified, 5 cases; total, 14 cases.

Burns from fire, 5 cases; from metal, 2 cases; total, 7 cases.

Infection from cuts, 2 cases; injury to eyes, 2 cases; caught in belt drives, 2 cases; crushed by falling object, 1 case; elevator accidents, 19 cases; hernia, 2 cases; total, 28 cases.

Loss of the arm had occurred in 16 cases in pressrooms, particularly newspaper pressrooms, where the revolving cylinders on the large, high-speed presses, coupled with hurried pace of the work, constitute a danger. This is amplified where some of the cylinders turn together and others on the same press turn away from each other, which was the case in some of the plants visited, by creating confusion and consequent catching of the hand or arm between the cylinders. On some of the newer presses safety bars were found that prevented getting the hands caught. In one newspaper establishment, guards 6 inches wide had been placed over the opening between each pair of blanket cylinders, which turned together, because two men each lost a hand between these about 15 years previous. The various automatic devices on newspaper presses have assisted greatly in eliminating accidents. Some of the cases, especially in the book and periodical printing plants, occurred through ignorance or carelessness, such as in trying to wipe a plate or a roller when in motion, through reaching for a piece of paper, or through another workman starting the press while some one was working on it, all of which could and should have been prevented. In one case an arm was lost through neglecting to replace a guard around the driving gear on a cylinder press in a large establishment in Chicago. This could have been prevented, and may not occur again in that establishment because the presses have been equipped with an automatic device for shutting off the power in such case. That example could be adopted with advantage by other establishments and similar arrangements for prevention of mutilation of the workers could be applied to a number of different machines used in the industry. Most of the States require guards on machines where danger exists, but overlook the human element. The guards are sometimes removed and not replaced, making it even more dangerous because the workers are accustomed to the protection of the covering and may overlook its absence. A partial remedy was seen in one establishment in Milwaukee where wire guards on a number of small machines were hinged to the floor so they could not be entirely removed and placed to one side, where they would be overlooked. Starting the machines when someone is working on them has been eliminated to a great extent by installation of push button systems with safety stops.

In one newspaper establishment in Chicago and in other plants in different cities each individual machine was equipped with automatic starters and safety stops, making the control as near fool-proof as possible. Signs were found in several plants warning workers not to clean the machines while in motion, but to be sure to shut off the power first. One loss of an arm occurred in a paper elevator, where a boy tried to straighten a bundle placed on it after the conveyor had been started. The other two cases were stereotypers who had their arms cut off on saws. One of these had lifted the table on the saw trimmer, but neglected to put it down again before starting the power, and in leaning over the table to do so, he placed the arm directly on the saw.

Loss of the hand had taken place in the pressrooms, in similar manner as described for loss of arm, in seven cases, and in two other cases on die presses. Eight cases were on flat paper-cutting machines. This is a machine that can not be made absolutely fool-proof and when he is using it the operator must keep his presence of mind. The machines which are being manufactured at the present time are comparatively safe as long as handled properly, since they are constructed with safety devices. A number of old machines were, however, found in different localities which were absolutely dangerous on account of their tendency to slip and repeat. The majority of accidents on paper-cutting machines, both of loss of hands and loss of fingers, were laid to that source. In some places this had been eliminated by a cam safety device attached to the machine by the manufacturers or by an auxiliary automatic brake added by the establishment where it was in use. An extra source of danger was found in small shops through neglect to overhaul these machines sufficiently, allowing the clutch to become full of oil and cause slipping. Still worse was the practice, also found in some places, of using the machine again, when it had shown signs of repeating, instead of cleaning the clutch. Some of the large establishments had issued strict instructions to report immediately anything observed out of order and not to use the machine until thoroughly overhauled. In others the fuse plugs were removed from the power wires as soon as they were discovered out of order and were kept out until inspected and fixed. Several plants stated that their cutting machines were overhauled regularly once a month. Accidents due to the mechanism of the machine can ordinarily be averted by keeping it in proper working condition, and others which usually are caused from excess speed can easily be eliminated by the use of common sense. One instance was seen which showed absence of it, both on the part of the operator and on part of the employer. The trip on the machine was tied back, keeping the knife in continuous operation while the operator was pushing the stock under the knife and removing the trimmed parts. Such a practice is absolutely foolhardy, and no employer should permit a man to take such chances.

Another hazardous performance, though not so dangerous, was seen in a number of plants. Two men were working on the same cutting machine in trimming three piles of pamphlets or books at one time. As soon as the knife was raised, one pile was taken out, the other two shifted to successive gauges, and a new pile inserted. One of the workers tripped the knife and there was a possibility

of its coming down before the other could get his hands out. It is, of course, easy to say that the operator should watch his work, but any distraction at all might result in tripping the machine too soon, with a consequent loss of a hand or some fingers. Two of the cases were claimed to have resulted in that manner. In one of the cities visited this danger, as well as other undesirable features, had been eliminated through an agreement between the employers and the operators, that "under no circumstances shall two men be allowed to work on the same straight cutting machine," later amplified with prohibiting any man or boy, other than the operator, from handling or taking away books from cutting machines, unless they are on the far side of the table. The operators were instructed not to allow any one to work on the machines with them, not to permit any one to stand or walk inside the cutting table, nor to operate a machine which is out of order until it had been adjusted. It was also agreed that when a plant was operated 24 hours a day three shifts would be employed, to prevent fatigue and possible danger through this in operating the cutting machines. Fatigue was responsible for several of the accidents mentioned by the employers, through dulling the intellect and powers of concentration. Some of them were also due to contributory negligence on the part of the workers, perhaps coupled with fatigue, which prevented clear thinking. Such an instance was found, where the foreman of a bindery had tripped the knife in a machine he was operating, then tried to straighten the pile of paper, which had become disarranged. He saw the knife coming and knew that it would catch his hand, but he could not concentrate sufficiently to pull his hand out of danger.

