MOBILITY OF MOLDERS AND COREMAKERS

1940-1952

A Study of the Work Experience, Training, and Personal Characteristics of Workers in a Skilled Occupation

UNITED STATES DEPARTMENT OF LABOR
James P. Mitchell, Secretary

BUREAU OF LABOR STATISTICS
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Letter of Transmittal

UNITED STATES DEPARTMENT OF LABOR,
Bureau of Labor Statistics,
Washington, D. C., June 4, 1954.

The Secretary of Labor:

I have the honor to transmit herewith a report on the mobility of molders and coremakers. This report is the third of a series of pilot studies covering the work experience, mobility, training, and personal characteristics of workers in occupations vital in defense mobilization. It evaluates the findings of the study in terms of their significance for manpower planning in a mobilization period.

The Department of the Air Force financed this study as part of a general program of developing systematic methods of determining the manpower feasibility of military programs. The research findings of this report however, are the exclusive responsibility of the Bureau of Labor Statistics.

The study was conducted in the Bureau's Division of Manpower and Employment Statistics under the supervision of Richard H. Lewis. The report was prepared by Abraham Bluestone and Sol Swerdloff.

The Bureau wishes to acknowledge the generous assistance and cooperation received in connection with this study from officials of other government agencies, trade associations, labor unions, and the 200 industrial firms from whose payrolls the workers interviewed were selected. The Bureau wishes to express its deep appreciation to the 1,800 molders and coremakers who gave their time and cooperation in furnishing the essential data from which this report was prepared.

Ewan Clague, Commissioner

Hon. James P. Mitchell,
Secretary of Labor.

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The Mobility of Molders and Coremakers

Introduction

Mobilization planning for the effective utilization of manpower requires extensive information on the Nation's resources in critical key occupations. Manpower policies in a mobilization period should be designed to provide for a flow of workers whose skills are in short supply into essential activities as well as to supplement the number of workers possessing these skills. Such policies should be based on knowledge of the pattern of movement of workers from job to job and of worker motivation in changing jobs. Plans for setting up training programs can be guided by data on how the workers in the occupation qualified for their jobs and on the lower skilled occupations from which these trainees may be drawn. When related to estimates of manpower requirements in particular occupations under mobilization conditions such information can aid in determining how many workers must be trained. A thorough understanding of the nature of our resources in key skilled occupations is also essential in balancing the requirements of the Armed Forces against the requirements for defense production and essential civilian activities and in formulating policies governing Selective Service deferments or reserve callups of workers in these occupations.

To provide information on these and other factors related to the measurement and utilization of the Nation's occupational resources, the Bureau of Labor Statistics has undertaken a series of pilot studies covering the work experience, training, personal characteristics, and mobility of workers in occupations particularly vital in a defense mobilization period. Funds for these studies have been provided by the Department of the Air Force. This report presents the results of the third of these studies, on the occupation of hand molder and coremaker. The first and second studies covered tool and die makers and electronic technicians respectively.[1]

The occupation of handmolding and coremaking was selected for study because of its importance during a mobilization period. Hand molders and coremakers are among the highest skilled workers in the

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1/ The Mobility of Tool and Die Makers, 1940-1951, Bulletin No. 1120, U. S. Department of Labor, Bureau of Labor Statistics, November 1952; The Mobility of Electronic Technicians, 1940-1952, Bulletin No. 1150, U. S. Department of Labor, Bureau of Labor Statistics, 1953.

foundry process. Foundries are particularly essential to an industrial economy under mobilization conditions. They produce metal forms, or "castings," by pouring molten metal into specially designed forms made by molders and coremakers. The process of casting is one of the oldest of the basic metalworking techniques. Castings are basic components of metalworking machinery, including such important types as machine tools and forging presses; they are used extensively in tanks and other ordnance items.

Hand molders and coremakers make various kinds and sizes of sand forms. Molders prepare the hollow forms (molds) into which metal is poured and allowed to solidify, forming a casting. Coremakers make the bodies of sand, called cores, used to form hollows or holes in castings. Earnings of qualified workers are on a par with those of other skilled workers in the metalworking trades.

In early 1952 it was estimated that about 40,500 hand molders and 22,000 hand coremakers were employed in some 5,500 foundries. About 1,500 of these establishments were "captive" foundries; that is, they were departments of, or wholly owned subsidiaries of, other establishments and directed more than half their output to the parent company rather than to outside customers. The remaining 4,000 establishments were independent foundries; they produce castings on order from outside customers. Foundries may also be classified with respect to the primary metal cast. The major metals are gray iron, steel, and malleable iron, comprising the ferrous group; and copper, aluminum, and magnesium, comprising the nonferrous group. In addition there are a number of minor metals, particularly in the nonferrous group.

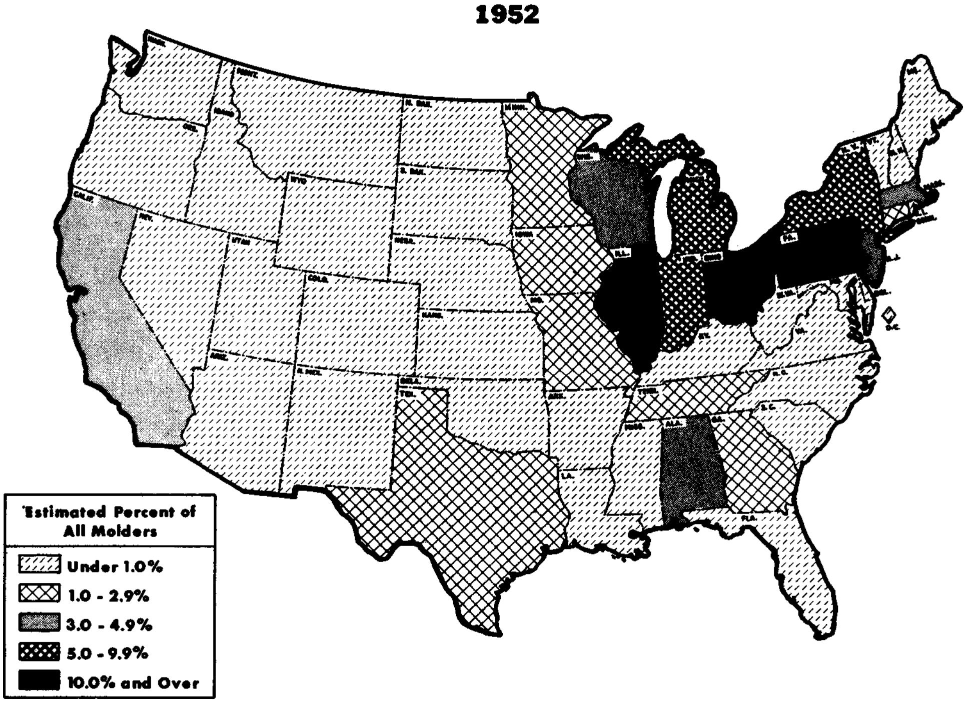
Gray iron foundries are the most important class; they employ almost half of the Nation's hand molders and coremakers. Almost one-fifth of them work in steel foundries, and less than 5 percent are in malleable iron shops. About three-tenths of the workers are employed in nonferrous foundries. Every State has some foundries, but most molders[2] work in the important industrial areas of the Midwestern and Northeastern States. Ohio, Pennsylvania, and Illinois together account for 35 percent of molder employment. Large concentrations of these workers are also found in such metalworking areas as Michigan, New York, Indiana, and California.

2/ The term "molder" used in this report denotes both molders and coremakers. These workers are occasionally referred to as "men," although 19 women coremakers were included. See p. 60.

The present study is based on an analysis of the work histories of 1,800 molders and coremakers who were interviewed in early 1952. Each worker furnished a complete work history for the period January 1940 to February 1952 as well as pertinent parts of his prior work history and training. Additional specific aspects of his personal history were also obtained from each worker.

The workers to be interviewed were selected from the payroll records of 195 foundries located in 8 cities which are important metal-working centers. These plants were so chosen that the selected workers would reflect the national distribution of molders among various types of foundries. These men were then interviewed by field representatives of the Bureau of Labor Statistics using a questionnaire form especially designed for the survey. In addition to data obtained from the individual workers, another questionnaire was filled out for each plant, providing information on hiring and training practices of the firm and the details of the work performed by its staff of molders.

Chart 1. Distribution of Molder Employment 1952



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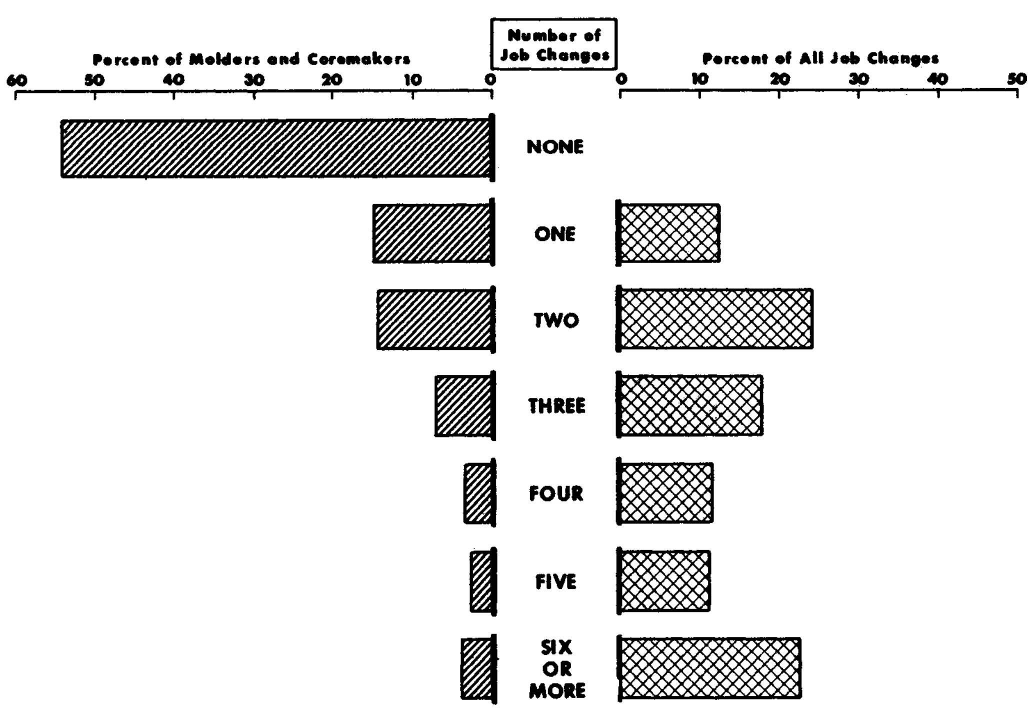
Summary

From the viewpoint of mobility, the two outstanding features of the work histories of molders and coremakers interviewed were their strong attachment to their employers, to the occupation, and to the areas in which they worked, and on the other hand, the fact that the molders who did change jobs were able to shift freely among the various types of foundries. Less than half of the 1,800 molders and coremakers interviewed had changed jobs between 1940 and 1952. Moreover, those workers who had changed jobs averaged only two such changes each. Even this limited number of job changes somewhat over states the mobility of these workers, since a small number of workers had accounted for a large proportion of the job changes; 34 percent of all the job changes was made by only 6 percent of the workers, who changed jobs five or more times.

The extent or rate of job changing, or any other aspect of the labor market behavior of a group of workers during a particular

Chart 2. More Than Half the Workers Did Not Change Jobs

Percent of Workers Making Specified Number of Employer Changes
1940-1952



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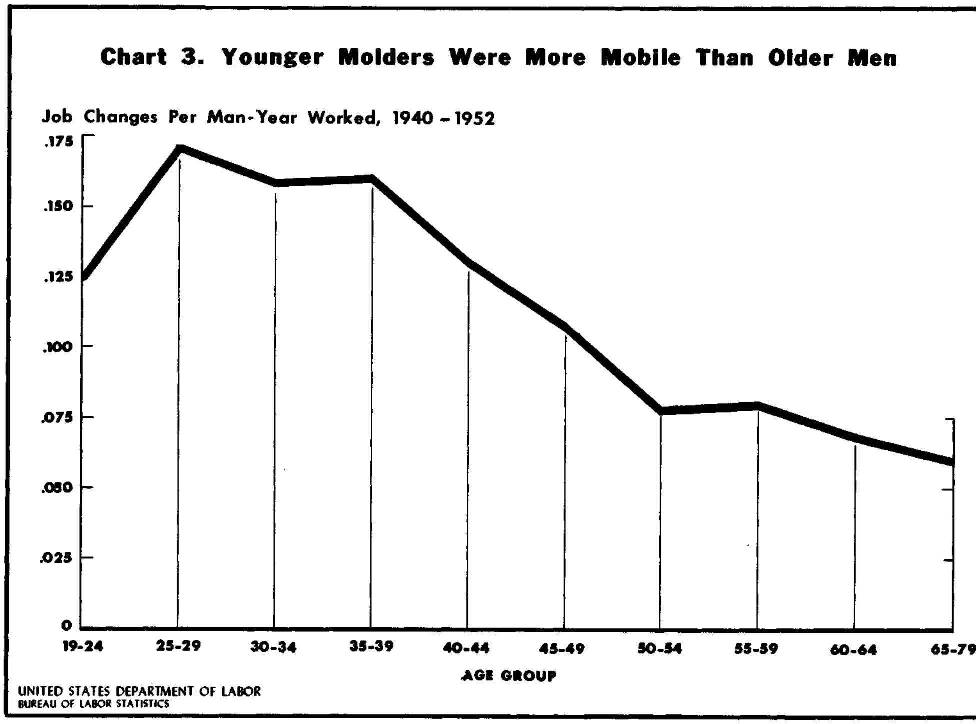


period is meaningful only when coupled with knowledge of the workers' personal characteristics, how they learned the trade, and their institutional and economic environment. The mere measurement of mobility rates was, therefore, only one objective of this study. The work histories and personal backgrounds of the men interviewed were analyzed in order to develop a broader understanding of the patterns of mobility which the survey revealed.

This investigation showed that the relative immobility of molders could be explained in large part in terms of their personal and status characteristics. Age and mobility were found to be closely related; older workers were relatively less mobile than younger men. When the workers were grouped by the ages at which they changed jobs, it was found that more than twice as many job changes per man-year were made when molders were under 35 years as when they were 50 years or older. A low mobility rate could thus be expected among hand molders and coremakers since they were comparatively an older group than most skilled workers. Their average age was 48 and there were as many men 60 years and over as there were under 35 years.

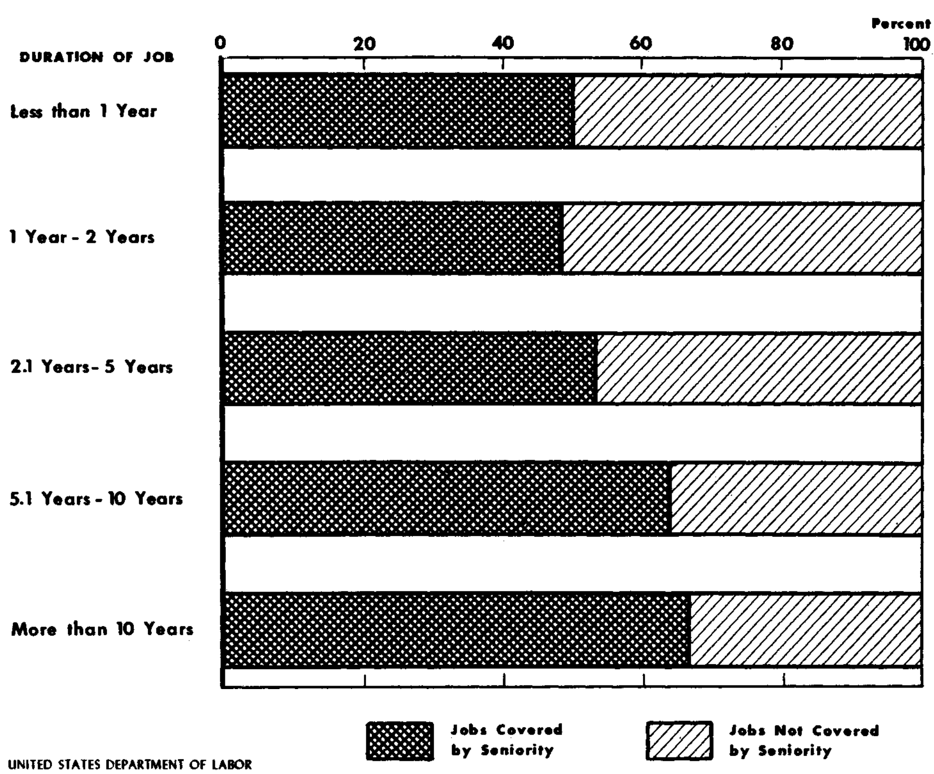
Home ownership was another strong factor affecting movement between employers. Homeowners were found to be less mobile, even after discounting the age factor. Men who did not own their homes had changed jobs about 50 percent more often than did homeowners.

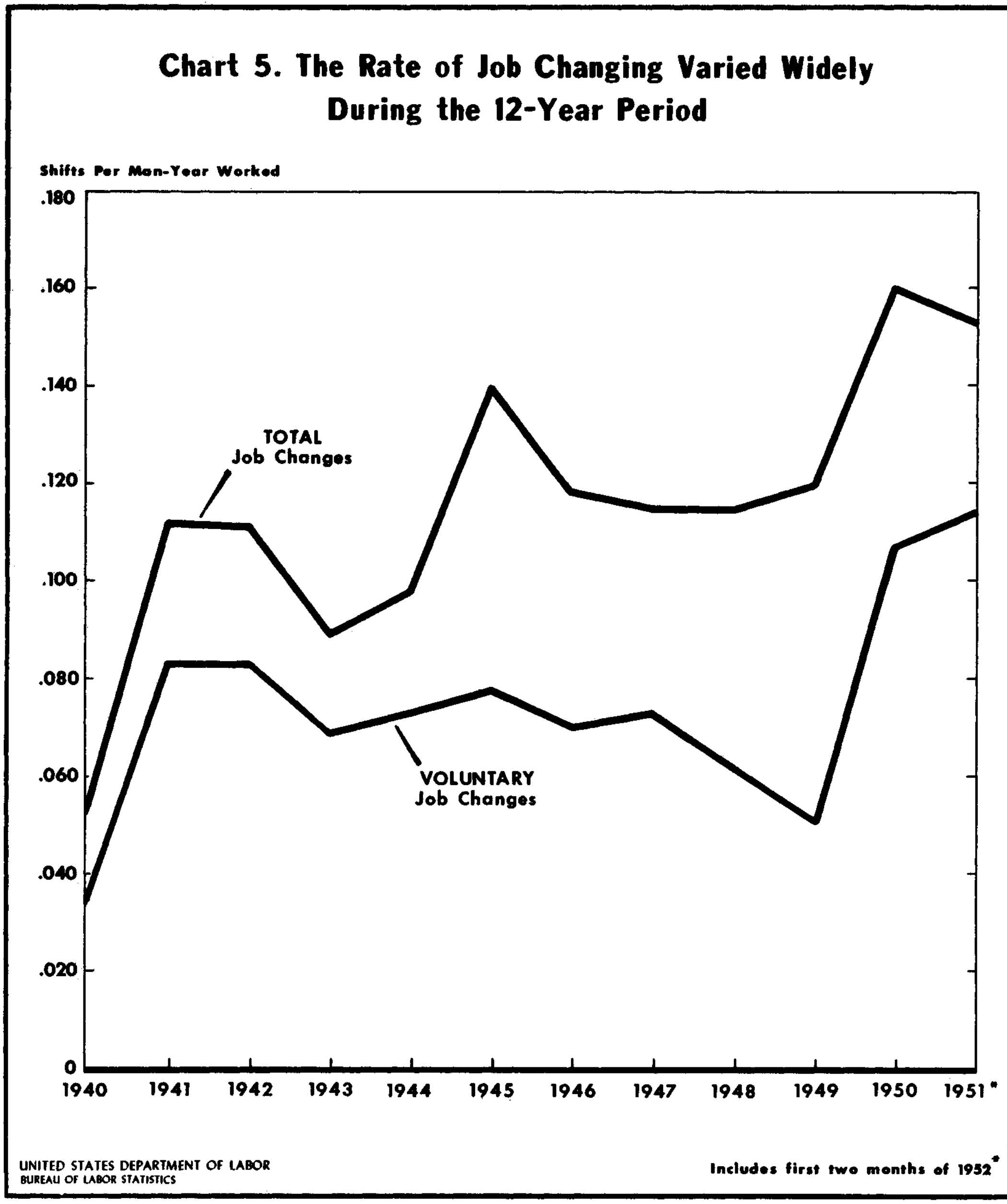
Many personal characteristics such as race, nativity, and educational level, however, had little apparent effect on the rate at which molders moved between employers.

Because the labor market environment significantly affects the behavior of workers, the relationship between certain institutional features of the labor market for molders and the mobility of molders was examined. Seniority was one important characteristic which apparently affected the tendency of molders to change jobs. Seniority arrangements in foundries were widespread--almost 80 percent of the molders interviewed reported their current jobs were covered by seniority provisions. The effect of seniority programs appeared to be to increase the average duration of jobs held by molders. Furthermore, a smaller proportion of jobs covered by seniority plans were terminated by quits.

Other institutional aspects of foundry employment did not appear to offer serious obstacles to job changes by molders. Although generally assumed by those familiar with foundries that the transfer of workers between the various types of foundries might be limited, the study showed that 4 out of 5 molders who had changed jobs from

Chart 4. Seniority Provisions Were a Prominent Factor in Jobs of Longer Duration





1940 to 1952 had worked with more than one kind of metal and that almost half of the workers who changed jobs had worked in both captive and independent shops.

Shifting of molders from one foundry to another may also entail moves between plants organized by different unions or between unionized and nonunionized plants. In this respect also, molders who changed jobs apparently encountered no difficulties. Of those who changed jobs, three-fifths had shifted between plants organized by different unions, or between unionized and nonunionized plants.

The impact of changes in general economic and labor market conditions on mobility was reflected in the wide fluctuations in the rate of job movement during the 12 years covered by the survey. Taken as a whole, the period was characterized by high levels of employment and ample job opportunities. Nevertheless, there were considerable fluctuations in foundry activity and general economic conditions from 1940 to 1952. The rate of job changing also varied widely; the highest annual rate of job movement in this period was double the lowest rate. Fluctuations in the rate of job changing and in the proportion which was voluntary closely paralled changes in foundry activity.

The motivations which impel molders to change jobs are important to both manpower planners and to employers who are either trying to attract new workers or to retain their current staffs. Explanations given by these workers indicate that they were concerned primarily with direct financial improvement. Almost half the quits made from 1940 to 1952 were for monetary considerations; either because the worker felt his current earnings fell below his minimum standards or because even if they did meet his minimum earning standards, he could make more money elsewhere. About one-quarter of the voluntary job terminations were due to other job-connected reasons such as working conditions, personal relationships on the job, and plant location.

Mobilization planning may also involve consideration of the problems arising from varying rates of expansion among foundries in different areas of the United States. The possibility of meeting the needs of rapidly expanding areas by the voluntary shifting of molders and coremakers appears to be limited. Only 10 percent of the 1,800 workers changed their cities of employment during the 12-year period and 80 percent of this small number made but one or two such changes. This low rate of job shifting between geographic areas appears to be related closely to family status and home ownership. Unmarried molders moved 50 percent more often than married molders, and nonhomeowners were three times as mobile as homeowners. Examination of the early work histories of the men interviewed showed that geographic immobility was not typical of 1940-1952 only. About three-fourths of the workers had been trained in the cities in which they were working when interviewed and most of the men who had moved into the survey cities had made moves covering short distances, mostly from the immediately surrounding States. The likelihood of successfully directing the movement of molders between geographic areas is even smaller than indicated by the above facts. Although direct economic considerations played a dominant role in most job shifts, personal reasons were the most important factors in job transfers between areas. Such changes, therefore, were less likely to be affected by any program of job-connected incentives.

One of the important findings of the survey was that molders are a stable occupational group. More than half of the 1,800 workers interviewed started their working lives in foundries and four-fifths of the workers were in foundry jobs within the first 5 years of their working lives. Once having moved into this field of work and having become qualified molders, they seldom left the occupation. Only about 15 percent of the workers interviewed had worked in an occupation other than molding during the 12-year period; of those who had, nearly all reported just one period of employment in other fields. In all, only about 3 percent of the time these men spent in the labor force between 1940 and 1952 was in jobs other than molding.

The low rate of occupational movement by molders can be explained partly by the personal backgrounds of the workers. The survey showed that 15 percent of the men interviewed had not gone beyond the fourth grade and about two-thirds had not gone beyond the eighth grade. About one-third of the group was foreign born. In addition, 7 percent were Negroes, and 4 percent were of Mexican extraction. For these workers, molding apparently offered a good "career" opportunity; a chance of becoming a member of a skilled trade group. The limited occupational mobility of molders can also be explained by the fact that there was little opportunity for these men to change to other fields of employment at the same skill level. Few of them had valuable secondary skills which could be used in jobs outside molding; practically all the jobs held by molders in other fields of work were in occupations less skilled (and probably lower paid) than molding.

Another factor bearing on the likelihood of shifts by molders to other occupations is the large "investment" of time and effort required to learn the trade. Almost three-fifths of the men interviewed had learned the trade through apprenticeships, usually lasting 4 years. Even of the men who qualified without apprenticeship, almost 60 percent required two or more years to learn the trade.

Considerable variation in the duration of training was reported by the molders and coremakers interviewed. As mentioned above, most of the apprentice-trained molders had relatively long periods of training, during which they learned all aspects of the trade. In contrast, only 5 percent of the non-apprentice-trained molders had any formal training. Most of them had simply "picked up" the trade while working in foundries, generally as a molder's helper and sometimes as a laborer. The non-apprenticed workers reported learning the trade in relatively short periods as compared with apprentice-trained workers. More than 40 percent of the non-apprenticed molders reported learning periods of 2 years or less. Inasmuch as it is generally held that a 3- to 4-year training period is desirable and almost necessary to produce an all-round skilled journeyman molder, the ease with which men with short and haphazard training have become "hand molders" suggests strongly the existence of various skill requirements for men working as hand molders. A review of changing foundry manpower practices and technology supports this probability.

During the past two decades, casting output per molder has increased tremendously. This has been accomplished largely by simplification of the molding process.[3] As a consequence, many foundries employ molders who do not perform the full range of duties of a hand mechanic but who specialize in a limited range of operations. Much foundry work, however, still requires the skill of the all-round molder. These variations in skill requirements indicate that molders and coremakers are not a homogeneous group with respect to skill level. Upward movement along the skill ladder in this occupation, therefore, is possible for a man even after he has nominally qualified as a journeyman molder. Thus, many workers are able to get jobs as molders after brief "learning" periods and to continue to learn the trade while employed as hand molders.

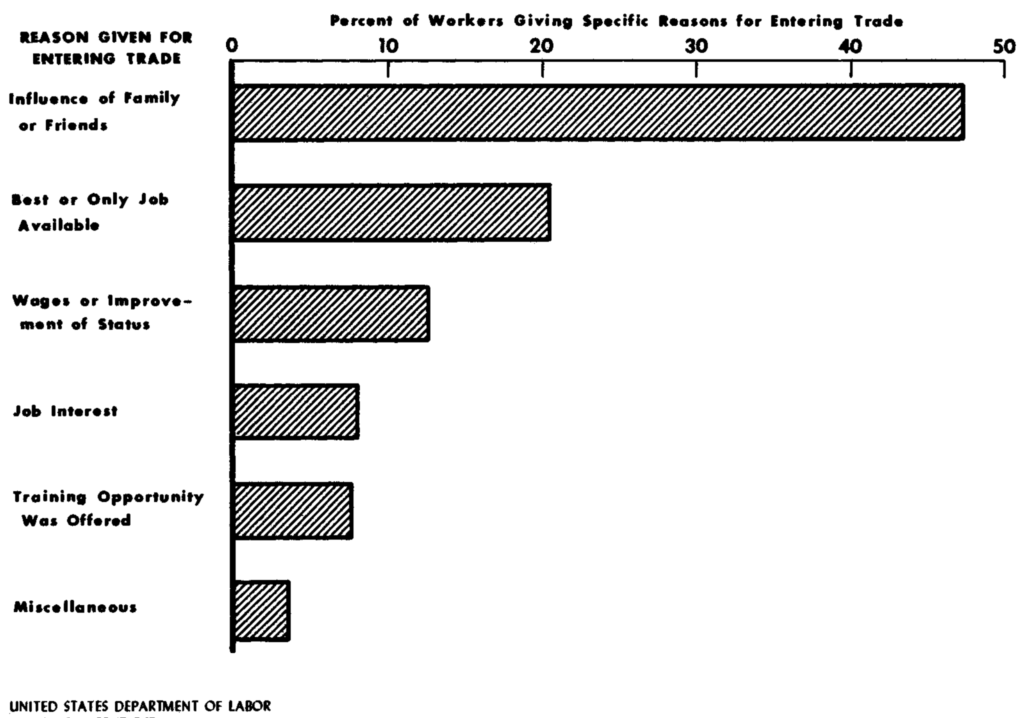
The workers were asked why they entered this trade. The reason most commonly reported was by the example or influence of family and friends. The importance of this factor is seen from the fact that two-fifths of the men reported that close relatives worked in foundries. Family relationships have also been a factor in determining how a worker qualified as a molder. Those men whose relatives were foundry workers qualified more often through apprenticeship than did men who had no relatives working in foundries.

3/ One of the principal factors in the increased output of foundries has been the mechanization of foundries, particularly the extensive use of molding machines. The transfer of much of the molding work from hand molders to machine operators has characterized this trend. It must be emphasized that machine molders were specifically excluded from the present study. The discussion of the wide range of skill levels found among the workers interviewed applies to hand molders and coremakers only.

In recent years the proportion of new entrants to molding who are Negroes or of Mexican extraction has increased sharply. Although these two groups constituted only 11 percent of the men interviewed, over one-third of those qualifying as molders in the post-World War II period have been Negroes or of Mexican extraction. This development may be partly attributable to the nature of the occupation.

Although hand molders and coremakers are among the highest paid foundry workers, with earnings on a par with those of other metal trades workers, there are features of this occupation which make it less desirable than other crafts. The job of molding often involves heavy, dirty work. In the past, working conditions have not been particularly favorable, but in recent years working conditions in foundries have generally improved.

Chart 6. Almost Half the Molders Entered the Trade Because of the Influence of Family or Friends

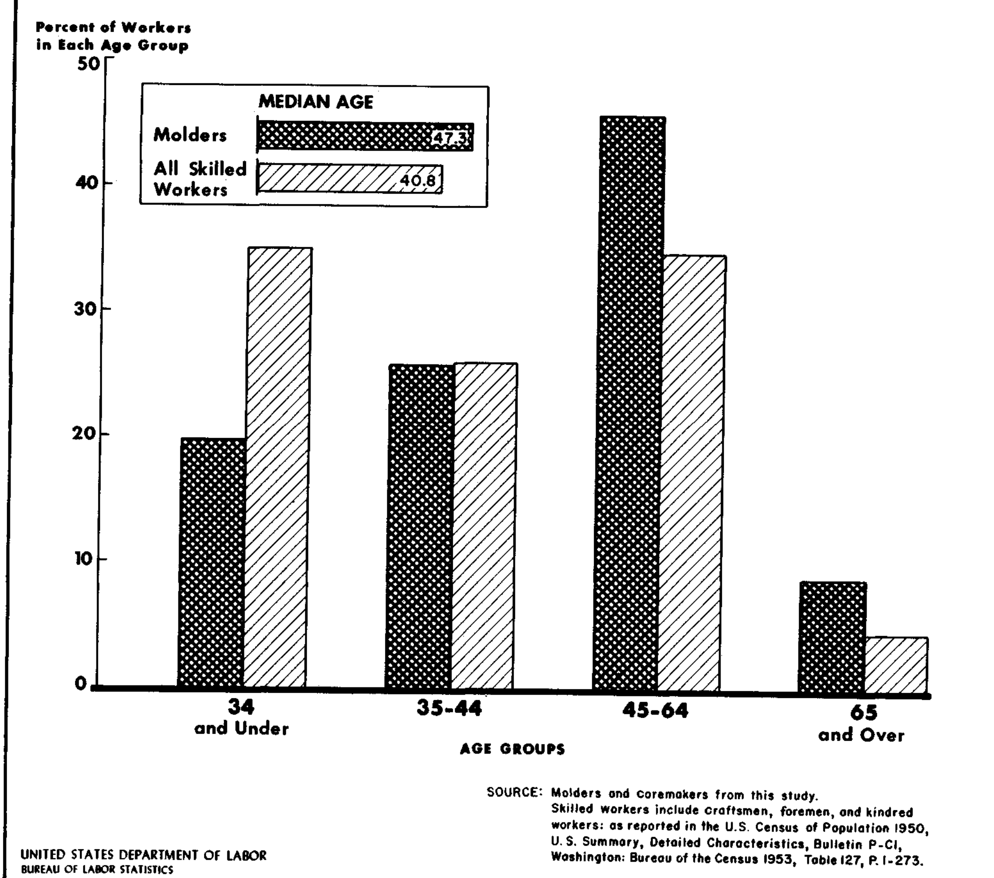


The attitudes of molders themselves about the desirability of the occupation is indicated by their responses when asked if they would recommend the trade as a career for young men. More than half said they would not recommend it and 30 percent of those who responded affirmatively qualified their recommendations in some manner such as "yes, but it is hard and dirty," "yes, if it paid better." It is noteworthy that the proportion of positive recommendations was especially high for workers with few years of schooling, those who did not serve apprenticeships, those of Mexican extraction, and among Negroes.

Some Manpower Implications

Molders and coremakers are of key importance during a mobilization period because of their role in the strategic foundry industry. Large volumes of castings are required for ordnance, tanks, and other military items as well as for machine tools and other production machinery. During World War II, shortages of these workers were acute, and extensive recruiting campaigns were undertaken to meet needs for workers in this occupation. Following the outbreak of Korean hostilities, these skilled workers were again in short supply and the occupation was included on the Department of Labor's List of Critical Occupations.[4] In the event of a recurrence of full mobilization, the sharp increase in the demand for castings for military production would again create

Chart 7. Molders and Coremakers Are an Older Group Than Skilled Workers as a Whole



4/ At the beginning of 1954, molders were no longer in short supply.

shortages of molders and coremakers. Because of the vital role of these workers in defense production and the probability of future shortages, problems of training, recruitment, mobility, and obligations for military service are important to industry and to the Government agencies responsible for planning effective manpower utilization.

What types of information are available from this study to help meet some of these mobilization manpower problems? The study provides data on the supply of molders and coremakers and in conjunction with data on mobilization requirements permits an evaluation of the adequacy of this supply. It indicates some of the steps which might be taken to maintain an adequate and flexible nucleus of skilled workers and to supplement this group with lesser skilled workers. The findings of the study also show the extent to which molders shift from job to job, and indicate how such movement can be directed to the plants which are essential during mobilization.

The study provides some information on the requirements for new workers in the trade. Survey data on the age distribution of molders and coremakers were used in conjunction with specific death and retirement rates (Table E-1) to make estimates of the number of such workers who will leave the labor force because of death or retirement. On the basis of these calculations it is estimated that almost 9,000 molders and coremakers will die or retire in the next 5 years, and the estimate for the next 10 years is about 18,000. This very high death and retirement loss is due to the large proportion of molders and coremakers in the older age groups; more than one-third of the molders and coremakers interviewed were 55 years of age or older. New workers also will be needed to replace those journeymen who leave the occupation for other fields of work. The nature of this study does not permit a precise estimate of the size of this group, but some men unquestionably drift out of the trade, and allowance must be made for these workers in estimating losses to the occupation.

Losses to the Armed Forces must also be considered in projecting replacement needs. If policies governing callups for military service in a future mobilization period are similar to those in effect during World War II, however, losses of molders and coremakers to the Armed Forces will be small. Only 20 percent of the molders and coremakers studied were less than 35 years of age and therefore in the age groups most susceptible to military service. Furthermore, three-fourths of the men under

35 years had dependent children and would not likely be among the first groups called up after mobilization began. Because of the importance of their work, occupational deferment might also be given to many of the molders and coremakers who would be subject to military service.

Prospective losses to the trade must be compared with the number of anticipated new entrants. Estimates of present training levels in the occupation were made from data obtained from the 195 foundries included in this study.[5] It was estimated that there were about 7 apprentices to every 100 journeymen molders and coremakers employed in early 1952, or about 4,400 apprentice molders and coremakers in training in the country as a whole. On the basis of past completion rates of apprentices in training in this trade, an average of about 800 workers would complete training in each of the next 5 years.