The attempt to straighten paper in the cutting machine had been responsible for a number of accidents, and an operator has no business to attempt it after tripping the knife. Some plants had provided the operators with sticks to use in case such an operation was necessary, but they were seldom used. As the knife was ordinarily tripped with the right hand, the left one was usually employed for straightening and consequently was the one mutilated. One case was found where both hands had been cut off, but in this the accident was due to the shirt of the operator catching in the tripper and releasing the knife while both hands were used to push the material against the back guide. In one city attempt had been made to introduce a double tripping device which necessitated the use of both hands for the operation, thinking that it would eliminate the accidents. It had been recommended by insurance companies, and one of the establishments interviewed had equipped its cutting machine with it, thinking it a State regulation. The device unquestionably has its merits, but the real utility is doubtful. It must necessarily slow up the operations and, as it involves the use of both hands instead of one, it would have a tendency to confuse the operator to a certain extent. An accident can take place in spite of it, because in one case an operator who had tripped a machine with his right hand placed this same hand under the knife before it came down. While it was not under far enough to sever the hand, he lost two of the fingers and, as blood poisoning followed, it looked as if it might be necessary to amputate the hand at least. If there was time to get the hand under the knife after releasing it by a single

hand trip, this could also take place with a double-hand trip, so nothing would be gained in that respect. Another undesirable feature was the fact that by loosening a set screw the use of two hands was rendered unnecessary and the knife could be tripped in the usual way with one hand. Some of the cutting machines were equipped with a shield, which descended in front of the knife and ahead of it, intended to warn the operator that the knife was coming down. In the majority of cases this had been taken off or rendered nonoperative, because the operators claimed it prevented them from seeing the knife and that the jam from it was as bad as the cut from the knife, with the additional disadvantage of being located closer to the body. Removal of disturbing surrounding influences, lessening the chances of fatigue, and the proper care of the machines seemed to have helped more to minimize the accidents than any other factors. The main difficulty in eliminating them entirely lies in finding some method of stopping the knife, in case of necessity, after it has been tripped. It seems possible that a magnetic braking device could be applied for the purpose.

One of the remaining two cases was a bindery worker who caught his hand in a book-covering machine, necessitating amputation. The other was a photo-engraver who lost the hand through an explosion.

Loss of fingers were sustained in similar manner as the loss of hands, and really were just a minor degree of such mutilation. Among the 30 cases mentioned, 15 had occurred on presses. Several of these were on platen presses, one style of machine that was formerly responsible for a number of accidents. These have been largely eliminated by the use of mechanical feeders, but in many small plants the platen presses were still hand fed, usually by boys or girls, sometimes minors, which naturally increased the hazard, as these would be more or less reckless and lack concentration on the work. In some States regulations prescribing minimum age requirements for platen-press feeders were in effect, while in others it was compulsory to equip the presses with safety guards, which were claimed by several to increase the danger through necessitating raising the arm higher and preventing the feeder from watching the actual operation of printing. One accident had happened on a bronzing machine, two on embossing presses, and one on a punch press. Employers usually claimed that such accidents were mainly due to carelessness of the workers, who were looking around or talking at the time. The monotony of the occupation may, however, have been partly responsible through attendant fatigue. Seven of the accidents took place on cutting machines and one through a man slipping on the floor and catching his fingers in a stitcher head. In two cases part of the hand was cut off by stereotype saws. The saws used by stereotypers, electrotypers, and photo-engravers for rough work are seldom provided with guides, as it would take too long to adjust these. Only a few were found with guards provided over the saw, and there was always a danger present of getting fingers nipped. The main difficulty seemed to be the lack of a suitable guard, according to both employers and workers. Saws used in composing rooms subject the workers to similar dangers, but mostly on account of speed and carelessness, especially where several of the workers use the saws. This had been eliminated in larger establishments by

having one man attend to all the trimming for the department. In such case it was usually isolated from the rest of the work, minimizing the danger from jostling the operator and shoving his hand against the saw. A possibility of this was especially seen in one newspaper composing room, where three Miller saw trimmers had been placed tandem in the middle of the floor with narrow aisles at the sides, through which other workers were constantly passing, who avoided jostling of the operators on the saws only with difficulty. The remaining case was attributed to carelessness on the part of a stereotyper, who was leaning with his back against a flat power shaver, holding one hand on the bed. He happened to lean up against the shifter and started the machine, with a consequent loss of three fingers. It was, of course, a direct act of carelessness, but would have been avoided if the machine had been provided with a safety stop instead of an old-fashioned shifter. The reason for the finger amputations in three cases was not learned.

Crushing of arms or hands were attributed to practically the same causes as the preceding accidents. Four of the cases involving the arm, and all eight cases of the hand, were on presses. Two of these cases, which resulted in compound fractures of the arms, occurred in one establishment and, according to the employer, were directly due to fatigue of the workers from excessive continued work during the busy season. Two additional cases were in the bindery, where one arm was crushed in a folding machine and one in a book compressor. Four cases of crushing of the foot also took place in presses. In one of these the foot was caught in a flywheel, necessitating amputation. Another was caught through the removal of a footboard across the bed of a cylinder press. The feeder on this press had been accustomed to place one foot on the footboard while feeding and, in attempting to resume his usual position, was caught in the bed motion. A good arrangement for prevention of such accidents was seen in one establishment where the presses had been provided with high guards along the side frames, so the feeders could not get their feet inside of them. The fifth case was caused by a heavy lithographic stone dropping on the foot of the operator, crushing it badly. These stones were usually handled by tongs on overhead tracks, both around the planing machines and in the pressrooms.

Broken bones were due to various causes. One fracture of a leg and one fracture of an ankle were caused through slipping on the floor. It was really surprising that only two accidents were given from that source, as quite a number of the floors were found in a deplorable state. Some of the concrete floors were full of holes, caused by dropping objects on them. In some cases they were covered with loose iron or steel plates, which also constituted a danger as the edges were often curled up or the plates were pushed away from the original location. Some wooden floors were also observed that were badly broken, and others where they had been repaired by placing an additional layer of flooring on top over the badly broken parts, leaving projections against which the workers would be liable to stumble. Similar danger was noticed where an establishment was located in several connecting buildings with uneven heights of floors, where platforms had been placed around sinks or machines, or where pipes had been laid on the floor surface, either entirely exposed or covered with wood strips. Modern plants did not contain any such

undesirable features, but some of the old buildings had been fixed as cheaply as possible, without regard to the danger for the workers, a false economy, because it naturally slows down the movements of the workers or else invites the hazard of stumbling. Additional danger was found when the floors were slippery from oil or water or a combination of both, due to careless or insufficient janitor service.

Three fractures, one of the leg, one of the toes, and one of the fingers had been sustained through type forms falling on the respective portions of the anatomy. The accidents may have been due to carelessness in handling the forms or to lack of proper equipment.

One fracture of a leg and one of an arm were the results of falls from the presses. It was also claimed that shocks were received from improperly insulated electric neutralizers, containing sufficient force to knock the men off the presses and injure them severely through the falls. Two other cases were fractured legs, but causes of these and of the remaining five cases of fractures were not specified.