A large proportion of the men who have qualified in the occupation did not have apprentice training. About 40 percent of the men interviewed who qualified as journeymen during the period 1947-52 were not apprentice-trained. If this ratio of apprentice-trained journeymen to non-apprentice-trained workers should continue in the future, about 600 men would qualify in the trade each year without having served a formal apprenticeship. Combining both methods of entry, about 1,400 men would enter the trade each year or approximately 14,000 men in the next 10 years. On this basis, the projected number of new entrants, therefore, would not cover the expected 10-year losses due to deaths and retirements. This anticipated disparity, together with the shift of workers to other fields and possible inductions into the Armed Forces, would result in substantial reduction of the number of workers in the trade, unless the flow of trainees increases.

Whether this reduction would result in a shortage during a mobilization period depends on prospective manpower requirements for skilled molders and coremakers. In determining mobilization requirements, consideration must be given to the effects of changing foundry technology and manpower utilization on the demand for skilled craftsmen. In the past decade, increasing mechanization, more extensive use of molding machines, and changing work methods have resulted in a smaller number of skilled hand molders being

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5/ These 195 foundries employed about 20 percent of the estimated 18,000 molders employed in 8 cities and about 6 percent of the national total. See p. 57.

required for a given volume of foundry production. Should full mobilization occur within the next few years, however, time would not be sufficient for these trends to have a further significant effect on the occupational requirements of foundries. The probable manpower needs of the industry in any foreseeable mobilization situation must therefore be calculated primarily within the framework of the existing technology of the foundry industry.

Studies of mobilization manpower requirements in the foundry industry based on the assumption that no major technological changes will occur in the near future show that a substantial increase in the number of persons doing molding and coremaking work would be required. If the experience of World War II is repeated, the additional labor requirements will be met principally by breaking down the jobs and utilizing less-skilled workers. This can be done effectively only if enough highly trained, all-round skilled workers are available at the beginning of the buildup period to act as supervisors. Many all-round skilled workers will also be needed to perform the tasks that cannot be broken down because of the complexity or size of the castings produced or because only one or a few of a kind are to be made.[6] It is important also that an adequate number of highly trained workers be available because of their greater ability to shift from one type of work to another. Such flexibility may be required in a mobilization period because varying rates of expansion of the different types of foundries may require partial redistribution of the skilled work force.

Considering the present number of workers in the occupation, current training levels, and anticipated manpower needs during mobilization, it appears that the requisite nucleus of highly skilled men is not available to provide a base for expansion of the occupation and the requisite flexibility of the work force. Therefore, training programs must be expanded. Because of the long training period required to produce the all-round molder, it is important that the expansion of training activities not be delayed until full mobilization is imminent or in effect.

The importance of planning training programs well in advance of mobilization is also shown by the response of foundry officials to

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6/ National Manpower Council Information Memorandum No. 45, p. 1, February 8, 1954, Report on Conference on Technical and Skilled Manpower, Chicago, Illinois, January 1954 ".... the participants agreed that in most industries there is a core of workers, such as tool and die makers or master tailors, who are essential and whose training time approximates that of a professional. Changes in supervisory practices cannot compensate for a lack of these workers."

the question as to how their plants would meet molding requirements in the event of mobilization. In more than half of the 195 plants studied, management stated that they expected to be able to hire qualified journeymen. Thus, foundrymen apparently expect a reserve of molders to be on hand. However, it appears that no such reserve would exist if training activity is not expanded above 1952 levels.

As to the kind of training which should be stimulated, training authorities agree that, in general, apprenticeship offers the best way of acquiring all-round skills.[7] Data from the study tend to confirm this conclusion. The flexibility of the apprentice-trained workers was, for example, indicated by their greater experience with different types of metals. It must be concluded therefore, that expansion of apprentice training is essential for the development of all-round workers.

It is also important to consider the large number of workers who enter the occupation without serving apprenticeship. More than 40 percent of the workers studied entered the trade through informal methods, mainly by picking up the trade through experience in lower grade foundry jobs. Immediately following their nominal qualification as journeymen, these non-apprenticed molders and coremakers are sufficiently skilled to handle the less difficult work assignments and thus could help meet mobilization manpower requirements by freeing the all-round men for more complex tasks and for supervisory duties. Furthermore, given proper supervision and training, many acquire the skills of the all-round journeyman. Future training programs, therefore, should make provision for on-the-job training to raise the level of competence of the large number of men who have not been fully trained and are working on lower grade molding assignments.

Foundries have experienced difficulties in recruiting new workers, especially under tight labor market conditions, such as occurred during World War II. The relative unattractiveness of foundry work is reflected in the fact that most of the molders interviewed stated that they would not recommend the occupation as a career for young men, and by the difficulties encountered by the foundry industry in recruiting workers during World War II. In the past, foundries have obtained many of their workers from among immigrants (one-third of the molders interviewed were born abroad). However, immigration has become a negligible source of new labor market entrants.

7/ "On-the-job training teaches the specialized skill a company may require, but does not provide the broad training which creates versatile craftsmen." National Manpower Council, Information Memorandum No. 46, Report on Conference on Technical and Skilled Manpower, Detroit, Michigan, January 28, 1954.

Meeting mobilization requirements for increased numbers of molders and coremakers, therefore, may require that new sources of supply be tapped. In a mobilization period, some of the core-room work might be done by women, as was done in World War II. Negroes, and to a lesser extent, workers of Mexican extraction however can be a more important source of additional entrants into molding and coremaking Their willingness to enter the occupation was shown by the very high proportion who considered molding a desirable occupation. This contrasted with the generally unfavorable attitude of the white workers. Moreover, in recent years there has been a growing acceptance by foundry management of these groups for molding jobs.

Another important problem facing manpower authorities in a mobilization period is the optimum distribution of the available supply of qualified workers. The amount of movement needed to distribute effectively the occupational work force depends upon the way in which defense production is organized. In general, individual foundries have no major problems in converting from peacetime to wartime products. Aside from changed quality standards, the only adjustment necessary for most foundries to begin military production is obtaining new patterns from which to make the desired castings. However, the relative importance of various types of foundries changes in mobilization. For example, steel foundries expand at a much faster rate than gray iron foundries.[8] Thus, some redistribution of skilled workers is required during a mobilization buildup.

Although molders and coremakers, for the most part, were found to be a relatively stable group, there was a sizeable minority who could be expected to change jobs in a given period, e.g., during mobilization. If it can be assumed that the rate of job changing in the near future would be the same as that which was found in the 12-year period covered by the study, between four and five thousand of the 62,500 hand molders and coremakers estimated to be working in the United States could be expected to change jobs in a given year. The data indicate that these workers were, by and large, able to move freely from one type of foundry to another. More than one-half of the men interviewed had work experience involving two or more of the major foundry metals. Almost one-half of the men who had changed jobs had worked in both captive and independent foundries. Molders were also apparently able to move from plant

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8/ Shipments of steel castings in 1944 were three and three-quarters times the 1939 level, whereas shipments of gray iron foundries went up only 38 percent over the same period.

to plant without regard to which union had organized the foundry. Thus, on the whole, no substantial barriers to movement between foundries appear to exist and molders may be regarded as a flexible group which may be available for work in all types of foundries. The significance of these findings for mobilization manpower planning is that potential pools of experienced molders are available to foundries located in the major metalworking areas.

Maximum utilization of manpower resources in this occupation can be accomplished, in part, by directing the flow of workers from job to job so that insofar as possible they move to the plants with the most urgent mobilization production needs. The study showed that most of the job changing, other than that which involved movement between geographic areas, was made in attempts to improve either earnings or some other aspect of the job. Specific inducements which capitalize on these desires for improvement may facilitate the most favorable distribution of molders and coremakers among foundries engaged in mobilization production. For example, the feasibility of a system of selective wage controls could be explored to assist in the directing of workers to the plants where they are most needed. However, the establishment of general wage controls would not preclude effective direction of movement between jobs in a mobilization period. Data obtained in this study showed that during periods of generally rising wage levels as in the early 1940's a substantial proportion of job changes were made to obtain better pay. When wages were controlled, workers turned their attention to other aspects of their jobs and moved more often to improve working conditions, to get closer to home, or because of personal relationships in the shop. Such behavior suggests that the possibility of channeling job shifting by molders will remain even in the absence of wage incentives.

Many molders who left their employers apparently did not have new positions lined up; they entered the labor market to look for new jobs. An effort should be made to direct the movement of these men as well as that of other molders who are returning to the occupation from other fields of work or re-entering the labor force (retired workers, etc.). These groups, all of whom appear in the labor market without definite job destinations, can be most effectively utilized by inducing them to make use of the United States Employment Service where a system of preferential placement can perform this function.

Since there was a very limited amount of geographic movement and because most of this movement was for personal reasons, inducements such as wages and better working conditions would not operate effectively to direct movement of workers to particular geographic locations. This fact has several important implications for manpower planning and policy formulation. New foundries or foundry departments established in areas where there are not normally large numbers of molders and coremakers will have difficulty in recruiting them from other parts of the country. Thus, special planning will be required to handle the problems which will arise in staffing such plants. In addition, availability of molders and coremakers in specific geographic areas should be considered in the allocation of defense contracts to existing plants.

The discussion of mobility thus far has been concerned with the role of mobility in supplying workers to the plants where they are most needed. Although emphasis has been placed on the amount of mobility and its adequacy in performing this supply function, it should be emphasized that too much job changing would result in a waste of manpower resources. Excessive turnover is time-consuming and costly.

Manpower administrators should also direct their attention, therefore, to the problems involved in assisting individual foundries in maintaining stable staffs of molders and coremakers. The survey showed that the tendency of these workers to change jobs can be reduced by job security such as is provided by seniority programs and by a foundry's reputation for steady employment. It also indicated that unsatisfactory relationships between supervisors and workers are responsible for some job changing. Personnel policies designed to eliminate tension and grievances can reduce excessive job changing of molders and coremakers.

Maximum utilization of the existing work force of molders must also include steps to retain those presently employed in the craft and to induce qualified molders who have left foundries to return to their former trade. Basically, this appears to be a problem of relative earnings and working conditions. Consideration should be given to maintaining the wages of molders and coremakers on a par with those of other skilled occupations so that in time of labor shortages molders will not be induced to leave foundries for better paying jobs in which their maximum skills are not utilized. In this connection also, the continuation of efforts by the foundry industry to improve plant working conditions should be of considerable aid in retaining its workers.

Labor Market Environment of Molders and Coremakers

Nature of the Occupation

Hand molders and coremakers are among the highest skilled workers in the foundry process. They make the various kinds and sizes of sand forms used in casting metal. Molders prepare the hollow forms (molds) into which metal is poured and allowed to solidify, forming a casting. Coremakers make the bodies of sand, called cores, used to form hollows or holes in castings. Both molders and coremakers work with intricate and sometimes delicate sand structures. They manipulate with care and dexterity the hand-tools and metal or wooden patterns used in their work. Earnings of qualified molders are on a par with those of other skilled workers in the metalworking trades.

Working conditions for molders vary from foundry to foundry but generally are not as good as for most other skilled metal-working trades. Very often foundries are hot, noisy, and dirty. Foundry injury rates are higher than in most other types of manufacturing plants. It should be noted that the foundry industry has made intensive efforts in recent years to raise its standards, and foundry working conditions are continuously improving.

Both hand molders and coremakers were included in the survey. In many respects molding and coremaking are twin aspects of the same occupation. Both molders and coremakers make forms used in the casting process. Each must deal with common problems such as the characteristics of the sand used (its permeability, strength, and moisture content) and with problems of metal flow and cooling rates. The similarity of both operations is indicated by the fact that in many small foundries the two jobs are not differentiated. Molders do coremaking when necessary. In many cases, both molders and coremakers serve apprenticeships of identical content.

Certain important differences, however, distinguish the molder from the coremaker. Generally speaking, cores, which are used to produce internal cavities, are simpler in form and fewer in variety of shapes than molds. Also, the procedure in finishing molds and cores differs substantially. Another major difference between the two groups is the shop environment in which they work. Coremakers generally work in a separate department, known as the core room, in which working conditions are considerably better than on the molding floor.

The aim of this study was to analyze the mobility and work histories of journeymen hand molders and coremakers. It specifically excluded machine molders or apprentices or other trainees. In selecting workers to be interviewed special safeguards were taken to eliminate from this sample workers below the journeyman grade.[9]

However, despite the care with which the men interviewed in this study were selected and screened, an analysis of their work histories showed that the men had widely differing skill levels. In large part this diversity can be attributed to the changing nature of the occupation and of the foundry process. One of the more important developments has been the transfer of much of the judgment and discretion formerly exercised by the molder to the supervisory staff of the plant. The molder formerly was a true artisan. Given a pattern from which to produce a casting, he exercised almost complete discretion in the performance of the job. In most cases, he mixed his own sand, relying on his knowledge of the material to determine proper mixtures of various types, wetted it to the proper degree, and added binder material such as clay or organic substances as necessary. He determined such important points as the placement of the pattern in the flask, the depth of the backing sand, and the uniformity and the intensity of the ramming necessary to pack the sand around the pattern. He placed and cut the gates and sprues to feed the molten metal into the mold. Today, however, many of these operations are not performed by the molder. Gates and sprues are often built onto the pattern. Many molders today work as part of crews under the direction of a foreman or master molder, who directs the men and whose judgment is substituted for theirs in many operations. In some cases the members of the crews do not perform the normal full range of functions, but instead are specialists in such operations as mold finishing or ramming.

These developments have had important implications for the occupation. The title "hand molder" is given to workers with varying degrees of skill but no longer clearly and unequivocally distinguishes a highly trained workman. Although a large part of molding work still requires the skill of the all-round mechanic, many workers who are called hand molders today do a job which is repetitive in nature and limited in scope, and which can be

9/ See Methodology, p.57, for detailed description of sample selection.

learned in a relatively short time. The fact that the occupation does include a great variety of skill levels accounts in part for the wide variation in training time and types of training reported by the workers studied.

Types of Foundries

To a considerable extent, the level of mechanization of foundries and the degree to which they have been able to reduce the skill requirements of their molding and coremaking staffs depend upon the methods of production used in the shop. In this respect the distinction between "jobbing" and "production" methods is fundamental. In production operations, large numbers of castings are made from each pattern, and machine methods or job breakdown may be employed to a substantial extent. In jobbing operations very limited numbers of castings, sometimes only one or two, are made from each pattern, and hand methods predominate.

Production foundries typically serve mass-production industries which use large quantities of identical castings as components of standardized end products, such as automobiles, heating equipment, and household appliances. Jobbing foundries provide castings used as parts for limited quantity products such as machine tools and special purpose machinery. The distinction between jobbing and production shops is partially blurred in practice since production foundries often do some jobbing work, especially in slack seasons.

Some of the information obtained from the foundries included in the survey helps in distinguishing further between production and jobbing shops. The identification of foundries as either "captive" or "independent" is one of these distinctions. Independent foundries produce to order from other plants. Although every shop seeks "repeat" business and long economical production runs, independent shops must compete for business and accept whatever work is available. For the most part, therefore, they are likely to be jobbing shops.

Captive or "integrated" foundries are departments or subsidiaries of parent companies to which they transfer their output for final assembly. Especially when they are associated with a large scale producer of standardized products, captive foundries are likely to be production shops.

Another way of grouping foundries is according to the principal metal cast in the shop. This classification is significant because the demand for castings of various metals frequently changes at varying rates. For example, in World War II there was an extremely sharp upturn in the output of steel and nonferrous castings, a more moderate rise in gray iron and a very small increase in the output in malleable iron foundries.

Economic Conditions of the Period Covered by the Survey

Since the movement of workers may be affected by the level at which the economy is operating, the data on mobility presented in this report should be interpreted in light of the economic conditions of the period. These 12 years included two periods of rapid expansion of output and employment, 1940-42 and 1950-51, sustained high level production during the war years 1943-45, a period of readjustment in 1946, and a slump in 1949. As might be expected these fluctuations influenced the rate of movement of molders

On the whole, the period was marked by high employment levels. Molders and coremakers were in short supply at many times, particularly during the war years and again in late 1950 and 1951. Layoffs were few and the widespread availability of jobs offered both inducement and opportunity to make job changes at the individual's initiative.

Trade Unions

One of the most important forces impinging on a group of workers in a modern industrial society is the trade union. Union activities affect the worker from the time he enters the labor market until the time he leaves it. Through their influence in the planning and execution of training programs, on determination of compensation, on the improvement of working conditions, on policies regarding promotions, and on retirement plans, trade unions affect individual workers directly and continuously. A study of the labor market behavior of a group of workers should therefore be interpreted against a background which includes the union structure of the industry in which they work.

Four out of five men interviewed worked in shops which were organized by unions[10] (table 1). Of the 1466 men in organized shops, 881, or three-fifths, worked in plants organized by the International Molders and Foundry Workers Union of North America, which is affiliated with the American Federation of Labor. Five hundred and twenty or 35 percent, said their shops were affiliated with various CIO unions, including the United Steelworkers of America, the United Automobile Workers, and the International Union of Electrical Workers. A minor proportion of the workers indicated that their plants were organized by unaffiliated or independent unions.

Table 1.—Union affiliation of foundries employing interviewed molders and coremakers, January-March 1952

Union affiliation of foundry	Number	Percent
All workers	1,800	100.0
In plants organized by:		
AFL	881	48.9
CIO	520	28.9
Independent unions	65	3.6
Non-union	326	18.1
Not reported	8	.5

10/ This information was obtained by asking the question (see employee schedule questionnaire item 16-G, Appendix, p. 84) "Was there a union in the plant? If so give name." It is possible that in some cases the answers given indicated the personal union affiliation of the worker rather than the plant union. Spot checks however, indicated that the number of such answers was extremely low. It was therefore assumed that the answers identified the unions in the plants, and the data were so considered in the study.

Findings

Although the major emphasis of this study is on the mobility of molders and coremakers, analysis of the work histories and personal backgrounds of these workers provided much additional data of importance in manpower planning. In addition to permitting analyses of the factors which affect the rate and extent of mobility and the reasons why molders change jobs, the findings are important because they contribute towards a well-rounded view of the workers in an occupation which becomes critical in a mobilization period. For example, data relating to how molders and coremakers qualified for their jobs and the occupational and social groups from which they may be drawn can be helpful in setting up training programs; a detailed knowledge of the age distribution of these workers and of their dependency and veteran status is important in estimating future death and retirement losses and probable liability to military service. Thus, the findings presented in the following section deal with molders and coremakers in a broad sense and are not confined to a limited analysis of mobility.

Personal Characteristics

Large prospective losses due to death and retirement are indicated by the age distribution of the molders and coremakers included in the survey. As many workers (20 percent) were 60 years of age or older as were under 35 years of age (table 2.). The mean age of all the workers was 47.8 years and the median age was 47.3. This compares with a median age of 40.8 for skilled workers generally.[11] The age distribution of the workers showed considerable variation from city to city, with average ages ranging from 44.7 in Los Angeles to 50.7 in Detroit.