Some of the processes involve considerable fire risk, mostly through the carelessness of the workers. Five serious accidents were cited, all claimed to be from that cause, and three of them with fatal results. Printing trade plants are in a class by themselves as fire risks. They have all the hazards common to ordinary factories but also have certain elements peculiar to themselves. Gasoline or benzene is commonly used for various purposes, and when it is considered that a pint of gasoline is estimated to render 200 cubic feet of air inflammable when evaporated in a closed space, the danger from this can easily be seen. When a room is provided with sufficient ventilation the danger is greatly minimized and the safety cans found in most plants reduce it additionally. The large number of gas heating devices, with open flames, are particularly dangerous in connection with this. In one instance, where a disastrous fire was averted only by quick action, a small fire originated through the use of gasoline for cleaning a stereotype blanket. This had been placed in a small kettle, partly filled with water and gasoline, the latter floating on top. Live steam was used for heating the mixture, through a pipe inserted in it, and caused a strong vapor of steam and gasoline to drift to the gas fuel burners under the metal kettle, located close by. The vapor was ignited by the gas flames and the fire traveled back on it to the container, where it caused an explosion, scattering fire all over an oil soaked floor. The workers, who luckily were not within range of the explosion, acted promptly and extinguished the fire before any headway was gained.

The workers are not always lucky enough to be outside the danger zone. In one periodical printing establishment in New York a rotary pressman was engaged in washing a form and the benzene he was using was ignited from a gas burner on the press. He was burned to death and another worker received serious burns. A color proofer in a photo-engraving establishment in Chicago spilled some alcohol on his clothing and it was also ignited from gas flames in the room, burning him severely. Another fatality, which occurred in a large plate printing establishment, differed somewhat as the fire was originated by electricity. A workman was engaged in cleaning motors when his clothing, which was saturated with gasoline and

oil, was ignited by a spark from a motor, resulting in his death from burns. As a rule electricity is considered safe and several rotogravure printing establishments had installed electric heating equipment in preference to gas on just that account, as the naphtha and xylol used for that method are extremely volatile and inflammable. Electricity is comparatively safe but the innocent-looking motors or transmission wires may create sheets of flame instead of power unless properly inclosed. Several of the modern plants were found to have tanks for gasoline, benzene, turpentine, or naphtha placed underground, outside the building, in courtyards or under the basement floors, provided with pipes to pumps on the various floors. The third fatality from burns was that of a pressman, killed in a fire in a press pit of a large newspaper establishment in Chicago about four or five years previously, the details of which were not learned.

One source of danger from fire is oily waste or rags, sometimes permitted to lie around in corners, such as in one large book and job printing establishment in New York, where a large pile was observed under a stairway, together with a heap of empty ink cans. An apparently burned out match tossed in such a heap would find excellent fuel. Fireproof containers were found in many of the plants, but even with the use of these constant watching is required because a careless worker might leave some rags, soaked in oil or ink, lying around loose. In the large cities these things, as well as methods for disposal of the inflammable paper waste, are usually regulated and looked after by insurance inspectors and fire departments. Fire escapes and exits are likewise taken care of but some undesirable conditions were seen in spite of the regulations. In one establishment in Pittsburgh, located in a three-story building, the only entrance or exit to the third floor was by means of an interior open stairway, leading to a large trapdoor in the floor, which was kept closed in spite of workers located on that floor. Some of the basements where pressrooms and stereotype foundries were located were mainly accessible through narrow, deep stairways with obstructions of rolls of paper or other material, providing very unsatisfactory exits in case of fire. Several of the modern establishments have regular fire drills, with selected employees who know just what to do in case a fire happens to break out. Such a drill was witnessed in the largest printing establishment in Washington. As soon as the gong sounded each employee went quickly but orderly to the appointed station, ready to fight the fire. Several plants were also found provided with large chemical tanks on wheels. One newspaper establishment in Philadelphia, occupying an eight-story building, was equipped with one on each floor.

"No smoking" signs were found posted in practically all of the establishments visited, but in several of these the regulation was absolutely ignored by the workers, and in many places it was not unusual to see the employers or the managers walk through the workrooms puffing on cigars, although the workers were strictly prohibited from smoking. In three establishments in Denver, housed in the same building, signs were found on the walls, but a number of the employees were smoking. In a large lithographic printing establishment in Cleveland smoking was also found among the workers in the art and plate-making departments. In Philadelphia

smoking was found in one large newspaper establishment, principally in the composing room and stereotype room, as well as in the photo-engraving establishment connected with the same. The most general disregard of the law, as well as of the safety of both themselves and fellow employees, was found in New York. In four of the large newspaper establishments smoking was indulged in by the heads of the departments and by the workers, especially in the composing rooms, while at work. The same was the case in two of the large book and job printing establishments and in five of the photo-engraving plants visited. One instance of the danger incurred through this practice was shown by an incident that happened during the inspection in New York. A photographer in a photo-engraving establishment was smoking while working in the dark room, and a spark from his cigarette ignited the collodion on the negative in his hands. His clothing, which was saturated with the chemicals after a minor explosion, caught fire and he was badly burned before the flames were subdued. It was stated in New York that several arrests had been made in various factories for smoking shortly before, but it had evidently not affected the printing trade establishments.

Two cases of burns from molten metal were reported. One was a stereotyper, the other an electrotyper. The latter, it was stated, developed into a serious case, due to carelessness of the physician.

Two cases of blood poisoning from cuts on the hand were also cited. One of these was a stereotyper who had gouged his hand with a screw driver; the other was an operator of a ruling machine who had cut his finger. Both cases had necessitated amputation. A number of minor injuries occur right along in the printing trade plants, such as cuts and bruises, which are apt to be ignored by the workers and, while insignificant at the time, may develop into serious infections. Many of the large establishments were equipped with splendid first-aid service and expected the employees to have all injuries treated. It is not always done and it is, in fact, a difficult matter to convince many of the workers that such a course should be followed. An excellent method was seen in a large periodical printing establishment in New York, which maintained an emergency hospital with four beds, graduate nurse in attendance, and daily calls by a visiting physician. Employees were requested to report all accidents, no matter how trivial, and if this was neglected they were posted on bulletin boards on each floor of the building. The card, which was posted at the time of the visit, read:

Due to their own negligence in not reporting slight accidents to nurse, the following employees have not only suffered considerable pain but lost time, which could have been avoided had the accident been reported at the time it happened:

- (Name) Scratched hand; infection set in.
- (Name) Splinter of wood in hand; infection set in.
- (Name) Lacerated finger; infection set in.
- (Name) Scratched hand; infection set in.

Be sure to report the slightest injury as soon as it happens and have it treated, no matter how trivial it may appear to you, and trouble will be avoided.

(Name of Firm.)

In this establishment accidents were investigated by a safety committee to determine if the machines were responsible and to suggest

improvements or elimination of anything that might affect the workers.

Loss of an eye through an accident was reported in one instance and a serious injury to the eyes of another worker through the breaking of an electric-light bulb. Minor injuries to the eyes were frequent, especially to operators of routing machines. These, as a rule, were provided with goggles to keep the fine chips from flying into the eyes, but considerable complaint was heard about the appliances. Some of them were provided with cloth sides. These were declared to be extremely hot, causing excessive perspiration. Other styles were provided with perforated metal screens, fitting close against the face on the outsides of the eyes. These did not fit close against the face between the eyes and permitted cuttings from the drills to enter through the openings there and lodge in the eyes. In one establishment ordinary spectacle frames, with plain glass, were worn and declared just as good as any. In some plants goggles were not used but in place of these a patented frame, containing a glass shield, had been attached to the routing machine, which was claimed to effectually protect the eyes of the operators from the flying chips. Similar glass shields, held by an arm, were used over saws in photo-engraving, stereotyping, and electrotyping establishments or departments.

Two accidents were caused by clothing catching in overhead belt drives, one of which resulted in death. Collective belt drives are gradually being eliminated and the danger from these has been minimized greatly through requirement of proper guarding by the State departments. A few plants were found where the overhead drives seemed dangerous, notably a small periodical and job-printing plant in Richmond, where collective belt drive was used in the basement for an old cylinder press, three platen presses, and a folding machine. The motor was located in another room adjoining, the ceiling was low, and the belts were consequently so low that it was necessary to duck the head to avoid hitting them, especially the one in the doorway from the motor. The basement was naturally very dark and the artificial light was badly placed, increasing the hazard from the low-hung belts.

Another fatal accident occurred through the fall of a platform on a press, which caught a boy and pinned him against the stanchions.

Elevator accidents were responsible for the injuries of 18 workers and the death of 1 additional. The latter and 2 of the others were individual accidents, falls down the elevator shaft. The other 16 were injured through the dropping of an overloaded elevator.

Only two cases of hernia were reported. If this is anywhere near correct it shows remarkable reduction in a formerly very common result of heavy lifting, necessary at times in pressrooms where large rolls of paper are handled. Tying machines have, of course, eliminated a great deal of the strain. Electric hoists for presses of several decks, and the magazine reels used on modern single-deck presses, have also reduced the muscular efforts required at one time in connection with such work.

The accidents which happen through the faults of the employer, the operator, or fellow workmen can all be eliminated, or at least

reduced to an even smaller minimum than was shown by this survey. Accidents from chance will naturally always exist, but can not be blamed against the trade.

SUMMARY OF TABULATION

A summary has been prepared of the tabulation made from the detail reports of the 536 establishments inspected. These were originally divided into three groups, eastern (339 establishments), southern (147 establishments), and western (50 establishments), but as the groups can not fairly be compared with one another, on account of the varied nature of the plants, the figures have been combined.

Each item of the summary has been referred to in the text under the special subject and explanation was given of the terms used. The classifications made represent, of course, just the viewpoint of one individual and may be either too critical or too lax, but are uniform, from the standpoint adopted, for the entire territory surveyed.

Number of establishments of specified classification among the 536 inspected

Operations:		Condition of light—Continued.	
Hand composition.....	400	Artificial—Continued.	
Machine composition.....	273	Fair.....	287
Photo-engraving.....	142	Bad.....	99
Stereotyping.....	103	Ventilation of building:	
Electrotyping.....	62	Natural—	
Press work.....	425	Good.....	157
Binding—		Fair.....	142
Book.....	103	Bad.....	62
Miscellaneous.....	290	Artificial—	
Building:		All plenum—	
Built for plant.....	221	Good.....	24
Adapted.....	315	Fair.....	6
Appearance—		Bad.....	0
Good.....	129	All exhaust—	
Fair.....	253	Good.....	11
Bad.....	154	Fair.....	7
Working space:		Bad.....	2
Ample.....	377	Part plenum—	
Crowded.....	159	Good.....	14
Motive power:		Fair.....	15
Individual.....	411	Bad.....	1
Collective.....	19	Part exhaust—	
Mixed.....	106	Good.....	26
Safety guards:		Fair.....	57
Good.....	308	Bad.....	12
Fair.....	169	Fuel of type-setting machines:	
Bad.....	59	Gas.....	2, 314
Condition of light:		Electricity.....	1, 262
Natural ¹ —		Ventilation of equipment:	
Good.....	216	Composing—	
Fair.....	213	Good.....	113
Bad.....	99	Fair.....	77
Artificial—		Bad.....	83
Good.....	150		

¹ Not including 8 establishments which work at night only.

² Including 8 establishments with additional exhaust and 9 with additional part exhaust.

³ Including 3 establishments with additional part exhaust.

⁴ All except 1 establishment have part exhaust.

⁵ Including 1 establishment using gasoline only.

Number of establishments of specified classification among the 536 inspected—Continued

Ventilation of equipment—Continued.		State of cleanliness—Continued.	
Photo-engraving—		Equipment—	
Good	42	Good	353
Fair	68	Fair	120
Bad	32	Bad	63
Stereotyping—		Type cases—	
Good	41	Good	271
Fair	32	Bad	130
Bad	30	Toilets—	
Electrotyping—		Good	357
Good	10	Bad	176
Fair	33	Dressing rooms:	
Bad	19	For both sexes	220
Other equipment—		For females only	45
Good	22	Lockers:	
Fair	55	Individual	295
Bad	70	Collective	28
State of cleanliness:		Hot water	329
Floors—		Shower baths	115
Good	219	Lunch rooms:	
Fair	187	Separate room	26
Bad	130	Restaurant	95
Windows—		Medical attention:	
Good	328	Hospital room	58
Fair	80	Rest room for females	49
Bad	⁶ 128	First-aid kit	326

Personnel

Number of employees	81,314
Over 60 years of age	1,363
Percentage of females	21.43

Sickness and accidents reported by employers

Tuberculosis (cases)	⁸ 29
Lead poisoning (cases)	⁸ 14
Other occupational diseases (cases)	⁸ 15
Accidents (number)	⁸ 139

⁶ Including 3 establishments that have no windows.

⁷ Including 2 establishments that have restaurants for use of executives only.

⁸ Explanation in text.