Of the 1,800 men interviewed, 1,594 or 89 percent, were white other than of Mexican extraction; 127 or 7 percent, were Negroes; and 79 or 4 percent, were of Mexican extraction.[12]

11/ U. S. Census of Population: 1950, U. S. Summary, Detailed Characteristics, Bulletin P-C1, Washington, Bureau of the Census, 1953, Table 127, p. 1-273.

12/ See footnote 29, p. 60, for explanation of racial designation used in this study.

Table 2.--Distribution of Molders and Coremakers by Age and by City of Employment, February - March 1952

City of employment	Average (mean) age	All age groups	19-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-79
		Age group										
						Percent						
All cities - -	47.8	100.0	0.7	4.6	14.5	13.9	11.9	9.6	10.3	13.8	11.9	8.8
Boston - - - -	48.3	100.0	.6	5.0	13.3	17.8	7.8	6.7	8.3	18.9	13.3	8.3
Chicago - - -	47.7	100.0	.5	4.0	11.7	17.1	14.9	9.0	9.5	11.7	13.5	8.1
Cleveland - -	50.0	100.0	-	2.4	8.8	14.7	15.2	9.8	6.4	15.7	16.7	10.3
Detroit - - -	50.7	100.0	-	1.9	9.9	9.4	12.2	11.8	9.0	22.2	16.5	7.1
Los Angeles -	44.7	100.0	1.2	3.3	15.9	17.9	18.4	11.4	13.5	8.6	4.9	4.9
New York - - -	48.9	100.0	0.8	5.0	16.9	11.5	5.4	9.6	13.1	12.3	11.5	13.9
Philadelphia -	46.9	100.0	1.1	5.9	20.4	10.8	10.8	6.3	11.2	12.3	12.3	8.9
Pittsburgh - -	45.8	100.0	1.0	9.1	15.9	13.0	11.0	12.0	10.1	11.5	8.2	8.2

There were wide variations from city to city in the proportion of molders who were Negroes or of Mexican extraction. In Los Angeles, of 245 workers interviewed, 79 were of Mexican extraction, 5 were Negroes, and 161 or 65.7 percent, were non-Mexican white workers. In Detroit, 18 percent of the molders were Negroes; in Chicago, 13 percent. Less than 5 percent of the workers interviewed in New York, Pittsburgh, and Boston were Negroes. The men of Mexican extraction and Negroes were generally in the younger age groups, probably attributable to the fact that only in recent years have they entered the occupation in any great number.

Almost one-third of the molders interviewed were born outside the United States. In contrast, only one-tenth of the 1950 male experienced labor force was foreign-born.[13] Nine-tenths of the foreign-born molders were 45 years of age or older whereas only about one-third of the molders born in the United States were 45 years or older.

The proportion of foreign-born workers varied by city. A high proportion (39 to 45 percent) of the molders in New York, Detroit, Cleveland, and Boston were born abroad. Philadelphia, with 15 percent, had the lowest proportion of foreign-born. In Pittsburgh, Los Angeles, and Chicago, about one out of four men was born outside this country.

It has been suggested that the Nation's rural areas are a common source of new entrants in this occupation. Although the survey showed that 30 percent of the men interviewed had been raised on farms, the proportion of molders with farm backgrounds has been decreasing; 40 percent of the men 45 years of age or older had been raised on farms as compared with less than 20 percent of those under 45 years. Because the proportion of foreign-born molders is also decreasing, it appears that the supply of new workers in this occupation must come principally from the cities and towns of the United States.

Molders generally had little schooling (table E-3). Of the molders interviewed, only 35 percent had more than 8 years of schooling, whereas for the male labor force 18 years or older,

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13/ Bureau of Census, Special Report, "Employment and Personal Characteristics," P-E, Number 1A, Table 5, April 1953.

80 percent had completed 8 years or more of schooling.[14] Only a little more than 1 percent of the molders went to college. The younger workers generally had more schooling than the older workers, directly reflecting the extension of education in recent years. Fifty-eight percent of the molders under 45 years of age had more than 8 years of schooling, but only 16 percent of the men 45 years old or older had gone beyond the eighth grade.

Because of their generally limited formal schooling, molders may be hampered in moving out of the occupation into other skilled fields of work. This educational factor may well be an inhibiting influence and must be considered when estimating the number of men who have left or will leave molding for other jobs.

Ninety percent of the workers studied were married. Only 8 percent had never been married and 2 percent were widowed or divorced. Half of the molders had 1 or more dependent children. Three hundred fifty-three, or 1 out of every 5 molders were veterans, and almost all of these had served in the Armed Forces during World War II. Of this number, 167 or 47 percent were qualified journeymen when they entered the Armed Forces. Almost 1 out of 4 of the 725 men in the age group from 30 to 44 years had had his working life interrupted by military service.

Half of the molders were homeowners, about the same proportion as among urban skilled workers generally.[15] Home-ownership in each age group rose steadily from 30 percent for those in the 25-29 group to 70 percent for those in the 60-64 group. Home ownership differed markedly among molders in the eight cities. In Boston, 32 percent of the molders were homeowners; in Los Angeles twice as high a proportion, 65 percent, owned their homes. Small percentages of molders in New York and Chicago were homeowners; but in Cleveland, Detroit, Philadelphia, and Pittsburgh, well over half of the molders owned their homes.

14/ Current Population Reports, U. S. Bureau of the Census, Series P-50, Number 49, Educational Attainment and Literacy of Workers: October 1952.

15/ Survey of Occupational Mobility, 1940-1951, Patterns of Mobility of Skilled Workers, Massachusetts Institute of Technology, February 1952, p. 114.

In general, these variations corresponded to differences in home ownership found in the eight areas by the 1950 Housing Census.[16] Only in Boston and Los Angeles were there any great differences in the proportion of homeowners between the general population and the molders interviewed.

Factors Related to Entry into Molding

Practically all the men interviewed gave definite reasons for becoming molders. Perhaps the most striking fact is that such a small proportion indicated they had become molders because of job interest; only one-twelfth said they entered the occupation for this reason. About 20 percent entered the occupation because it offered an opportunity to better themselves, that is, to learn a skilled trade, to improve their social status, or to earn higher wages. Such reasons as "improvement," "to learn a trade," "to make more money," were most often mentioned by the nonwhites and the least educated men, for whom the alternatives were presumably rather limited.

The largest single reason reported as inducing the men to enter the molding trade was the influence of family members or friends. This reason was given by 851 men, or 47.3 percent of the total. When the men interviewed were grouped according to the occupations of their fathers the importance of family background as an influence was apparent. Of the 404 men whose fathers had been foundry workers, about three-fourths had entered the occupation because of family influence. The higher the status of the father in the foundry, the more likely was his son to follow his father's example and enter the trade. Thus, 83.0 percent of the men whose fathers were foundry foremen reported family influence, as compared with 61.5 percent for men whose fathers' usual occupation was some lower skilled foundry work other than molding.

Forty-four percent of the molders interviewed reported that there were other members of their families in foundry work at the time they themselves first entered the foundry. In one-half of the cases, the other family member was the father. Of

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16/ 1950 United States Census of Housing, U. S. Summary, Housing Census Report H-A1, Table 22, Occupancy Characteristics, Type of Structure, and Plumbing Facilities, for Standard Metropolitan Areas: 1950, p. 1-36.

the 404 fathers who were foundry workers, one-eighth were foremen, three-fifths were molders, and the remainder worked in other foundry occupations.

Generally, except for periods of severe economic stress such as in the 1930's, reasons for entering molding have been the same over the years. But in the depression years, the importance of "job scarcity" rose sharply. Of the men who entered the trade between 1930-39, 27 percent did so because "it was the only job open" as compared with 19 percent of the 1,400 men who entered the trade in other periods.

More than half of the molders began their working lives in foundries. However, 25 percent had not started foundry work until they had been in the labor force 5 years or more, and 169 men - 9 percent of the total - had not entered foundry work until after 10 years or more in the labor force (table 3). The tendency to go directly into foundry work was related to the occupation of the worker's father and to the worker's race. Molders whose fathers were employed in foundries generally entered foundry work immediately or quickly after entering the labor force. Of the men whose fathers were foundry workers, about nine-tenths had begun foundry work within 5 years of their entry to the labor market, as compared with 75 percent for men whose fathers worked in nonfoundry occupations.

Negro molders and those of Mexican extraction entered foundry work later in their working lives (table 3) While 80 percent of the white molders were employed in foundries within 5 years of their initial labor market entry, only 62 percent of the men of Mexican extraction and of the Negroes had started foundry work after the same length of time in the labor market.

Of the 958 men who began their working lives in foundries, about two-thirds started immediately on jobs which led directly to qualification as molders; 45 percent started as apprentice molders and 20 percent as molders' helpers. The remaining 35 percent began their working lives as foundry laborers or in other foundry work, and later were able to advance to molders' helpers or apprentice molders and subsequently qualify for the trade.

It is noteworthy that apprenticeship as a foundry job has been declining in importance, whereas other foundry jobs such as molder's helper, laborer, and general helper, are increasing in importance as entry jobs for molders (table 4).

Table 3.--Distribution of Molders and Coremakers, by Time in Labor Force Prior to Entering Foundry Work, and by Race

Years in labor force prior to entering foundry work	All molders and coremakers		Race: White		Race: Negroes and men of Mexican extraction	
	Number	Cumulative percent	Number	Cumulative percent	Number	Cumulative percent
All groups	1,800	100.0	1,594	100.0	206	100.0
None	958	53.2	883	55.4	75	36.4
One year	116	59.7	109	62.2	7	39.8
Two years	117	66.2	104	68.8	13	46.1
Three years	84	70.8	76	73.5	8	50.0
Four years	78	75.2	59	77.2	19	59.2
Five years	54	78.2	48	80.2	6	62.1
Six years	65	81.8	54	83.6	11	67.5
Seven years	53	84.7	42	86.3	11	72.8
Eight years	53	87.7	43	89.0	10	77.7
Nine years	40	89.9	33	91.0	7	81.1
Ten or more years	169	99.3	133	99.4	36	98.5
Not reported	13	100.0	10	100.0	3	100.0

Despite the declining proportion of men who begin foundry work as apprentices, the proportion qualifying through apprenticeship has remained constant. This indicates that foundries have increasingly selected their apprentices from among employees working as molder's helper or molding department laborer.

Attitudes of Molders Toward the Occupation

Each of the workers interviewed was asked if he would recommend molding as a career to a young man.[17] It was intended that this question would develop some indication of the attitude of molders and coremakers toward their work; that is, their satisfaction with their occupational status.

Less than half of those interviewed said that they would recommend to a young man that he learn molding; and of this number 3 out of 10 qualified the recommendation with a statement such as "yes, but it's hard and dirty," "yes, if it would pay better," or "molding is OK, but not coremaking," or the reverse. Among the 922 men who would not recommend the occupation, the most frequent reasons given included "it's too hard and dirty," "the pay is too low." Only 29 molders did not express any opinion.

The most striking result of the analysis is the divergence in opinion between the whites and the Negroes and men of Mexican extraction. Less than one-half of the white molders said they would recommend the occupation, while 70 percent of the other group felt it was a good trade for young men (table 5). This difference in the comparative attractiveness of the occupation to the two groups is undoubtedly related to the kind of jobs and careers open to each.

Educational level also influenced the molders' attitudes. About three-fifths of the 269 men with four or fewer years of schooling recommended the occupation, compared with less than half of the men with five or more years of formal education (table E-4). Even if allowance is made for the influence of race, the more favorable opinion of the workers with less schooling persists. Apparently these men felt handicapped by their lack of formal education, and molding offered an opportunity to achieve a higher economic and social status than they could expect in other fields of work.

17/ See questionnaire, p. 84, question 20 for exact phrasing.

Table 4.--First Foundry Job of Molders and Coremakers, by Year of Entry Into Foundry Work

Year of first foundry job	First foundry job				
	All workers		Apprentice molder or coremaker	Molder's or coremaker's helper	Other foundry jobs
	Number	Percent			
All periods - - - - - - - - - -	1,800	100.0	40.6	23.5	35.9
1915 and earlier - - - - - -	575	100.0	51.3	22.4	27.3
1916-29 - - - - - - - - - - - -	479	100.0	39.5	21.9	38.6
1930-39 - - - - - - - - - - - -	400	100.0	34.3	22.0	43.7
1940 and later - - - - - - - -	346	100.0	31.5	29.2	39.3

Table 5.--Opinions of Molders and Coremakers About the Occupation as a Career for Young Men, by Race

Recommendations	All molders and coremakers		Race			
			White		Negroes and men of Mexican extraction	
	Number	Percent	Number	Percent	Number	Percent
All recommendations - - - -	1,800	100.0	1,594	100.0	206	100.0
Yes - - - - - - - - - - - - -	590	32.8	481	30.1	109	52.9
No - - - - - - - - - - - - -	922	51.2	864	54.2	58	28.2
Yes with reservation - - -	259	14.4	223	14.0	36	17.5
Undecided - - - - - - - - -	29	1.6	26	1.6	3	1.5

The apparent importance of social and economic backgrounds in determining the opinions of molders about the occupation is shown by grouping the men interviewed according to their fathers' occupations. The lowest proportion of positive recommendations came from those men whose fathers' occupations were high in the socioeconomic scale - foremen and craftsmen; professional and technical workers; proprietors, managers, and officials; or clerical ("white collar") workers. A favorable recommendation came most often from men whose fathers had been farmers and service workers, lower skilled foundry workers and other lower skilled factory workers.

Nonapprenticed workers recommended the trade more often than did their formally trained co-workers. The workers who had had no formal training, apparently believing they had done quite well to advance themselves as far as they had done, considered that molding offered a pretty good chance to get ahead. That such subjective evaluations entered into responses to the query is also apparent when the men were grouped according to their explanations of their own reasons for entering the occupation. Of the 146 men who had become molders because they "liked the work" or gave some other indication of job interest, 94 or 64.4 percent, recommended the occupation, whereas only 44 percent of those who became molders because of the influence of family or friends felt that molding was a good career.

It would seem from the foregoing analysis that the question asked of these workers offers a convenient method of ascertaining workers' attitudes towards their work. The same question was asked of tool and die makers and about 70 percent, 1,170 out of 1,712, gave affirmative recommendations.[18] Tool and die makers are generally considered to be the elite of metalworking craftsmen; molders and coremakers rank low, in terms of prestige, among craftsmen. The much higher proportion of tool and die makers who are satisfied with their status, compared with the molders, reinforces the hypothesis that the response given measured workers' satisfaction with their lot.

Nature and Duration of Training

Well over half (1,020) of the molders interviewed had served apprenticeships. An apprentice, as defined by the Bureau of Apprenticeship, U. S. Department of Labor, is a worker who,

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18/ The Mobility of Tool and Die Makers, op. cit., unpublished table.

under a written or oral agreement, learns a recognized skilled trade requiring at least 2 years of on-the-job work experience and related trade courses, such as blueprint reading.

The apprenticeship period usually ran 4 years; more than two-thirds of the molders reported this duration of training. Apprenticeships of less than 4 years duration were reported by 17 percent of the molders and 13 percent reported apprenticeships in excess of 4 years. Practically all of the apprentice-trained men indicated that they had served the scheduled term of their apprenticeships and had been awarded either a certificate from an apprenticeship council or individual employer, or more frequently, a journeyman card from a union.

The kind of job training a molder received was partly determined by his personal background. Men whose fathers were foundry workers had more often been apprenticed. About two-thirds of the men whose fathers worked in foundries had been apprentices, compared with somewhat more than half of the remaining 1,396 men. In addition, apprentice-trained molders generally had more schooling. Forty percent of the apprentice-trained men had gone beyond the eighth grade as compared with 30 percent of the nonapprenticed molders; only 11 percent of the apprentices had finished 4 years or less of schooling, compared with 20 percent of the non-apprenticed workers.

The proportion of Negroes or molders of Mexican extraction having apprentice training was substantially lower than that for white molders (table 6). However, the proportion of such workers qualified

Table 6.—Distribution of molders and coremakers by race and method of qualification

Method of qualification	All molders and coremakers		Race: White		Race: Negroes and men of Mexican extraction	
	Number	Percent	Number	Percent	Number	Percent
All molders and coremakers . . .	1,800	100.0	1,594	100.0	206	100.0
Apprenticeship	1,020	56.7	938	58.8	82	39.8
Other than apprenticeship	780	43.3	656	41.2	124	60.2

through apprenticeship has been increasing steadily during the war and postwar period (table E-5). This undoubtedly reflects the greater acceptance accorded these groups in the industry.

Forty-three percent of the men interviewed had learned the trade without serving apprenticeships. Only 5 percent of these men had some more or less formal on-the-job training by which they had progressively learned the trade. Non-apprenticed molders typically learned the trade by working as a molder's helper, sometimes following experience as a laborer. Few of the men had previously worked in other foundry operations such as chipping, grinding, melting etc.

Some of these men went directly from laborers' jobs into molding. For example, one man stated, "the plant needed a molder so the foreman showed me what to do for about six months, then I got the money and did the same as the rest of them (molders)." Apparently, the piece rate system made entry into the occupation easier for these relatively untrained men. Many of these men reported something similar to the following: "worked as a laborer and watched the molders. After a while, I felt I could do the work and asked the boss to break me into the job. He put me on piece work and I did OK."

The determination of the length of "training period" for the workers who had served no apprenticeship period presented some problem, since many of them claimed that they began working as molders after little training. Immediately after nominally qualifying as molders, these men were able to perform only routine, simple work and could not have compared in proficiency with the apprentice-trained worker. However, at the time of interview all these men were carried on the employers' payrolls as hand molders and were earning molders' wages. Therefore, unless the questionnaire showed obvious signs of inconsistency, the "training" history and date of qualification given were accepted. For those men who worked first as molders' helpers, and then became molders, only the time worked as a helper was considered to be the training period, and prior work experience in the foundry in other occupations, if any, was not counted. For those men who either went directly from laborers' jobs to molding or who claimed they started immediately as molders, the time which they claimed it took them to reach proficiency was considered to be the training period. The achievement of the proper level of proficiency was indicated by a statement that journeymen wages were paid, or that a journeyman card was issued, or that the individual was given a job as a journeyman.

On this basis, the average duration of such informal training was considerably shorter than that found for apprentices.

More than 40 percent of molders who had no apprentice training reported learning periods of 2 years or less; 83 percent got jobs as molders after 4 years or less. The wide range of the training periods reported apparently reflects the diversity of skill levels in the occupation that has developed from changes in foundry technology and the continuing dilution of the skills required of many of the the molders. Much of the work done by hand molders today is repetitive and relatively limited in scope. The wide range of skill levels that exist in the occupation today permits relatively untrained men to enter the occupation at lower levels than the all-round worker. The existence of these gradations of skill permits a reconciliation between the generally accepted 4-year apprenticeship and the shorter learning period reported by many of the nonapprenticed men.