SERIES OF BULLETINS PUBLISHED BY THE BUREAU OF LABOR STATISTICS

[The publication of the annual and special reports and of the bimonthly bulletin was discontinued in July, 1912, and since that time a bulletin has been published at irregular intervals. Each number contains matter devoted to one of a series of general subjects. These bulletins are numbered consecutively, beginning with No. 101, and up to No. 236 they also carry consecutive numbers under each series. Beginning with No. 237 the serial numbering has been discontinued. A list of the series is given below. Under each is grouped all the bulletins which contain material relating to the subject matter of that series. A list of the reports and bulletins of the Bureau issued prior to July 1, 1912, will be furnished on application. The bulletins marked thus * are out of print.]

Wholesale Prices.

- *Bul. 114. Wholesale prices, 1890 to 1912.
- Bul. 149. Wholesale prices, 1890 to 1913.
- *Bul. 173. Index numbers of wholesale prices in the United States and foreign countries.
- *Bul. 181. Wholesale prices, 1890 to 1914.
- *Bul. 200. Wholesale prices, 1890 to 1915.
- Bul. 226. Wholesale prices, 1890 to 1916.
- Bul. 269. Wholesale prices, 1890 to 1919.
- Bul. 284. Index numbers of wholesale prices in the United States and foreign countries. [Revision of Bulletin No. 173.]
- Bul. 296. Wholesale prices, 1890 to 1920.
- Bul. 320. Wholesale prices, 1890 to 1921.
- Bul. 335. Wholesale prices, 1890 to 1922.
- Bul. 367. Wholesale prices, 1890 to 1923.

Retail Prices and Cost of Living.

- *Bul. 105. Retail prices, 1890 to 1911: Part I.
Retail prices, 1890 to 1911: Part II—General tables.
- *Bul. 106. Retail prices, 1890 to June, 1912: Part I.
Retail prices, 1890 to June, 1912: Part II—General tables.
- *Bul. 108. Retail prices, 1890 to August, 1912.
- *Bul. 110. Retail prices, 1890 to October, 1912.
- *Bul. 113. Retail prices, 1890 to December, 1912.
- *Bul. 115. Retail prices, 1890 to February, 1913.
- *Bul. 121. Sugar prices, from refiner to consumer.
- Bul. 125. Retail prices, 1890 to April, 1913.
- *Bul. 130. Wheat and flour prices, from farmer to consumer.
- Bul. 132. Retail prices, 1890 to June, 1913.
- Bul. 136. Retail prices, 1890 to August, 1913.
- *Bul. 138. Retail prices, 1890 to October, 1913.
- *Bul. 140. Retail prices, 1890 to December, 1913.
- Bul. 156. Retail prices, 1907 to December, 1914.
- Bul. 164. Butter prices, from producer to consumer.
- Bul. 170. Foreign food prices as affected by the war.
- Bul. 184. Retail prices, 1907 to June, 1915.
- Bul. 197. Retail prices, 1907 to December, 1915.
- Bul. 228. Retail prices, 1907 to December, 1916.
- Bul. 270. Retail prices, 1913 to December, 1919.
- Bul. 300. Retail prices, 1913 to December, 1920.
- Bul. 315. Retail prices, 1913 to 1921.
- Bul. 334. Retail prices, 1913 to 1922.
- Bul. 357. Cost of living in the United States.
- Bul. 366. Retail prices, 1913 to December, 1923.
- Bul. 369. The use of cost-of-living figures in wage adjustments. [In press.]

Wages and Hours of Labor.

- Bul. 116. Hours, earnings, and duration of employment of wage-earning women in selected industries in the District of Columbia.

* Supply exhausted.

Wages and Hours of Labor—Continued.

- *Bul. 118. Ten-hour maximum working-day for women and young persons.
- Bul. 119. Working hours of women in the pea canneries of Wisconsin.
- *Bul. 128. Wages and hours of labor in the cotton, woolen, and silk industries, 1890 to 1912.
- *Bul. 129. Wages and hours of labor in the lumber, millwork, and furniture industries, 1890 to 1912.
- *Bul. 131. Union scale of wages and hours of labor, 1907 to 1912.
- *Bul. 134. Wages and hours of labor in the boot and shoe and hosiery and knit goods industries, 1890 to 1912.
- *Bul. 135. Wages and hours of labor in the cigar and clothing industries, 1911 and 1912.
- Bul. 137. Wages and hours of labor in the building and repairing of steam railroad cars, 1890 to 1912.
- Bul. 143. Union scale of wages and hours of labor, May 15, 1913.
- *Bul. 146. Wages and regularity of employment and standardization of piece rates in the dress and waist industry of New York City.
- *Bul. 147. Wages and regularity of employment in the cloak, suit, and skirt industry.
- *Bul. 150. Wages and hours of labor in the cotton, woolen, and silk industries, 1907 to 1913.
- *Bul. 151. Wages and hours of labor in the iron and steel industry in the United States, 1907 to 1912.
- Bul. 153. Wages and hours of labor in the lumber, millwork, and furniture industries, 1907 to 1913.
- *Bul. 154. Wages and hours of labor in the boot and shoe and hosiery and underwear industries, 1907 to 1913.
- Bul. 160. Hours, earnings, and conditions of labor of women in Indiana mercantile establishments and garment factories.
- Bul. 161. Wages and hours of labor in the clothing and cigar industries, 1911 to 1913.
- Bul. 163. Wages and hours of labor in the building and repairing of steam railroad cars, 1907 to 1913.
- Bul. 168. Wages and hours of labor in the iron and steel industry, 1907 to 1913.
- *Bul. 171. Union scale of wages and hours of labor, May 1, 1914.
- Bul. 177. Wages and hours of labor in the hosiery and underwear industry, 1907 to 1914.
- Bul. 178. Wages and hours of labor in the boot and shoe industry, 1907 to 1914.
- Bul. 187. Wages and hours of labor in the men's clothing industry, 1911 to 1914.
- *Bul. 190. Wages and hours of labor in the cotton, woolen, and silk industries, 1907 to 1914.
- *Bul. 194. Union scale of wages and hours of labor, May 1, 1915.
- Bul. 204. Street railway employment in the United States.
- Bul. 214. Union scale of wages and hours of labor, May 15, 1916.
- Bul. 218. Wages and hours of labor in the iron and steel industry, 1907 to 1915.
- Bul. 221. Hours, fatigue, and health in British munition factories.
- Bul. 225. Wages and hours of labor in the lumber, millwork, and furniture industries, 1915.
- Bul. 232. Wages and hours of labor in the boot and shoe industry, 1907 to 1916.
- Bul. 238. Wages and hours of labor in woolen and worsted goods manufacturing, 1916.
- Bul. 239. Wages and hours of labor in cotton-goods manufacturing and finishing, 1916.
- Bul. 245. Union scale of wages and hours of labor, May 15, 1917.
- Bul. 252. Wages and hours of labor in the slaughtering and meat-packing industry, 1917.
- Bul. 259. Union scale of wages and hours of labor, May 15, 1918.
- Bul. 260. Wages and hours of labor in the boot and shoe industry, 1907 to 1918.
- Bul. 261. Wages and hours of labor in woolen and worsted goods manufacturing, 1918.
- Bul. 262. Wages and hours of labor in cotton-goods manufacturing and finishing, 1918.
- Bul. 265. Industrial survey in selected industries in the United States, 1919.
- *Bul. 274. Union scale of wages and hours of labor, May 15, 1919.

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Wages and Hours of Labor—Continued.

- Bul. 278. Wages and hours of labor in the boot and shoe industry, 1907 to 1920.
- Bul. 279. Hours and earnings in anthracite and bituminous coal mining.
- Bul. 286. Union scale of wages and hours of labor, May 15, 1920.
- Bul. 288. Wages and hours of labor in cotton-goods manufacturing, 1920.
- Bul. 289. Wages and hours of labor in woolen and worsted goods manufacturing, 1920.
- Bul. 294. Wages and hours of labor in the slaughtering and meat-packing industry in 1921.
- Bul. 297. Wages and hours of labor in the petroleum industry.
- Bul. 302. Union scale of wages and hours of labor, May 15, 1921.
- Bul. 305. Wages and hours of labor in the iron and steel industry, 1907 to 1920.
- Bul. 316. Hours and earnings in anthracite and bituminous coal mining—anthracite, January, 1922; bituminous, winter of 1921–22.
- Bul. 317. Wages and hours of labor in lumber manufacturing, 1921.
- Bul. 324. Wages and hours of labor in the boot and shoe industry, 1907 to 1922.
- Bul. 325. Union scale of wages and hours of labor, May 15, 1922.
- Bul. 327. Wages and hours of labor in woolen and worsted goods manufacturing, 1922.
- Bul. 328. Wages and hours of labor in hosiery and underwear industry, 1922.
- Bul. 329. Wages and hours of labor in men's clothing industry, 1922.
- Bul. 345. Wages and hours in cotton-goods manufacturing, 1922.
- Bul. 348. Wages and hours of labor in the automobile industry, 1922.
- Bul. 353. Wages and hours of labor in the iron and steel industry, 1907 to 1922.
- Bul. 354. Union scale of wages and hours of labor, May 15, 1923.
- Bul. 356. Productivity costs in the common-brick industry, 1922–1923.
- Bul. 358. Wages and hours of labor in the automobile-tire industry, 1923.
- Bul. 360. Time and labor costs in manufacturing 100 pairs of shoes.
- Bul. 362. Wages and hours of labor in foundries and machine shops, 1923.
- Bul. 363. Wages and hours of labor in lumber manufacturing, 1923.
- Bul. 365. Wages and hours of labor in the paper and pulp industry.
- Bul. 371. Wages and hours of labor in cotton goods manufacturing, 1924.
- Bul. 373. Wages and hours of labor in slaughtering and meat packing, 1923.
- Bul. 374. Wages and hours of labor in the boot and shoe industry, 1907 to 1924.
- Bul. 376. Wages and hours of labor in hosiery and underwear industry, 1907 to 1924.
- Bul. 377. Wages and hours of labor in woolen and worsted goods manufacturing.
- Bul. 381. Wages and hours of labor in the iron and steel industry, 1907 to 1924.
- Bul. 387. Wages and hours of labor in the men's clothing industry, 1911 to 1924.
- Bul. 388. Union scale of wages and hours of labor, May 15, 1924.

Employment and Unemployment.

- *Bul. 109. Statistics of unemployment and the work of employment offices.
- Bul. 116. Hours, earnings, and duration of employment of wage-earning women in selected industries in the District of Columbia.
- Bul. 172. Unemployment in New York City, N. Y.
- *Bul. 182. Unemployment among women in department and other retail stores of Boston, Mass.
- *Bul. 183. Regularity of employment in the women's ready-to-wear garment industries.
- Bul. 192. Proceedings of the American Association of Public Employment Offices.
- *Bul. 195. Unemployment in the United States.
- Bul. 196. Proceedings of the Employment Managers' Conference held at Minneapolis, Minn., January, 1916.
- *Bul. 202. Proceedings of the conference of Employment Managers' Association of Boston, Mass., held May 10, 1916.
- Bul. 206. The British system of labor exchanges.
- Bul. 220. Proceedings of the Fourth Annual Meeting of the American Association of Public Employment Offices, Buffalo, N. Y., July 20 and 21, 1916.
- Bul. 223. Employment of women and juveniles in Great Britain during the war.
- *Bul. 227. Proceedings of the Employment Managers' Conference, Philadelphia, Pa., April 2 and 3, 1917.
- Bul. 235. Employment system of the Lake Carriers' Association.
- *Bul. 241. Public employment offices in the United States.

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Employment and Unemployment—Continued.

- Bul. 247. Proceedings of Employment Managers' Conference, Rochester, N. Y., May 9-11, 1918.
- Bul. 310. Industrial unemployment: A statistical study of its extent and causes.
- Bul. 311. Proceedings of the Ninth Annual Meeting of the International Association of Public Employment Services, September 7-9, 1921, Buffalo, N. Y.
- Bul. 337. Proceedings of the Tenth Annual Meeting of the International Association of Public Employment Services, Washington, D. C., September 11-13, 1922.
- Bul. 355. Proceedings of the Eleventh Annual Meeting of the International Association of Public Employment Services, Toronto, Canada, September 4-7, 1923.

Women in Industry.

- Bul. 116. Hours, earnings, and duration of employment of wage-earning women in selected industries in the District of Columbia.
- *Bul. 117. Prohibition of night work of young persons.
- *Bul. 118. Ten-hour maximum working-day for women and young persons.
- Bul. 119. Working hours of women in the pea canneries of Wisconsin.
- *Bul. 122. Employment of women in power laundries in Milwaukee, Wis.
- Bul. 160. Hours, earnings, and conditions of labor of women in Indiana mercantile establishments and garment factories.
- *Bul. 167. Minimum-wage legislation in the United States and foreign countries.
- *Bul. 175. Summary of the report on condition of woman and child wage earners in the United States.
- *Bul. 176. Effect of minimum-wage determinations in Oregon.
- *Bul. 180. The boot and shoe industry in Massachusetts as a vocation for women.
- *Bul. 182. Unemployment among women in department and other retail stores of Boston, Mass.
- Bul. 193. Dressmaking as a trade for women in Massachusetts.
- Bul. 215. Industrial experience of trade-school girls in Massachusetts.
- *Bul. 217. Effect of workmen's compensation laws in diminishing the necessity of industrial employment of women and children.
- Bul. 223. Employment of women and juveniles in Great Britain during the war.
- Bul. 253. Women in the lead industries.