About 1 out of 8 of the molders had received some kind of classroom instruction which was related to the occupation. Study courses included blueprint reading, shop mathematics, foundry practice, and basic metallurgy. About 72 percent of these men had taken courses while employed in the foundry; 21 percent had these courses in schools before starting foundry work. The remaining 7 percent of the men had taken the courses both while they were still in school and after they had started full-time foundry work. Because apprentice training agreements often stipulate some formal instruction in addition to work experience, more apprentice-trained molders had studied such courses than had nonapprenticed men. One out of 6 apprenticed men reported technical schooling compared with 1 out of 14 nonapprenticed workers.

The proportion of molders who have taken courses in addition to on-the-job training has steadily increased. Of the molders who qualified as journeymen in 1929 or earlier, 1 out of 12 had some technical courses as compared with 1 out of 5 molders who qualified between 1946 and 1952. The advantage of broad training together with some emphasis on background in related subjects and theory is indicated by the fact that the proportion of foremen who had some technical schooling was twice as high as for other molders.

Mobility

Movement In and Out of the Occupation - One important aspect of the mobility of molders is their inter-occupational movement. The rate of movement of molders in and out of the trade and the amount of time they spend outside molding are important to manpower officials because of the effects on the available supply of these skilled workers. Also, the kinds of work molders do when working outside the foundry may indicate the existence and extent of underutilization of manpower resources.

From the point of view of manpower supply, occupational movement[19] was of relatively minor importance. Between 1940 and 1952, 268 men or 15 percent of the 1,800 men interviewed had worked outside molding; the time they had spent outside the trade represented only 3 percent of the total time the 1,800 men spent in the labor force as journeymen molders.[20] Although of minor importance, the time lost to the occupation not only decreased the supply of molders to the foundries but was also an overall loss to the economy. Analysis of the "outside" jobs these workers held showed that most of them were at lower skill levels and thus represented under-utilization of manpower resources. Only a small proportion of the jobs in nonmolding work could even nominally be classified as equal to or higher than molding in the hierachy of occupations. By far the largest number of nonmolding jobs were in semiskilled factory work. A few men owned or managed small businesses. Most of the remainder of the nonmolding jobs were in the building trades.

Of interest with regard to the problem of augmenting the supply of molders during mobilization is the fact that qualified molders who had been working in other fields did return to the occupation during the 12-year period surveyed. The year by year job movements of molders indicates that most of the influx occurred in two periods of expanding activity for foundries: the early '40's and again in 1950-51. This suggests that, although some men leave foundry work in good times, there is also a tendency for others who had previously left the occupation to return to it when jobs are plentiful. An analysis of the work histories of the 108 men who returned to molding in 1950-51 illustrates the pattern which has occurred. Ten percent of these 108 workers had left the occupation prior to 1940, so no record is available of their reasons for leaving the trade. Of the 98 workers who gave reasons, 56 percent left molding after being laid off, 19 percent had "wanted to get out of the trade," and 25 percent gave miscellaneous reasons for leaving the occupation. When asked why they reentered molding, 70 percent said they could make more money in molding, 25 percent said it was the

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19/ An occupational shift was defined as any job change which involved a change of job duties, with or without a change of employer.

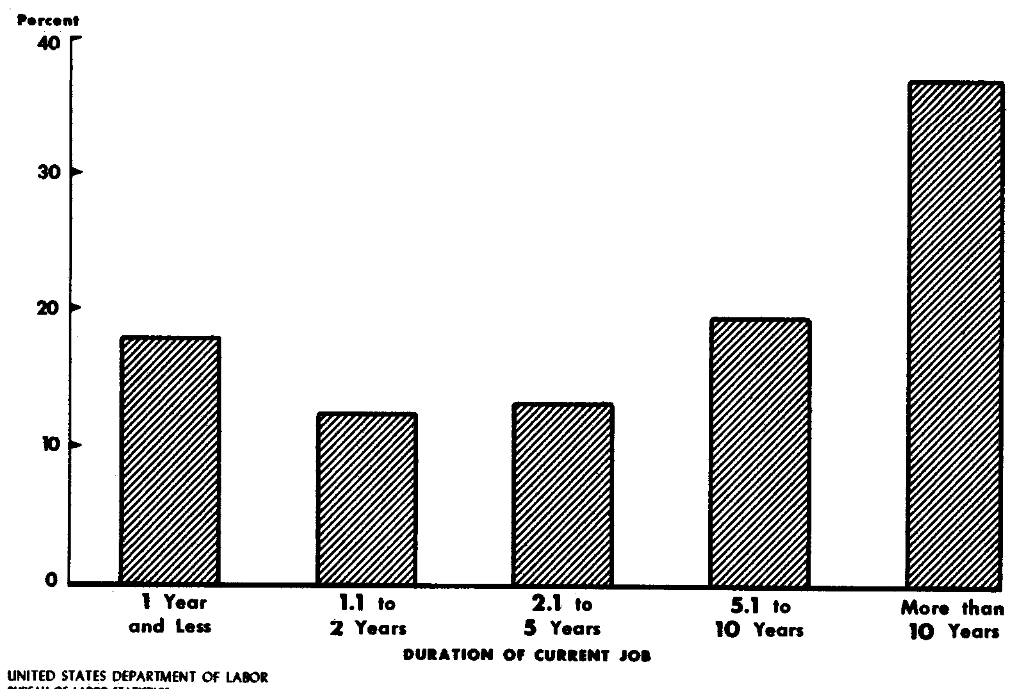
20/ It should be recognized that these data refer only to those men who were working in the trade at the time the survey was made. Undoubtedly, some men who worked as molders sometime during the period 1940-52 shifted to other fields of work and had not returned to molding in early 1952. How large this group might be compared to the total number of workers in the occupation, how many occupational changes they made, and thus, to what extent the noninclusion of this group understates the occupational mobility of molders are not known.

first job available, and 5 percent gave miscellaneous reasons. A fairly definite pattern thus emerges; more than half of the men who left the occupation did so involuntarily. Others had done so because they wanted to try their luck at something else. Most of them returned to the trade simply because they could not do as well in other work and recognized that their best opportunities were in molding.

Movement out of the occupation over the 12-year period followed an apparent pattern. One large group of molders took jobs outside the occupation following their military service but later returned to molding. The recession in 1949 curtailed foundry activity and apparently impelled another group of molders who had been laid off or working short hours to shift to other occupations. These men reentered molding in 1950 and 1951 when foundry work expanded and jobs became available.

Movement Between Employers - Molders are, by and large, not a mobile group. Less than half the molders in the survey had changed jobs during the 12-year period, and those who did each averaged 2.6 shifts. Moreover, 37 percent (667 men) had been

Chart 8. More Than One-Third of the Molders Had Been Working on the Same Job Longer Than Ten Years



working in their current jobs for more than 10 years at the time they were interviewed,[21] 25.3 percent (465 men) had not changed jobs for 15 years or more, and 11.3 percent (203 men) had been working on the same job for 25 years or more.

A considerable proportion of the job changes of molders was made by a small group of highly mobile men who might be characterized as "drifters." The 116 men who made five or more changes represented about 6 percent of all the workers but accounted for 34 percent of the job changes (table E-6).

One of the problems connected with the establishment of training programs is the feeling of employers that it does not pay them to participate in such programs. The operation of a well-rounded program involves the utilization of supervisors as training personnel. Often it involves giving the trainees time off the job for schooling, and requires the payment of a wage to the worker when he is, from the employer's point of view, in a nonproductive status. Some employers may feel that they do not receive an adequate return on this investment of time and money because the worker, after becoming a journeyman, soon leaves the plant and seeks more attractive opportunities elsewhere. The data of the study do not substantiate this belief. About 37 percent of the workers studied stayed 6 years or longer as journeymen in the plants where they had learned the trade. Twenty-two percent of the total remained longer than 10 years as qualified molders with the employers who had trained them. Moreover, the data indicate that the trend is for molders to stay longer in the plants where they were trained. This reflects the changing meaning of the word "journeyman." The term today designates the worker who had graduated from a trainee status. Originally, it meant an apprentice who had completed his training and had begun traveling from one job to another in order to learn some of the finer points of his art. Gradually this practice has disappeared. Whereas one-third of the men who qualified before 1915 remained 6 years or more in the plants where they had qualified, half of the men who learned the trade between 1940 and 1945 remained six years or more with the employer in whose plant they learned their trade (table E-7). Furthermore, of the 357 men who qualified between 1940 and 1945, only 62 or about 17 percent, left the plants in which they had learned the trade for voluntary reasons such as for better wages or better working conditions. The remainder either were still employed at the plant or had left only because of layoff, slack work or because

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21/ Even these figures actually understate the immobility of the group since an additional 18 percent of the 1,800 men had been with one employer for their entire working lives as molders but had not been qualified workers for as many as 10 years.

they were called into the Armed Forces. Thus, in recent years the proportion of new trainees who have, of their own desire, left the plants where they were trained within a few years after qualifying has not been large. On the basis of the findings in this study it appears that employers today may plan training programs for molders with a fairly high degree of confidence that the newly trained workers will stay with them for a reasonable length of time.

The wide changes in economic activity and foundry output that occurred from 1940 to 1952 are reflected in the rate of movement of molders between employers. The rate of job changing varied, fluctuating with changing economic conditions (table 7). Starting off relatively low in 1940, the rate of movement increased in 1941 and 1942 as foundry activity picked up during the preparedness period and molders returned to the foundries from other fields. In 1943 when wartime production was at a high level, the rate of movement fell to its lowest point during the 12 years, since the major expansion of employment for the industry and the adjustment of manpower requirements for individual plants had already taken place. (Government manpower restrictions may also have been a factor causing the low mobility rate of these years.) In 1945 the rate of movement increased

Table 7.--Rate of job changing of molders and coremakers, by year of changes, 1940-52

Year of change	Number of man-years worked	Job changes		Job changes per man-year for:	
		Total	Voluntary only	Total rate	Voluntary rate
Total for period	18,000	2,128	1,378	0.118	0.077
1940	1,213	64	41	.053	.034
1941	1,270	142	105	.112	.083
1942	1,306	145	108	.111	.083
1943	1,325	118	92	.089	.069
1944	1,341	131	98	.098	.073
1945	1,375	192	107	.140	.078
1946	1,510	180	106	.119	.070
1947	1,588	182	116	.115	.073
1948	1,621	187	100	.115	.062
1949	1,621	194	83	.120	.051
1950	1,722	275	185	.160	.107
1951 1/	2,076	318	237	.153	.114

1/ Includes first 2 months of 1952.

sharply as many foundries laid off workers in the re-conversion period immediately following the war. During the first postwar years, the rate of movement was steady. It rose again in 1949 as many men were laid off, and moved to peak levels in 1950 and 1951 when foundry employment expanded to meet the needs of the Korean defense program.

To meet the needs of defense production plants for skilled workers, it is important to have some idea of the extent and level of voluntary job changes. Of the 927 men who changed jobs, 650 or 79 percent, had made one or more voluntary changes. A close relationship existed between economic conditions and voluntary movement of workers in the labor market. During the years when foundry employment was expanding, molders changed jobs of their own accord frequently. On the other hand, when foundry activity was declining, the rate of quits dropped.

An estimate of the amount of voluntary movement likely to occur in the near future can be made by projecting the data obtained in the study. If the frequency of the voluntary movement of the estimated 62,500 molders and coremakers employed in 1952 were the same as that of the 1,800 men in the sample during the 12 years covered by the survey, approximately 4,700 voluntary shifts would be made annually. Since the number of shifts and molders is not identical however (a small number of men may change jobs more than once in a given year) the 4,700 voluntary shifts indicate that roughly 4,000 molders and coremakers would change jobs in this country each year.

Factors Affecting Movement Between Employers - The amount of movement[22] was affected by a number of factors such as age, exposure to the labor force, seniority, home ownership, and military service. Other observable characteristics of the workers such as marital status, education, and race were apparently not related to the propensity of molders to change jobs. There was apparently an inverse relationship between age and the rate of movement; the higher the age, the lower the rate of movement. This relationship is not, however, brought out clearly by an examination of the amount of movement based on a grouping of workers according to their ages at the time of the survey (table 8). Such an analysis results in an

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22/ It was found that the ratio of voluntary to involuntary movement was about the same for all workers no matter how they were grouped, except in a few specific categories. Consequently, most of the tabulations are presented in terms of total movement. The conclusions based on these tables, however, are the same as if the data were for voluntary movement.

Table 8.--Job Changes by Age of Molders and Coremakers at Time of Survey

Age group	All molders and core-makers	Molders and coremakers who changed jobs one or more times		Total number of job changes	Average number of job changes made by --	
		Number	Percent		All molders and coremakers	Molders and coremakers who changed jobs one or more times
All age groups - - -	1,800	827	45.9	2,128	1.2	2.6
19 - 24 years - - -	12	2	16.7	2	.2	1.0
25 - 29 years - - -	83	30	36.1	63	.8	2.1
30 - 34 years - - -	260	108	41.5	291	1.1	2.7
35 - 39 years - - -	250	119	47.6	355	1.4	3.0
40 - 44 years - - -	215	125	58.1	362	1.7	2.9
45 - 49 years - - -	172	89	51.7	250	1.5	2.8
50 - 54 years - - -	186	107	57.5	267	1.4	2.5
55 - 59 years - - -	249	101	40.6	232	.9	2.3
60 - 64 years - - -	215	94	43.7	199	.9	1.7
65 years and over -	158	52	32.9	107	.7	1.0
Under 45 years - - -	820	384	46.8	1,073	1.3	2.8
45 years and over -	980	443	45.2	1,055	1.1	2.4

understatement of the rate of movement of younger workers because many of them did not enter the labor force until after 1940 and consequently did not have the full 12 years in which to make shifts. If however, the amount of movement is related to the number of years worked at given ages, the number of shifts per man-year shows an almost uninterrupted decline as age increases (table 9).[23] Molders as a whole changed jobs about half as often when they were 45 years of age or over as they did when they were younger than 45.

The rate at which molders and coremakers changed jobs was also affected by their status as homeowners. The 916 men who were homeowners at the time of the survey had made an average of 1.1 percent shifts each, compared with an average of 1.3 shifts each for the 876 men who did not own homes. However, analysis of homeownership status at the time of job shift showed that nonhomeowners made significantly more job changes per man-year worked than did homeowners (table E-8).

Mobility of molders was not significantly affected by such personal characteristics as marital status, education, race, or nativity. The differences in mobility that did appear could be attributed primarily to age.

Grouping molders by the number of months they were in the labor force in the period covered by the survey showed differences

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23/ A comparison of tables 8 and 9 illustrates the difference between the two methods of analysis. Table 8 shows that a total of 65 shifts were made by the 95 workers who were less than 30 years of age when interviewed, an average of 0.7 shifts each. The table also shows that the 373 men who were more than 60 years old when interviewed had made 306 shifts, an average of about 0.8 shifts each. Thus, the impression is given that the rate of mobility was almost the same for both groups. However, when the analysis is made in terms of the ages which these men had attained when they changed jobs, a different picture emerges. As table 9 shows, 344 shifts were made over the 12-year period by workers who were under 30 years of age when they shifted. During the same 12 years, these men had worked a total of 2,143 man-years while they were under 30 years of age. Thus, molders as a whole, when in this age group, averaged 0.164 shifts per year. The table also shows that 110 shifts were made when workers were 60 years old or more and that 1,676 man-years were worked at these ages. The average number of shifts for the upper age bracket was 0.065 per year. Thus, this analysis indicates that molders were two and one-half times as mobile in their younger years than when they approached the end of their working lives.

Table 9.--Job Changes of Molders and Coremakers, by Age at Time of Change, 1940-52

Age	Number of job changes made by men at specified ages	Number of man-years worked during period, by men at specified ages	Job changes per man-year made by men at specified ages
All ages - - - - - - -	2,128	18,000	0.118
19 - 24 years - - -	61	488	.125
25 - 29 years - - -	283	1,655	.171
30 - 34 years - - -	384	2,430	.158
35 - 39 years - - -	363	2,266	.160
40 - 44 years - - -	282	2,156	.131
45 - 49 years - - -	264	2,468	.107
50 - 54 years - - -	208	2,672	.078
55 - 59 years - - -	173	2,189	.079
60 - 64 years - - -	82	1,204	.068
65 - 79 years - - -	28	472	.059
Under 45 years - - -	1,373	8,995	.153
Over 45 years - - -	755	9,005	.084

in mobility. Workers with fewer months in the labor force after qualifying as molders made proportionately more job changes in relation to the length of their work experience. Much of this difference, however, is accounted for by age, since the workers with fewest years in the labor force as molders are also likely to be be the youngest. Another factor contributing to this relationship was military service. Some of the workers were qualified molders when they entered the military service. Since the time spent in the service was subtracted from their potential time in the civilian labor force, the number of years these men spent in the trade during the 12-year period was relatively low. In general, these veterans made more job shifts than the average for the entire group. Upon returning to civilian life, many veterans tried work in nonfoundry employment before they returned to work as molders. Similarly, other men on being separated from the service, did not go back to their old jobs but found new jobs as molders. The combined effect of this "readjustment" period and of the generally shorter time spent by veterans in the civilian labor force resulted in the highest rate of mobility being found among men whose careers as molders were interrupted by service in the Armed Forces.

Molders' awareness of seniority provisions apparently contributed to stability of employment. This was evidenced by the relationship between both the duration of their jobs and reasons they gave for job termination and whether the job was covered by seniority provisions. Of the 1,405 workers in plants with seniority programs at the time of the survey, 57 percent had not changed jobs over the 12-year period, as compared with 44 percent of the men employed in plants without seniority programs. These data relate only to the current status of the men interviewed. In order to determine the effect of seniority provisions on job duration for the entire 12-year period, the workers who changed jobs were asked whether or not each job they had left over the 12-year period had been covered by some seniority program. The average duration of all jobs which had been covered by seniority was 4.3 years as compared with 3.5 years for jobs not under any seniority program (table E-9). Molders, apparently, were also less likely to voluntarily leave jobs on which they had seniority protection. The proportion of jobs under seniority which had been ended by quits was lower than for those jobs which, according to the respondents, were not under seniority programs.

The tendency of workers to change jobs voluntarily was also affected by duration of service. Although length of job duration is closely associated with both age and job seniority, it appears to have an independent effect. The study found that as the duration of the job increased it became less likely that the worker would quit (table E-10). Thus, only 59 percent of jobs held 10 years or more were terminated by quits, whereas 68 percent of jobs lasting 2 years or less were terminated by molders voluntarily.

It is important, in mobilization planning, to be aware of any barriers to interplant movement which may exist. The data indicated no substantial barriers to such movement. Consequently, should different types of foundries expand at varying rates during a mobilization period and thus this situation require some redistribution of molders and coremakers, such readjustments would probably occur fairly smoothly. Molders shifted between captive and independent plants, apparently without much difficulty. Of the 827 men who changed jobs, 375 or 45 percent had worked in both independent and captive shops with interchange of molders in both directions. This is a significant finding since it has been widely assumed that molders who have been trained or whose experience has been largely in captive shops could not adapt to the more varied work of independent foundries.

Perhaps more important than the transferability of molders between captive and independent shops is their ability to work in foundries casting different metals. Changing levels of activity in the foundries usually affect requirements for the various metals differently. It has already been stated that the ability of molders to shift from foundries casting one metal to those specializing in others is important in an orderly transfer of manpower resources during a mobilization period. The data showed that such transfer of molders is possible. Of the 827 men who had changed jobs, 78 percent worked with more than one metal during the 12 years (table E-11). In addition, 34 percent of the 973 men who did not change jobs had also worked with two or more metals, reflecting the great number of foundries which commonly cast two or more metals. Taking the group as a whole, 54 percent had experience with two or more metals. Thus, whichever metal's output is expanded in a mobilization period, there would be an adequate number of proficient molders capable of handling the workload in that metal.

Inasmuch as each of the major unions which organize foundry workers is generally identified with particular types of foundries--AFL with independent shops and the CIO with large captive shops--the movement of molders from one foundry to another frequently entailed shifts between plants organized by different unions or between unionized and nonunionized plants. Molders who changed jobs apparently encountered no difficulties in making such transfers. Of the 827 men who had changed jobs during the 12-year period, 61 percent had moved between plants organized by one union to plants organized by another or between unionized and nonunionized shops.

Movement Between Geographic Areas - There was relatively little geographic movement by the molders interviewed. Only about

10 percent of the 1,800 men reported changing their city[24] of employment during the 12-year period covered by the work histories and and these men averaged only 1.8 moves each. Well over half of those who had changed their cities of employment moved only once, and 4 out of 5 had made only one or two locational moves.

The low rate of geographic mobility was also apparent from examination of the entire work histories of the 1,800 men. Seventy-five percent of the group were still working in the cities in which they had qualified as journeymen. Furthermore, most of the men who had moved into the survey cities had come from other localities within the same major geographic region.[25] Thus, 85 percent of the group were working in the regions within which they had learned the trade (table E-12). Only in New York and Los Angeles was there any substantial in-migration. In the case of New York, 26 percent of the 260 workers interviewed had been trained outside the metropolitan area and half of these in-migrants were trained in Europe. Los Angeles drew a third of its molders from areas outside California.

The other six survey cities had drawn relatively few workers from outside the major geographic regions in which they were located. However, the number of workers moving into each city from other points in the same region varied considerably. For example, almost all of the workers in Pittsburgh had been trained within the city. On the other hand, nearly a fifth of the molders working in Philadelphia had qualified as journeymen in other localities in the Middle Atlantic region and had subsequently moved into Philadelphia.

Following the pattern found for all job changes, younger workers changed their city of employment relatively more often than older men. Twelve percent of the molders under 45 years made geographic transfers, averaging 2.0 shifts each; this compared with 8 percent of the men 45 years of age and older who changed their areas of employment and who made an average of 1.6 such changes each.

Geographic mobility was also affected by marital status. During the 12-year period, men not married at the time of job changes made about 70 percent more geographic changes per man-year worked than did married men (table E-13). Even greater

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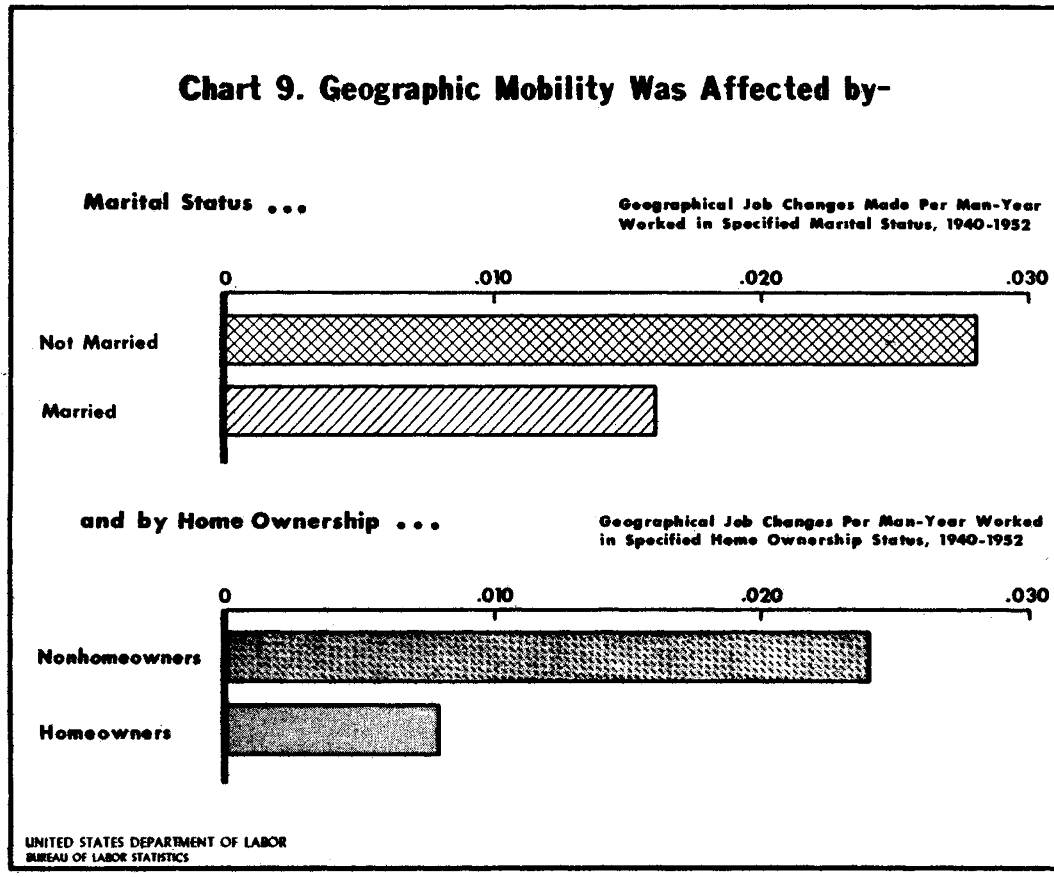
24/ "City" was defined as standard Census metropolitan area. See Methodology, footnote 33, p. 63.

25/ "Region," as used in this study, corresponds to standard Census geographic dividion, i.e., New England, Middle Atlantic, Pacific, etc.



differences in geographic mobility rates were found between homeowners and nonhomeowners. Thirteen percent of the men who were not homeowners when interviewed had made job changes involving changing the area of employment as compared with 7 percent of the homeowners. When the movement of these workers was adjusted for the time in the labor force in the given status, it was found that nonhomeowners made three times as many moves per year worked as did homeowners (table E-14). Nonhomeowners also made 70 percent of all shifts, but 83 percent of the shifts between geographic areas.

Worker Motivation in Changing Jobs - An essential part of any study of labor mobility is a consideration of worker motivation in making job changes. Economic theorists are interested in testing the assumption that the behavior of workers is rational, informed, and calculated. Manpower planners are concerned with the process of job choice in order to evaluate alternative programs for facilitating the flow of workers to the plants where they are most needed during mobilization.

This study attempted to examine worker motivation by asking the molders who had changed jobs during the 12-year period to explain why they made each job change. Specifically, the workers were asked to explain two aspects of their shifting; why they left their old jobs and why they took their new positions. The form of the questions was designed to obtain some insight into the labor market behavior of this group of workers. Specifically, why do molders quit jobs? Do they generally have job offers when they quit? Will the same inducements which persuade men to quit jobs and enter the labor market operate to guide workers to the jobs where they are needed?

The consistency of worker motivation was also explored by this technique. That is, if it is known that workers typically quit jobs for a specific set of reasons, can it be assumed that they will be attracted to their next places of employment for the same reasons? For example, if an individual says that he left a plant because of undesirable working conditions, can it be assumed that improved working conditions will be the principal criterion by which he judges possible new jobs? Or does the worker upon entering the labor market evaluate each possible new job in terms of a rather fixed scale of values he has built up for the purpose of determining the desirability of proffered employment?

Reasons given by molders for leaving jobs were grouped as either voluntary or involuntary. Involuntary job changes were those made for reasons beyond the control of the individual worker. Included in this group were those job terminations resulting from layoff, ill health, or discharge.

Of the 2,128 job changes, about two-thirds were voluntary. These voluntary reasons were classified according to the worker's reported motivation. "Monetary considerations" were given as explanation for 30 percent of the quits (table 10). Included in this group were job changes made to obtain higher hourly wage rates, higher piece rates, better weekly earnings, and those in which the individual reported that he "got a better job," "advanced himself," or "was promoted." Although it is not necessarily true that "better jobs," "promotion," or "advancement" involved more money, a sub-sampling of these answers indicated that almost invariably molders and coremakers referred to higher earnings when they talked of a "better deal." "Advancement" often referred to job shifts which involved getting better piece rate standards or in some cases getting jobs with overtime at premium pay or promotion to a supervisory job.

An additional 14 percent of the explanations for voluntary job exits were closely related to "monetary considerations" but were

Table 10.--Job changes of molders and coremakers by nature of change and reason for leaving, 1940-52

Reason for leaving job	All jobs	
	Number	Percent
All reasons	2,128	100.0
Voluntary	1,378	64.8
Involuntary	734	34.5
Reason not reported	16	.7
Voluntary job exits	1,378	100.0
Wages	278	20.2
Advancement	136	9.9
Insufficient work	193	14.2
Working conditions	154	11.2
Fairness of treatment . . .	104	7.5
Location of plant	63	4.6
Return to trade	57	4.1
Return to former employer .	49	3.6
Move to another area . . .	91	6.6
Miscellaneous	250	18.1

classified as "insufficient work." These were changes made because of substandard total earnings resulting from a short workweek. Many workers reported that they had quit jobs because "the work was slack" or "wasn't getting enough hours" or because "only three days a week." Although for some purposes job changes made for this reason might be considered the same as those made for better pay, in the sense that both relate to total earnings, there is an important difference between the two groups. Job chan ges made because of slack work or a short workweek are to some extent involuntary. Decreases in take-home pay caused by a short workweek put considerable pressure on a worker to find another job. A decline in the workweek may also lead to the fear of an impending layoff, inducing workers who had previously been quite satisfied with their jobs to look around for new positions. Because of this important difference the two groups have been maintained separately. Nevertheless, if one should attempt to answer the question as to how much movement was directly related to monetary considerations, the two groups could be combined and it could be said that 44 percent of the quits made over these 12 years were for monetary reasons.

Twenty-three percent of job exits were made because of a variety of job-connected reasons which were grouped under the heading "nonmonetary job considerations." Included under this heading were 154 job changes made because of working conditions in the plant or objectionable or undesirable hours of work. Another cateogry was "location of the job," which included 63 job changes made because the plant was too far from home or because of transportation difficulties. Personal difficulties with supervisors was given as the explanation for 104 quits.

Forty-nine job changes were made because workers wanted to return to former employers, had been contacted by former employers, or had heard of openings in shops where they had previously worked. In 57 cases, men working outside of the occupation indicated they quit their job so that they might return to work as molders. These two groups were maintained separately because of the difficulty in determining the motivation for the change. It may be generally assumed that these workers made the change because they thought they were bettering themselves It is not known, however, whether this betterment involved increases in pay, responsibility, prestige, better working conditions, better personal treatment, or simply a desire to return to more familiar surroundings and work habits.

A relatively small number of job changes (91) were made because the workers wished to move to other geographic areas. This group was classified separately because of the comparatively small amount of inter-area movement found by the study and the importance of this response as an explanation of inter-area movement.

A miscellaneous classification covering 18 percent of the voluntary changes included all reasons which were of minor importance because of the few times they were reported or which were not generally classifiable. In the first class were included such responses as "strike at the plant," "liked working with gray iron," and "just needed a change." In the second class were such reasons as "wife trouble," "wanted to work with my son," "go into defense work," and "payroll check bounced."

Layoffs were by far the reason most often given for involuntary job exits (table 10). Six hundred and ten of the 734 involuntary changes were reported made for this reason. In only 16 cases did the workers report they had been discharged. Other reasons given were failure of the individual's own business, bad health, refusal of the employer to reemploy the individual after return from military service, or closing of the firm while the worker was in the service.

As stated above, the objectives of this analysis of reasons for changing jobs included the estimation of the consistency of worker response and the drawing of some conclusions as to whether molders and coremakers usually have new jobs in hand when they change employers. In order to accomplish these aims the reasons given by the workers for entering new jobs were classified, in general, in groupings paralleling those given for job exits.

Of the 2,128 jobs entered during the period, in less than one-half of the cases did the workers give specific reasons for taking these jobs. Generally speaking, when reasons for taking new jobs were given, it appeared that the same influences which caused molders to leave their old jobs also attracted them to new jobs (table 11). Fifty-four percent of the job entrances for which specific reasons were given were made for wages or advancement. About 20 percent were taken for reasons grouped as "nonmonetary job considerations." (Like the grouping of reasons for job quits, this group included job changes made because of working conditions and transportation difficulties.) In some respects, however, pairing of a given reason for terminating employment with a similar reason for accepting a new position was clearly not possible. Although a considerable number of jobs were quit because of personal difficulties, no worker reported explicitly that he entered a new job because he felt he could get along with the boss or for a similar reason. (Some of the cases in which the molders "returned to former employers," however, may imply this motive.)

In more than half of the 2,128 new jobs taken, it was not possible to determine the workers' motivation. Of these job entries, 695 were explained as being "the first job available" or "the only job I could find." Such explanations might indicate that the worker, having left his old job either of his own accord or involuntarily, had shopped around for a new position. After some period of searching, the need for current income impelled him to take a job. It might be assumed that the kinds of jobs available to him were so limited that being under pressure to find employment, he took the best of an unsatisfactory lot. On the other hand, it might be assumed that when molders said "took first job available," they meant that they had located a new job which did not have the objectionable features which caused them to leave their old jobs, and met their minimum standards for a job. For example, if a worker reported that he quit a job

Table 11.--Reasons given by molders and coremakers for taking new jobs, 1940-52

Reason given for taking job	Number	Percent	Percent
All job changes	2,128	100.0	
Job entries for which motivation could be classified	906	42.6	100.0
Wages	323		35.7
Advancement and promotion	169		18.6
More work (slack at job left) . .	87		9.6
Working conditions	78		8.6
Location of plant	97		10.7
Miscellaneous	152		16.8
Job entries for which no motivation could be classified .	1,222	57.4	100.0
First job available	695		56.9
Informed of job by friend or in some other way	3,364		29.8
To return to former employer . .	102		8.3
To return to molding	61		5.0

because "it was too far from home" and also stated that he "took the first thing that came along," it might be logically held that he meant "I took the first job which came along which was close to home and which met my other standards for a job." Because of the uncertainty of interpretation, no attempt has been made to draw conclusions concerning worker motivations from these rather ambiguous data. Ir was; however, concluded that this class of answer indicated that the movement of the workers was not from job to job directly, but rather from employment then to the labor market for a period of job shopping and thence once again to a job.

In another 364 cases, the workers did not indicate why they chose a particular job, but reported how they learned of it. Usually they reported that friends or members of their families had told them of the jobs. Some men reported that foremen or managers of plants had contacted them. A very small number indicated that a public or private employment service had referred them to the employer. These responses also shed little light on worker motivation. However, it can be assumed with certainty that the 190 men who found their next jobs through employment services or other agenices were job hunting before they were referred to their next employers. In addition, it can also be assumed that some of the men who learned of jobs through friends probably took the initiative in contacting their friends because they were already without work and looking for jobs.

These two groups taken togetner -- those cases where the "first job available" was taken and those cases where the workers reported how they learned of new jobs -- indicate that in a high proportion of the job changes the worker had been looking for a job. That is, the worker spent some time in the labor market in an unattached status, rather than moving from one job directly to another. The fact that this pattern of movement was manifested in so large a proportion of the job changes made by the men in this occupation has important implications for manpower planning. It indicates that the task of manpower administrators in attempting to redistribute the force of molders and coremakers through any particular program of incentives may be easier than might be expected. That is, many molders can apparently be counted to appear in the labor market as job hunters without the necessity of action on the part of manpower officials. Thus the problem of reallocating the supply of molders, to the extent it may be necessary, becomes, to a substantial degree, one of directing the movement of workers already looking for jobs, rather than of inducing employed molders to change their places of employment.

Methodology of the Survey

Scope of Survey

This report on the mobility of molders and coremakers is based on information obtained from 1,800 journeymen molders and coremakers selected from the payrolls of 195 foundry establishments located in eight metropolitan areas. At the time of the survey, January-February 1952, an estimated 30 percent of the hand molders and coremakers in the United States worked in these eight areas. The 1,800 interviewed workers represented about 3 percent of the national total for the occupation and approximately 10 percent of the total number located in the eight metropolitan areas included in the sample.[26]

The Sample

In selecting the cities in which the study was to be made, the major metropolitan areas of the United States were arrayed in order of estimated molder and coremaker employment and the seven largest; Chicago, Cleveland, Detroit, Los Angeles, New York, Philadelphia, and Pittsburgh, were included in the sample. Boston, although it had fewer of these workers than several other areas, was added to the sample to provide a better balanced geographical representation by including a New England city. The sample was limited to eight metropolitan areas because of cost limitations.

Although the selection of cities was intended to generally represent the major geographic areas in which molders and coremakers are employed, the sample was designed to yield a representative industrial distribution of the members of the occupation for the eight cities. Analysis of the universe data for these eight metropolitan areas indicated that their foundry composition was essentially similar to that nationally. For all practical purposes, therefore, the sample drawn from these ares may be considered to be representative of the national distribution of molders and coremakers, by type of foundry; independent foundries by type of metal, and captive foundries by industry affiliation.