Workmen's Insurance and Compensation (including laws relating thereto).

- *Bul. 101. Care of tuberculous wage earners in Germany.
- *Bul. 102. British National Insurance Act, 1911.
- Bul. 103. Sickness and accident insurance law of Switzerland.
- Bul. 107. Law relating to insurance of salaried employees in Germany.
- *Bul. 126. Workmen's compensation laws of the United States and foreign countries.
- *Bul. 155. Compensation for accidents to employees of the United States.
- *Bul. 185. Compensation legislation of 1914 and 1915.
- Bul. 203. Workmen's compensation laws of the United States and foreign countries.
- Bul. 210. Proceedings of the Third Annual Meeting of the International Association of Industrial Accident Boards and Commissions, held at Columbus, Ohio, April 25-28, 1916.
- Bul. 212. Proceedings of the conference on social insurance called by the International Association of Industrial Accident Boards and Commissions, Washington, D. C., December 5-9, 1916.
- *Bul. 217. Effect of workmen's compensation laws in diminishing the necessity of industrial employment of women and children.
- Bul. 240. Comparison of workmen's compensation laws of the United States.
- Bul. 243. Workmen's compensation legislation in the United States and foreign countries.
- Bul. 248. Proceedings of the Fourth Annual Meeting of the International Association of Industrial Accident Boards and Commissions, held at Boston, Mass., August 21-25, 1917.
- Bul. 264. Proceedings of the Fifth Annual Meeting of the International Association of Industrial Accident Boards and Commissions, held at Madison, Wis., September 24-27, 1918.
- Bul. 272. Workmen's compensation legislation of the United States and Canada, 1919.

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Workmen's Insurance and Compensation (including laws relating thereto)—Continued.

- Bul. 273. Proceedings of the Sixth Annual Meeting of the International Association of Industrial Accident Boards and Commissions, held at Toronto, Canada, September 23-26, 1919.
- Bul. 275. Comparison of workmen's compensation laws of the United States and Canada.
- Bul. 281. Proceedings of the Seventh Annual Meeting of the International Association of Industrial Accident Boards and Commissions, held at San Francisco, Calif., September 20-24, 1920.
- Bul. 301. Comparison of workmen's compensation insurance and administration.
- Bul. 304. Proceedings of the Eighth Annual Meeting of the International Association of Industrial Accident Boards and Commissions, held at Chicago, Ill., September 19-23, 1921.
- Bul. 312. National Health Insurance in Great Britain, 1911 to 1920.
- Bul. 332. Workmen's compensation legislation of the United States and Canada, 1920 to 1922.
- Bul. 333. Proceedings of the Ninth Annual Meeting of the International Association of Industrial Accident Boards and Commissions, held at Baltimore, Md., October 9-13, 1922.
- Bul. 359. Proceedings of the Tenth Annual Meeting of the International Association of Industrial Accident Boards and Commissions, held at St. Paul, Minn., September 24-26, 1923.
- Bul. 379. Comparison of workmen's compensation laws of the United States as of January 1, 1925.
- Bul. 385. Proceedings of the Eleventh Annual Meeting of the International Association of Industrial Accident Boards and Commissions, held at Halifax, Nova Scotia, August 26-28, 1924.

Industrial Accidents and Hygiene.

- *Bul. 104. Lead poisoning in potteries, tile works, and porcelain enameled sanitary ware factories.
- Bul. 120. Hygiene of the painters' trade.
- *Bul. 127. Dangers to workers from dust and fumes, and methods of protection.
- *Bul. 141. Lead poisoning in the smelting and refining of lead.
- *Bul. 157. Industrial accident statistics.
- *Bul. 165. Lead poisoning in the manufacture of storage batteries.
- *Bul. 179. Industrial poisons used in the rubber industry.
- Bul. 188. Report of British departmental committee on the danger in the use of lead in the painting of buildings.
- *Bul. 201. Report of committee on statistics and compensation insurance cost of the International Association of Industrial Accident Boards and Commissions. [Limited edition.]
- Bul. 205. Anthrax as an occupational disease.
- *Bul. 207. Causes of death by occupation.
- *Bul. 209. Hygiene of the printing trades.
- *Bul. 216. Accidents and accident prevention in machine building.
- Bul. 219. Industrial poisons used or produced in the manufacture of explosives.
- Bul. 221. Hours, fatigue, and health in British munition factories.
- Bul. 230. Industrial efficiency and fatigue in British munition factories.
- *Bul. 231. Mortality from respiratory diseases in dusty trades.
- *Bul. 234. Safety movement in the iron and steel industry, 1907 to 1917.
- Bul. 236. Effect of the air hammer on the hands of stonecutters.
- Bul. 251. Preventable death in the cotton manufacturing industry.
- Bul. 253. Women in the lead industries.
- Bul. 256. Accidents and accident prevention in machine building. Revision of Bul. 216.
- Bul. 267. Anthrax as an occupational disease. [Revised.]
- Bul. 276. Standardization of industrial accident statistics.
- Bul. 280. Industrial poisoning in making coal-tar dyes and dye intermediates.
- Bul. 291. Carbon monoxide poisoning.
- Bul. 293. The problem of dust phthisis in the granite-stone industry.
- Bul. 298. Causes and prevention of accidents in the iron and steel industry, 1910 to 1919.
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- Bul. 339. Statistics of industrial accidents in the United States.

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Conciliation and Arbitration (including strikes and lockouts).

- *Bul. 124. Conciliation and arbitration in the building trades of Greater New York.
- *Bul. 133. Report of the industrial council of the British Board of Trade on its inquiry into industrial agreements.
- *Bul. 139. Michigan copper district strike.
- Bul. 144. Industrial court of the cloak, suit, and skirt industry of New York City.
- Bul. 145. Conciliation, arbitration, and sanitation in the dress and waist industry of New York City.
- Bul. 191. Collective bargaining in the anthracite coal industry.
- *Bul. 198. Collective agreements in the men's clothing industry.
- Bul. 233. Operation of the Industrial Disputes Investigation Act of Canada.
- Bul. 303. Use of Federal power in settlement of railway labor disputes.
- Bul. 341. Trade agreement in the silk-ribbon industry of New York City.

Labor Laws of the United States (including decisions of courts relating to labor).