A listing of plants including about 1,300 establishments and believed to cover virtually all of the sand-casting foundries in the eight cities was used as the universe listing. Previous studies of the foundry industry and its occupations made by the Bureau of Labor Statistics had indicated a number of factors such as size and

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26/ See table E-15 for details of city distribution of sample.

organization of the foundry which might affect the mobility, training, and work histories of men in the occupation. These factors were considered and the establishment were placed in random order in 15 cells, stratified as follows:

Stratum I Independent foundries

A. Ferrous foundries

1. 1 - 50 production workers
2. 51 - 250 production workers
3. 251 - and over production workers

B. Nonferrous foundries

1. 1 - 50 production workers
2. 51 - 250 production workers
3. 251 - and over production workers

Stratum II Captive foundries

A. SIC 34[27] Fabricated metal products
1. 1 - 50 production workers
2. 51 - 250 production workers
3. 251 - and over production workers

B. SIC 35 - Machinery, except electrical
1. 1 - 50 production workers
2. 51 - 250 production workers
3. 251 - and over production workers

C. All other industries

1. 1 - 50 production workers
2. 51 - 250 production workers
3. 251 - and over production workers

The number of molders and coremakers employed in each plant was estimated from data available in the Bureau of Labor Statistics and from other sources. Varying sample ratios were applied to the 15 cells. For the foundries employing more than 250 workers, 1 out of every 2 plants in each cell was selected; from those employing

27/ Standard Industrial Classification Manual, U. S. Bureau of the Budget, November 1945.

between 51 and 250, 1 out of 5; and among plants which employed less than 50, the sampling ratio was 1 out of 10.

Molders to be interviewed were selected from each plant, using ratios which depended upon the sampling ratio used in selecting the plant from its cell. In the large plants which had been selected on the basis of 1 out of every 2 plants, the workers were selected at random from the payrolls on a 1 to 5 ratio. Thus, the overall sampling ratio for workers in large plants was 1 out of 10. In the medium-size plants where the sampling ratio had been 1 in 5, a ratio of 1 of 2 was used in selecting employees' names from the records; and in the smallest plants which had been selected on a 1-out-of-10 basis, all molders' names were taken. This method of combining varying sampling ratios for plants and workers resulted in giving each worker a weight of 1. Varying the ratios in this manner also reduced the number of small plants in the sample, lowering plant visit costs substantially.

Provision was made for nonresponse or for lack of plant cooperation by drawing a reserve sample from the original list of plants minus the ones selected for the first sample. These reserve plants were used as substitutes for those which did not participate in the survey. An alternative list of workers was similarly selected to allow for refusals, inaccessible addresses, or failure to locate workers.

Workers Interviewed

The sample was selected in such a way that only qualified workers in this occupation were included. The names of molders and coremakers were selected by field agents of the Bureau of Labor Statistics from payroll records of the foundries. The field agents checked the employers' job descriptions for these workers against a standard job description.[28] Each individual interviewed described his current job duties. This method of sample selection and screening permitted the elimination of trainees, molding machine operators, and other persons who were not qualified journeymen, but whose names might have been inadvertently selected from the employers' payrolls. It insured a more precise occupational classification than is possible in a household enumeration survey, in which the occupational classification is made on the basis of statements of individual workers or members of the household which can be verified only indirectly.

The sample was drawn from journeymen molders and coremakers,[28] including those employed as foremen. It did not include

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28/ See Appendix, p. 80, for definition of occupation used in collecting the data.

machine molders or apprentices and other trainees, although a molder currently working on a molding machine was not excluded if his previous experience included a completed apprenticeship or at least 6 months' work as a hand molder at hand molders' wages. In drawing the sample, molding and coremaking were considered as one occupation. That is, the type of training, skill level, and type of work were assumed to be the same for both molders and coremakers.

In the body of the report the designation "molders" is used frequently to identify both molders and coremakers. In the coding and processing of the data each occupation was coded separately so that identification was possible at all times. In cases where the findings regarding molders were different from those of coremakers, specific reference has been made to that fact. In all other cases it can be assumed that molders and coremakers are included in the generic expression "molder" and that the findings were the same for both groups.

No attempt was made to stratify the sample by race[29] and sex. It was assumed that random sampling within each cell would insure the drawing of a representative racial distribution. Tabulations showed that only 19 women, all employed as coremakers, were included in the 1,800 workers interviewed. Because of their small number, no attempt was made to analyze the work histories or backgrounds of the women separately from those of the male workers.

29/ In the analysis the data reported by the 79 workers who stated they were of Mexican origin were in most cases grouped with that reported by the Negroes. (All 79 of the men of Mexican origin were working in the Los Angeles areas.) In general, Mexicans in Los Angeles occupy a place in the social structure similar to that of the Negro in many other large cities. The data of the survey also indicated the comparability of the two groups as a sociological class. For example, of the white molders, 65.4 percent had completed 8 years of schooling; of the Negroes, 56.7 percent; and of the Mexican, 55.7 percent. The data on entry patterns show that employment barriers into this occupation were reduced for Mexicans and Negroes at much the same rate in the last 25 years. In view of their similar backgrounds, the two groups were treated together. This grouping was altogether one of convenience and was not intended, in any sense, to be a biological, ethnic, or racial designation.

Data Collection Methods

Each molder was interviewed in his home by a field agent of the Bureau of Labor Statistics, using a specially designed questionnaire.[30] Each worker reported his complete work history from January 1940 through February 1952. A complete record of training was also obtained from each worker, including the method, duration, and the type and location of the foundry in which he was trained.

The schedule also included questions relating to entry into the occupation and factors influencing workers to select this occupation. Data concerning personal characteristics of the worker included age, marital status, number of dependents, place of birth, military service, homeownership, and race.

For each of the 195 plants from which a sampling of molders was taken, a special questionnaire[31] was filled out at the same time as the names of individual workers were selected. In addition to requesting information concerning type of foundry, number of foundry production workers, and number of molders and coremakers employed, the plant questionnaire called for data on personnel and training practices, both in 1952 and during World War II. It also sought data on the types of product made by the foundries and methods of production because of their possible effect on the employment and utilization of hand molders and coremakers. These data supplied background information which aided the interpretation of the training and work experience of the workers; it also permitted some check on the accuracy of individual worker responses. In addition, the data provided the means for confirming the preliminary estimates of the number of workers in the occupation and their distribution among the various types of foundries.

Types of Movement Analyzed

The primary emphasis in this study of the mobility of molders and coremakers was upon the supply and availability of these workers during a mobilization period. For this reason, the work histories of these individuals prior to the time they qualified as molders were not

30/ See Appendix, p. 83, for copy of this questionnaire.
31/ See Appendix, p. 83, for copy of this questionnaire.

considered in the development of measures of the movement of journeymen in the labor market.[32]

One important consideration in mobility analysis is a measurement of the flexibility of the work force in a specific occupation. The work histories of molders and coremakers were examined, therefore, to determine whether they had certain types of work experience which are manifestations of this flexibility. The analyses covered work experience in captive and/or independent foundries; experience with different kinds of metal cast in the foundries in which the individual had worked; and movement between plants affiliated with different unions.

When a worker changes jobs, more than one type of movement is often involved, such as a change in employer, occupation, industry of employment, or area of employment. In order to analyze separately the various kinds of movement involved in shifts made by molders, to determine typical combinations, and to identify the characteristics associated with each kind of shift, each job change was identified as including one or more types of movement: between employers, between occupations, between foundry and non-foundry employment, and between geographic areas. Movement between employers was defined as a job transfer from one establishment to another. Other types of mobility such as movement in and out of the labor force or in and out of the civilian labor force were not identified separately. They were tabulated only to the extent that they coincided with shifts between employers. For example, if a man left an employer to go into military service the change was counted as a job shift only if the worker's next job was with a new employer. It was not a shift if he returned immediately to the same employer after separation from the Armed Forces. Similarly, movement to and from unemployment, was counted only if a change of employers was also involved.

32/ On the other hand, the movement of workers upward through the hierarchy of occupations and the accompanying acquisition and development of skills is, however, another important aspect of mobility. Investigation of the work histories prior to qualification as journeymen was especially pertinent in this study in view of the large proportion of molders who became journeymen without formal training. For these workers, the years of their working lives prior to their first jobs as molders were actually their training periods. In order to trace and measure the process of qualification for such workers, the men interviewed were requested to report information on their early working lives. Data was obtained on such important phases as the periods of entry into the labor market, entry into foundry work, and the duration of training.

Occupational movement was defined as a shift from one job classification to another; that is, from molding (or coremaking) to some other occupation, or vice versa, regardless of whether a shift of employer was involved. Changes involving movement between hand molding and coremaking jobs were not treated as involving changes in occupation. However, moves from hand molding to machine molding were considered occupational shifts, as were shifts between two nonmolding occupations.

An important aspect of the supply of skilled manpower is the extent to which it is effectively utilized. Movement of molders out of the occupation may involve the utilization of these skilled workers in jobs requiring lesser skills. Such movement was identified by coding job changes involving changes in occupation to show movement from a molding job to a nonmolding job, between two nonmolding jobs, and from work outside the trade back to molding. The nonmolding jobs were classified by occupational skill group. The extent to which molders were lost to the foundries was gaged by measuring the periods spent in jobs outside molding and relating them to total available time in the labor force. The extent to which manpower resources were under-utilized was measured by determining what proportion of this "lost time" was in semiskilled or unskilled work.

Because of their status in the market, independent plants are likely to be jobbing shops and are likely to require a relatively large proportion of skilled workers. Captive foundries typically employ relatively larger proportions of semiskilled and unskilled workers. To the extent that the work methods and skill requirements of the two types of foundries differ, the amount of movement between them measures the flexibility of the group as a whole and indicates in which direction such shifting is more readily accomplished.

Movement between geographic areas was defined as a change of employment from one city to another, or movement between cities[33] and other parts of the same geographic region.

"Movement between metals" was defined as the type of shift in which the worker shifted between foundries casting different metals. Foundries usually work predominantly with one metal and may therefore be classified by this characteristic. The types of

33/ "Cities were defined as standard Census metropolitan areas because it is believed that they correspond roughly to the local labor markets, the areas within which it is customary for workers to commute to plants located in the central city or its suburbs. "Region," as defined in this study, corresponds to standard Census geographic divisions such as New England and Middle Atlantic.

metal identified were the three major ferrous metals cast; gray iron, malleable iron, and steel. In the nonferrous group, copper and copper alloys, aluminum, and magnesium were coded separately. Inasmuch as the demand for each type of metal may vary, transferability of men from shops casting one type of metal to another is basic to efficient utilization of these workers within a minimum "breaking in" or readjustment period.

Measurement of Movement and Factors Related to It

Mobility of a group of workers may be measured by two standards--the proportion of the group which is mobile and the rate of movement. Those men who changed jobs at any time during the period studied after qualifying in the trade constituted the mobile group. The rate of mobility was measured by the frequency of movement either for the entire group or for the mobile portion. Frequency of movement in a given period may be measured in terms of total number of jobs held, average duration of job, or average number of shifts. In this study, the average number of shifts has generally been the measure used. Both standards are important in describing the movement of workers. The proportion of the whole which the mobile group accounted for measured the likelihood of job changes being made by any member of the group. To manpower authorities or to individual employers, it indicated the probability that any individual molder or particular groups of molders will change jobs. The rate of mobility indicated how much a given type of movement will occur in a specific time period.

The analysis of factors affecting mobility or associated with it has generally been conducted in terms of the characteristics of workers at the time the information was collected. While this technique may be broadly satisfactory, its use in analysis covering any extended time period is subject to the criticism that it is, in effect, a process of imputation. Under this technique, particular characteristics in the current period are related to the behavior of the individual in the past, thus implicitly assuming that the individual has remained unchanged throughout the period. For example, one may attempt to measure the effect of marital status on mobility by tabulating the average number of shifts per worker by marital status at the time of the survey. The result of such a tabulation might indicate that married men made more moves than single workers. It would not, however, indicate whether or not the men who shifted were married or single at the time they moved. Hence such a tabulation would not indicate conclusively the effect of marriage on mobility.

In order to arrive at a more exact determination of the influence of particular personal characteristics and of work experience on the amount of movement, much of the analysis in this report is in terms of the status of each worker at the time of each move he made. When a specific job change was recorded, the status (married, homeowner, etc.) of the worker at the time of the change was also identified.[34] Next, the years spent in each status and the number of job changes which occurred when the worker was in that status were totaled; it was then possible to compute a rate of job changing per year in a given status. For example, the rate of movement per year for the time the worker was single could be compared with the rate for the period during which the worker was married. An illustration may make this clear. Consider the hypothetical case of 100 workers over a 2-year period. Assume that in the first year all of the workers were single and that they made 200 moves. On January 1 of the second year, 50 of the workers married and during the year, each of these 50 married men changed jobs once, making a total of 50 job changes. During the same year, the 50 single men made 100 job changes. Thus, for the 2-year period, a total of 350 moves were made. In 300 cases, the workers were single at the time they changed jobs; in 50 cases the men were married when they shifted. During the 2-year period, a total of 200 man-years were worked; 150 were worked in an unmarried status and 50 in a married status. The adjusted mobility rate for married men is 1.0 shifts per man-year worked (50 shifts divided by 50 man-years); for single men the rate is 2.0 shifts per man-year worked (300 moves divided by 150 man-years). All other things being equal, the conclusion, therefore, is that single men are more mobile than married men.

It has been suggested that the mobility of workers is affected by certain aspects of their work experience. One hypothesis is that seniority inhibits movement; that a worker on a job covered by seniority provisions is more reluctant to change jobs than a man whose job security is not so protected. To test this theory, each worker was asked whether he knew if each job which he had held had been covered by a seniority program. The duration of each

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34/ The mechanics of this procedure may be of interest. An IBM card was prepared from the questionnaire of each worker. The IBM layout form for this card is presented on p. 89. In addition, for each job, other than that currently held, an "excess card" was prepared. See p. 90 for the IBM layout form for this card. On the excess card, by means of special tabulating procedures and auxiliary coding, information referring specifically to that job and to selected personal characteristics of the worker at the time the job change took place was punched. These data are contained in columns 16-37 and columns 64-68. Some additional information was transferred from the primary card to each job change card, permitting analysis of factors which it was thought might affect mobility. These transcribed data are contained in columns 39-63 and column 69.

job was also coded. From these data, tabulations were prepared showing the average duration of covered jobs as compared to those without seniority coverage. Since these data could be used in conjunction with the information on the workers' age at the time of each job change, it was possible to eliminate the effect of age in drawing conclusions about the effects of seniority on job duration and hence mobility.

Statistical Reliability

A basic problem involved in any study based on a sample rather than on the complete universe is the extent to which the sample selected reflects the characteristics of the universe itself. In this study the problem is of particular importance due to the fact that the method of sample selection was rather complex. Since this was a two-stage cluster sample rather than an unrestricted random sample, the usual statistical tests of reliability could not be applied. The specific formulas used for determining the sampling variances of the four types of estimates derived from the survey data are discussed in a statistical note (pp. 69-79). The reliability of selected estimates of each type is also shown in this note. The sampling error for these examples appeared to be acceptable and it was assumed that comparable degrees of reliability would be obtained for other estimates of each type, without actually computing these measures of reliability in every case.

The testing of the statistical significance of the differences between estimates is illustrated in the statistical note by the use of two formal tests. Here too, because of the work involved, these tests were not applied to each set of observations. Instead, another form of the Chi-square test was used. While the use of the test in this form was not strictly applicable to a sample of this nature, it is not believed that the results obtained varied greatly from those which would have been derived from the use of the more appropriate measures discussed in the statistical note.

Limitations of the Study

One problem in studies based upon interviews is the accuracy of responses made by individuals. Investigations of the reliability of worker responses has shown that work histories of skilled workers obtained by personal interview are by and large reliable.[35]

35/ See, for example, The Reliability of Response in Labor Market Inquiries, by Gladys L. Palmer, Technical Paper No. 22, U. S. Bureau of the Budget, Division of Statistical Standards, July 1942; and Validity of Work Histories Obtained by Interviews, by Elizabeth Keating and C. Harold Stone, Industrial Relations Center, University of Minnesota.

In addition, the questionnaire used in this survey afforded the opportunity to make some internal checks of the consistency of the workers' answers. For example, the year of the first full-time job was checked against the year of the first job in a foundry, and answers given in the section on training were compared with information reported in the work history.

On the other hand, it is believed that the reliability and completeness of the workers' explanations of their motivation for movement from job to job are probably lower than for the data as a whole. It must be recognized that the answers given by the respondents to this question were highly subjective in nature. No check on the accuracy of the worker's explanation of his reasons for leaving a specific job was possible. The extent to which the answers obtained are invalidated by the respondent's misunderstanding of the question is not known, although, as indicated previously, many workers did not give reasons for changing jobs but instead indicated how they got their next job or the source of their labor market information. It is also possible that in many cases the workers confused two or more jobs, forgot the details involved in the job change, or attempted to rationalize a course of action, the motivation of which was not entirely clear to the individual himself. In some cases, also, attempts may have been made to actually conceal the real motivation or causations of job changes. With these limitations in mind, it should also be considered that the distribution of the reasons given by these workers for changing jobs appeared to be generally similar to the results of other studies in this field.

A more general limitation is imposed by the nature of the study itself. The use of the retrospective interview technique, limited to men working in the occupation at the time of the survey, assures a homogeneous sample but restricts the scope of conclusions. The conclusions offered can apply only to the molder and coremaker work force as it was constituted at the time the sample was drawn. Those men working outside the occupation for any reason and those unemployed or temporarily out of the labor force could not have been included in the sample. If the work experience and personal characteristics of these workers should be significantly different from those interviewed in the survey, their exclusion may have resulted in an incomplete or distorted view of the workers in this occupation. The extent to which this is true and the extent to which failure to include the workers has biased the study could only be determined by a follow-up study covering these workers.

The likelihood of substantial numbers of workers taking jobs outside their usual occupation depends, to a large extent, on the availability of jobs in that field, the general desirability of the occupation, and ability of workers in the trade to transfer to other fields of work with comparable earnings. In the study of tool and die makers,[36] the probability of bias because of the exclusion of tool and die makers working in other fields was regarded as small. This was so because tool and die making carries great social prestige among manual workers and pays relatively well. Moreover, tool and die making jobs were readily available during the period of the study, and other jobs which tool and die makers could transfer to at comparable or higher earnings were limited.

In the case of molders and coremakers, however, it appears somewhat more likely that qualified journeymen were working outside the trade at the time of the survey. While it is true that molders were in short supply in early 1952, that qualified workers could easily find jobs, that wages of molders are comparable to those of other skilled workers, and that it is even more true of molders that they have little transferability to other well paying occupations, other factors indicate that an any given time some proportion of qualified workers would be in other fields. For example, molders do not rank high on the prestige scale of skilled workers. In large part this is due to less desirable working conditions which formerly characterized foundry work. Although great improvements have been made in foundry conditions, the "standing" of the occupation has not substantially increased. A further indication that some qualified workers may be outside molding is the finding that in two periods of foundry expansion which occurred during the 12-year study numbers of qualified journeymen returned to the field from other trades of work. This probably can be explained by the fact that there have been periods when molding jobs were hard to get, such as in 1938-39 and in 1949. However, early 1952, when the study was conducted, was a period of high foundry activity and workers outside the trade could easily have found jobs as molders.