- *Bul. 111. Labor legislation of 1912.
- *Bul. 112. Decisions of courts and opinions affecting labor, 1912.
- *Bul. 148. Labor laws of the United States, with decisions of courts relating thereto.
- *Bul. 152. Decisions of courts and opinions affecting labor, 1913.
- *Bul. 166. Labor legislation of 1914.
- *Bul. 169. Decisions of courts affecting labor, 1914.
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- *Bul. 189. Decisions of courts affecting labor, 1915.
- Bul. 211. Labor laws and their administration in the Pacific States.
- *Bul. 213. Labor legislation of 1916.
- *Bul. 224. Decisions of courts affecting labor, 1916.
- Bul. 229. Wage-payment legislation in the United States.
- *Bul. 244. Labor legislation of 1917.
- *Bul. 246. Decisions of courts affecting labor, 1917.
- *Bul. 257. Labor legislation of 1918.
- Bul. 258. Decisions of courts and opinions affecting labor, 1918.
- *Bul. 277. Labor legislation of 1919.
- Bul. 285. Minimum-wage legislation in the United States.
- Bul. 290. Decisions of courts and opinions affecting labor, 1919-1920.
- Bul. 292. Labor legislation of 1920.
- Bul. 308. Labor legislation of 1921.
- Bul. 309. Decisions of courts and opinions affecting labor, 1921.
- Bul. 321. Labor laws that have been declared unconstitutional.
- Bul. 322. Kansas Court of Industrial Relations.
- Bul. 330. Labor legislation of 1922.
- Bul. 343. Laws providing for bureaus of labor statistics, etc.
- Bul. 344. Decisions of courts and opinions affecting labor, 1922.
- Bul. 370. Labor laws of the United States, with decisions of courts relating thereto.

Foreign Labor Laws.

- *Bul. 142. Administration of labor laws and factory inspection in certain European countries.

Vocational Education.

- Bul. 145. Conciliation, arbitration, and sanitation in the dress and waist industry of New York City.
- *Bul. 147. Wages and regularity of employment in the cloak, suit, and skirt industry.
- *Bul. 159. Short-unit courses for wage earners and a factory school experiment.
- *Bul. 162. Vocational education survey of Richmond, Va.
- Bul. 199. Vocational education survey of Minneapolis, Minn.
- Bul. 271. Adult working class education (Great Britain and the United States).

Labor as Affected by the War.

- Bul. 170. Foreign food prices as affected by the war.
- Bul. 219. Industrial poisons used or produced in the manufacture of explosives.
- Bul. 221. Hours, fatigue, and health in British munition factories.
- Bul. 222. Welfare work in British munition factories.
- Bul. 223. Employment of women and juveniles in Great Britain during the war.
- Bul. 230. Industrial efficiency and fatigue in British munition factories.
- Bul. 237. Industrial unrest in Great Britain.
- Bul. 249. Industrial health and efficiency. Final report of British Health of Munition Workers Committee.
- Bul. 255. Joint industrial councils in Great Britain.
- Bul. 283. History of the Shipbuilding Labor Adjustment Board, 1917 to 1919.
- Bul. 287. National War Labor Board.

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Safety Codes.

- Bul. 331. Code of lighting factories, mills, and other work places.
- Bul. 336. Safety code for the protection of industrial workers in foundries.
- Bul. 338. Safety code for the use, care, and protection of abrasive wheels,
- Bul. 350. Rules governing the approval of headlighting devices for motor vehicles.
- Bul. 351. Safety code for the construction, care, and use of ladders.
- Bul. 364. Safety code for mechanical power-transmission apparatus.
- Bul. 375. Safety code for laundry machinery and operations.
- Bul. 378. Safety code for woodworking machinery.
- *Bul. 382. Code of lighting school buildings.

Miscellaneous Series.

- *Bul. 117. Prohibition of night work of young persons.
- *Bul. 118. Ten-hour maximum working-day for women and young persons.
- *Bul. 123. Employers' welfare work.
- *Bul. 158. Government aid to home owning and housing of working people in foreign countries.
- *Bul. 159. Short-unit courses for wage earners and a factory school experiment.
- *Bul. 167. Minimum-wage legislation in the United States and foreign countries.
- Bul. 170. Foreign food prices as affected by the war.
- *Bul. 174. Subject index of the publications of the United States Bureau of Labor Statistics up to May 1, 1915.
- Bul. 208. Profit sharing in the United States.
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- Bul. 299. Personnel research agencies: A guide to organized research in employment management, industrial relations, training, and working conditions.
- Bul. 307. Proceedings of the Eighth Annual Convention of the Association of Governmental Labor Officials of the United States and Canada, held at New Orleans, La., May 2-6, 1921.
- Bul. 313. Consumers' cooperative societies in the United States in 1920.
- Bul. 314. Cooperative credit societies in America and foreign countries.
- Bul. 318. Building permits in the principal cities of the United States.
- Bul. 320. The Bureau of Labor Statistics: Its history, activities, and organization.
- Bul. 323. Proceedings of the Ninth Annual Convention of the Association of Governmental Labor Officials of the United States and Canada, held at Harrisburg, Pa., May 22-26, 1922.
- Bul. 326. Methods of procuring and computing statistical information of the Bureau of Labor Statistics.
- Bul. 340. Chinese migrations, with special reference to labor conditions.
- Bul. 342. International Seamen's Union of America: A study of its history and problems.
- Bul. 346. Humanity in government.
- Bul. 347. Building permits in the principal cities of the United States in 1922.
- Bul. 349. Industrial relations in the West Coast lumber industry.
- Bul. 352. Proceedings of the Tenth Annual Convention of the Association of Governmental Labor Officials of the United States and Canada, held at Richmond, Va., May 1-4, 1923.
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- Bul. 383. Works council movement in Germany.
- Bul. 384. Conditions in the shoe industry in 1924.
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- Bul. 389. Proceedings of the Eleventh Annual Convention of the Association of Governmental Labor Officials of the United States and Canada, held at Chicago, Ill., May 19-23, 1924.

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Description of occupations, prepared for the United States Employment Service, 1918-19.

Boots and shoes, harness and saddlery, and tanning.

Cane-sugar refining and flour milling.

Coal and water gas, paint and varnish, paper, printing trades, and rubber goods.

Electrical manufacturing, distribution, and maintenance.

Glass.

Hotels and restaurants.

Logging camps and sawmills.

Medicinal manufacturing.

Metal working, building and general construction, railroad transportation, and shipbuilding.

Mines and mining.

Office employees.

Slaughtering and meat packing.

Street railways.

*Textiles and clothing.

*Water transportation.

*Supply exhausted.

(VIII)