It should be realized that whatever bias may be present in these data as a result of the non-inclusion of men not working in the occupation does not invalidate the manpower implications of the study. The men who were not working as molders in early 1952 were not readily available manpower for the foundry industry. Manpower planning in the foundry field must, therefore, as regards the adoption of programs for the most effective use of manpower in this skilled occupation, concern itself almost entirely with the group of molders represented by the sample studied -- the men who tend to stay in the trade and who will be most readily available in any future mobilization.

36/ The Mobility of Tool and Die Makers, op. cit., p. 21.

APPENDIXES

Appendix A STATISTICAL NOTE*

Four different types of estimate may be obtained from the data collected in this survey, using schedules both from establishments and from individual molders and coremakers.

The first of these is the estimate from plant schedules of an aggregate of some characteristic of the population. Examples of such estimates concerning plants in the survey are the number of hand molders and coremakers in the eight metropolitan areas surveyed, the number of plants in these areas with apprentice training programs, and the total employment in independent or captive foundries in the universe. In this report emphasis has not been placed upon these aggregates - neither sample totals such as the 1,800 molders, nor the implied estimate of 18,000 molders in the universe. For those interested in such figures, however, formulae are included below for estimates of population totals and their sampling variances.

A second type of estimate is that of an estimate of the total of a specified characteristic of the population, as derived from data collected from individual molders and coremakers. As for the first estimate, sample aggregates rather than estimated totals are shown in the report for such characteristics. For example, sample aggregates of this type are the number of shifts made by all molders and the number of man-years in the labor force. In each case, there is an implied estimate for the universe which is 10 times the sample aggregate.

A third type of estimate obtained from data for individual molders and coremakers is an estimate of the ratio of two characteristics in the population, such as the ratio of total number of shifts to total man-years of exposure to shift, or the ratio of total number of shifts to total number of molders who shifted. Thus, this type can be used conveniently to measure quite a variety of averages as well as other ratios.

The fourth type of estimate obtained from the data for molders and coremakers is the proportion of the total which possesses a particular characteristic. For example, the proportions of workers

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* The statistical note was prepared by Office of Statistical Consultant of the Bureau's Division of Manpower and Employment Statistics.

which are classified in each age group are derived from the data for the workers in this study, and the percent of molders making shifts. This type of estimate is actually a particular case of the Type III estimate.

Reliability of Estimates from the Survey

The design of the sample is a stratified one with a two-stage sampling process within each stratum. Each stratum is divided into primary sampling units (or clusters) which are firms classified into the particular stratum. The first stage of sampling is the selection of the primary sampling units and the second stage is the selection of the workers within the primary sampling units. The method of estimation and reliability of such estimates are discussed in terms of this design for the four types of estimate.

Type I Estimate

The first type of estimate is made as follows:

$$X' = \sum_{i=1}^{r} \frac{M_i}{m_i} \sum_{j=1}^{M_i} a_{ij} X_{ij}$$

where

i is the number of the stratum

j is the number of the cluster within the ith stratum

M is the number of plants (clusters) in the universe

m is the number of plants in the sample

X is the measure of the characteristic (for example, the number of molders and coremakers)

a_{ij} is 1 if the plant is included in the sample and O if it is not included.

It will be observed that there is no subsampling in this form of estimate.

The variance of this estimate is as follows:

$$\sigma^2_{X'} = \sum_{i=1}^{r} \frac{M_i^2(M_i - m_i)}{m_i(M_i - 1)} \sigma^2_{X_{ij}}$$

If X is defined as the sample aggregate for this type of estimate, in all cases it will be true that $\dot{X} = \frac{1}{10} X'$ and hence that $\sigma^2_{X'} = 100\,\sigma^2_{\dot{X}}$

Type II Estimate

This type of estimate is made as follows:

$$X' = \sum_{i=1}^{r} \frac{M_i}{m_i} \sum_{j=1}^{M_i} a_{ij} \frac{N_{ij}}{n_{ij}} \sum_{k=1}^{N_{ij}} X_{ijk}\, a_{ijk}$$

where

N is the number of molders in the universe

n is the number of molders in the sample

k is the number of the individual molder

X is the characteristic being measured

a_{ijk} is the conditional probability that the ijkth worker will be in the sample when the ijth plant is in the sample.

The variance of this estimate is as follows:

$$\sigma^2_{X'} = \sum_{i=1}^{r} \frac{M_i}{m_i} \left[\sum_{j=1}^{M_i} \frac{N^2_{ij}(N_{ij} - n_{ij})\sigma^2_{X_{ijk}}}{n_{ij}(N_{ij} - 1)} + \frac{M_i(M_i - m_i)\sigma^2_{X_{ij}}}{M_i - 1} \right]$$

where

$$\sigma^2_{X_{ijk}} = \frac{1}{N_{ij}} \sum_{k=1}^{N_{ij}} X^2_{ijk} - \bar{X}^2_{ij}$$

and

$$\sigma^2_{X_{ij}} = \frac{1}{M_i} \sum_{j=1}^{M_i} X^2_{ij} - \bar{X}^2_{i}$$

Note 1. In the preceding variance formulae, the summations are over the universe rather than the sample. In applying the formulae, it is assumed that average values over the sample are the same as average values over the universe, and sample calculations are inflated accordingly.

Note 2. It may be observed that the Type II estimate could be used to estimate any quantity which is estimated by the Type I estimate, although in general the Type II estimate will have the greater variance. For an estimate of number of molders, the Type II estimate, with $X_{ijk} = 1$ for all values of ijk, yields identical results as does the Type I estimate.

Note 3. The variance formula for Type II estimates is made up of two sets of terms of the form $\sigma^2_{X'} = \sigma^2_W + \sigma^2_B$, where σ^2_W is the contribution to variance of sampling workers within the plants and σ^2_B is the contribution from sampling plants in the cities - the "between-plant" component.

Later in the report an illustration for a Type II estimate - estimated total number of job shifts - is given in which the relative sampling standard deviation is 6.7 percent. Of this, all but 0.1 percent is contributed by σ^2_B. The within-plant variance is almost negligible as compared with the between-plant variance. This suggests that satisfactory approximations to variances of similar quantities can be obtained by assuming that within-plant variances are zero. It also suggests that insofar as statistics similar to "number of shifts" are desired, very small within-plant samples might be employed, with resources being allocated to cover a larger number of plants.

Note 4. As in Type I estimates, we have

$$\sigma^2_{X'} = 100\sigma^2_X$$

Type III Estimate

The third type of estimate is $R' = \frac{X'}{Y'}$, where X' and Y' are estimates of X and Y, two characteristics of the population, and is derived as follows:

$$R' = \frac{\sum\limits_{i=1}^{r} \frac{M_i}{m_i} \sum\limits_{j=1}^{M_i} a_{ij} \frac{N_{ij}}{n_{ij}} \sum\limits_{k=1}^{N_{ij}} X_{ijk}\, a_{ijk}}{\sum\limits_{i=1}^{r} \frac{M_i}{m_i} \sum\limits_{j=1}^{M_i} a_{ij} \frac{N_{ij}}{n_{ij}} \sum\limits_{k=1}^{N_{ij}} Y_{ijk}\, a_{ijk}}$$

If the denominator is a qualitative characteristic indicating possession or not of an attribute, then Y_{ijk} is equal to either one or zero, depending upon whether the individual possesses the characteristic being measured. A special case of this estimate occurs when $Y = N$ in which case R' is an estimate of the mean $\bar{X}' = \frac{X'}{N'}$ (See also type IV, following.).

The approximate variance[37] of the Type III estimate is as follows:

$$\sigma^2_{R'} = \frac{1}{Y^2} \sum_{i=1}^{r} \frac{M_i}{m_i} \left[\sum_{j=1}^{M_i} \frac{N_{ij}^2}{n_{ij}} \frac{(N_{ij} - n_{ij})}{N_{ij} - 1} \sigma^2_{ijk} + \frac{M_i(M_i - m_i)}{M_i - 1} \sigma^2_{ij} \right]$$

where

$$\sigma^2_{ijk} = \sigma^2_{X_{ijk}} + R^2 \sigma^2_{Y_{ijk}} - 2R\, r_{X_{ijk}Y_{ijk}} \sigma_{X_{ijk}} \sigma_{Y_{ijk}}$$

and

$$\sigma^2_{ij} = \sigma^2_{X_{ij}} + R^2 \sigma^2_{Y_{ij}} - 2R\, r_{X_{ij}Y_{ij}} \sigma_{X_{ij}} \sigma_{Y_{ij}}$$

with $\sigma^2_{X_{ij}}$ and $\sigma^2_{X_{ijk}}$ defined as for the Type II estimate and $\sigma^2_{Y_{ij}}$ and $\sigma^2_{Y_{ijk}}$ similarly defined, and with the following definitions:

$$r_{X_{ijk}Y_{ijk}} = \frac{\sum_{k=1}^{N_{ij}} (X_{ijk} - \bar{X}_{ij})(Y_{ijk} - \bar{Y}_{ij})}{N_{ij}\, \sigma_{X_{ijk}}\, \sigma_{Y_{ijk}}}$$

and

$$r_{X_{ij}Y_{ij}} = \sum_{j=1}^{M_i} \frac{(X_{ij} - \bar{X}_i)(Y_{ij} - \bar{Y}_i)}{M_i\, \sigma_{X_{ij}}\, \sigma_{Y_{ij}}}$$

37/ Calculations for the variance of the Type III estimate are based upon the following approximation:

$$S^2_{R'} = \frac{(1 - f)}{Y^2} \sum_{i=1}^{r} \left\{ \frac{m_i}{m_i - 1} \sum_{i=1}^{m_i} \left[(\dot{X}_{ij} - \bar{X}'_i) - R'(\dot{Y}_{ij} - \bar{Y}'_i) \right]^2 \right\}$$

where Y is the sample total, and X_{ij} and Y_{ij} are the sample totals for the ijth plant. The quantity $f = \frac{m_i}{M_i} \cdot \frac{n_{ij}}{N_{ij}}$ is a constant equal to 0.9 in the present design. (See e.g., <u>Sampling Techniques</u>, William G. Cochran, New York; John Wiley and Sons, Inc., 1953, Chapter 11; or <u>Sample Survey Methods and Theory</u>, Morris H. Hansen, William N, Hurwitz, and William G. Madow, New York; John Wiley and Sons, Volume I, Chapter VII.)

where $\bar{X}_i = \frac{X_i}{M_i}$, $\bar{Y}_i = \frac{Y_i}{M_i}$

and $\bar{X}_{ij} = \frac{X_{ij}}{N_{ij}}$ and $\bar{Y}_{ij} = \frac{Y_{ij}}{N_{ij}}$

Observe that there is a difference between $\bar{X}' = \frac{X'}{N'}$, the average number of shifts per molder as calculated from the sample, and $\bar{X}'' = \frac{X'}{N}$—an estimate of average number of shifts per worker which could be obtained by dividing the estimate of total shifts, X', by a known total number of molders (if such a figure were known). The variance of $\bar{X}'$ is less than the variance of $\bar{X}''$.

Type IV Estimate

The fourth type of estimate is derived as follows:

$$p' = \frac{\sum_{i=1}^{r} \frac{M_i}{m_i} \sum_{j=1}^{M_i} a_{ij} \frac{N_{ij}}{n_{ij}} \sum_{k=1}^{N_{ij}} Y_{ijk} a_{ijk}}{N'} ,$$

with N' being the estimated number of molders and p' the estimated proportion of individuals possessing the characteristic being measured. Since this is a ratio estimate of the same general form as Type III estimate, the formula for the variance[38] of the estimate is also of the same general form as for the Type III variance.

38/ Calculations for the variance of this type of estimate were obtained by use of the following approximation:

$$S^2_{p'} = \frac{(1-f)}{\dot{n}^2} \sum_{i=1}^{r} \left\{ \frac{m_i}{m_i - 1} \sum_{j=1}^{m_i} \left[(\dot{X}_{ij} - \bar{X}'_i) - p'(\dot{n}_{ij} - \bar{n}'_i) \right]^2 \right\}$$

where $\dot{n}$, $\dot{n}_i$, and $\dot{n}_{ij}$ are the number in the sample for the particular sample collected for the total, the stratum, and the plants, respectively.

Computation of Reliability of Estimates from the Survey

Calculations of sampling reliability are shown below for an example of each type of estimate.

Type I Estimate

The sample total of 1,800 molders has an absolute error for the 95 percent confidence interval of 76. This means that in 95 out of every 100 possible samples the number of molders interviewed would range from 1,876 to 1,724, depending upon the random choice of establishments for the sample.

Type II Estimate

An example of the sample total for this type of estimate is 2,128 shifts made by all molders in the survey. The absolute error for this sample total is 284 shifts for the 95 percent confidence interval.

Type III Estimate

The reliability of estimates of this type was computed for four different estimates: (1) the average number of shifts made by all molders, (2) the average number of shifts made by molders who shifted, (3) the average number of shifts per man-year, and (4) the average age of molders. The measures of accuracy for the average number of shifts were computed for these statistics for each city as well as the total and are shown in the following table for the 95 percent confidence interval:

Average number of shifts

City	All molders		Molders who shifted	
	Average number of shifts	Absolute error	Average number of shifts	Absolute error
All cities	1.18	0.13	2.57	0.14
Boston	1.95	.38	3.03	.31
Chicago	0.96	.34	2.37	.20
Cleveland . . .	1.31	.31	2.50	.31
Detroit	.92	.27	2.57	.38
Los Angeles . .	1.88	.40	3.03	.42
New York	.85	.20	2.10	.32
Philadelphia . .	1.05	.30	2.47	.27
Pittsburgh . . .	.66	.30	2.04	.25

The reliability of the estimates of average number of shifts per man-year for all molders and by number of years in the labor force is as follows:

Average number of shifts per man-year

Years in labor force	Average number of shifts	Absolute error
All groups	0.118	0.014
0.0 - 4.0	.183	.072
4.1 - 8.0	.198	.037
8.1 - 12.0	.164	.028
12.1 - over	.095	.013

The accuracy of the estimated average age of molders, 47 years, was also calculated and the absolute error is one year for the 95 percent confidence interval.

Type IV Estimate

The particular estimate studied as an example of the Type IV estimate is the proportion of molders making shifts. The sampling errors in such estimates, for the 95 percent confidence limits, both for the total and by city are as follows:

Percent of molders making shifts

City	Percent of molders making shifts	Absolute error
All cities	45.9	3.8
Boston	64.4	11.8
Chicago	40.5	12.7
Cleveland	52.5	9.1
Detroit	35.8	10.7
Los Angeles	62.0	7.7
New York	40.4	6.7
Philadelphia	42.4	8.1
Pittsburgh	32.2	13.9

It might be noted that for this characteristic, the variance is not greatly different for "all cities" from what it would have been from a random sample of 1,800 workers.

Significance of Differences Between Estimates

At a number of points in the study, the statistical significance of the difference between or among estimates is a question of keen interest. More than one formal test can be brought to bear on this question. Two of the most direct and useful are illustrated for the data on average number of shifts per man-year for workers with different lengths of time in the labor force.

The data show, for example, that molders with less than 4.0 years in the labor force average 0.188 shifts per year (x) while those with more than 12 years average 0.095 shifts per year (y). Is there a significant difference between these two figures?

Our design is such that x should be distributed normally (or nearly so) about $\bar{x}$ with variance $\sigma_x^2 = 0.00129$ and y would be distributed normally about $\bar{y}$ with variance $\sigma_y^2 = 0.00004$. Since these two variables are independent of one another, the quantity $d = x - y$ should be distributed normally about $(\bar{x} - \bar{y})$ with variance $\sigma_d^2 = \sigma_x^2 + \sigma_y^2 = 0.00133$. Consider the hypotheses that there is no difference between the means of the two groups, that is that $\bar{x} = \bar{y}$. Then, the quantity d should have a mean of o. and a variance $\sigma^2 = 0.00133$, or a sampling standard error of $\sigma = 0.0365$. The observed d divided by this σ, $0.093/0.0365$ is tested. This value, which is 2. 5, is a highly unlikely chance result, well beyond 95 percent confidence limits. Consequently, the hypothesis is untenable, and the conclusion is that there is a significant difference between the two classes.

The second test makes use of the basic Chi-squared distribution: If n independent variables Z_i are normally distributed about a common mean zero with standard deviations σ_i, then

$$\chi^2 = \sum_i Z_i^2/\sigma_i^2$$

is the Chi-squared distribution with N degrees of freedom, where N is n reduced by the number of linear constraints placed on the Z_i.

This theory may be adapted to test whether the observed average number of shifts per man-year for the various classes of years of attachment to the labor force differ, collectively, in significant degree from the all-class estimate.

In applying the chi-square test we use the following definitions:

x_i - the ith class average

u - the all-class average

w_i - class weight - in this example, the estimated ratio of the number of man-years in the ith class to the number of man-years in all classes combined

σ_u^2 - a weighted variance of all classes, $\Sigma w_i^2 \sigma_{X_i}^2$

If $Z_i = (x_i - u)$ and $\sigma_i^2 = \sigma_{X_i}^2 + \sigma_u^2 - 2w_i\sigma_{X_i}^2$ the chi-squared distribution is appropriate for the test. There is one linear constraint on the Z_i since u is a linear function of the x_i. The data show $u = .118$. The necessary computations are summarized in the following table:

x_i	Z_i	w_i	σ_i	Z_i/σ_i	$(Z_i/\sigma_i)^2$
0.188	0.070	0.02	0.0356	1.97	3.88
.198	.080	.09	.0177	4.52	20.43
.164	.046	.17	.0127	3.62	13.10
.095	- .023	.72	.0035	6.57	43.16
					χ^2 = 80.57

So large a value of chi-squared, for three degrees of freedom, is extremely unlikely, from which we conclude that there are significant differences among the classes collectively with respect to average number of shifts per man-year.

JOB DESCRIPTIONS

1. Occupations included:

a. HAND BENCH MOLDER

A worker who shapes small and medium-sized molds (or component sections of a mold that are assembled into complete units) by hand on a bench, by ramming and packing sand around patterns placed in flasks, and whose work involves most of the following: selecting and assembling appropriate flasks and patterns for varying molds; determination of appropriate sand blends and moisture content of sand required for different types of molds; packing and ramming green sand, dry sand or loam around patterns; drawing patterns and smoothing molds; selecting and setting cores in position; determination of the types of gating necessary for the molds; finishing molds by performing such operations as facing, venting, and reinforming; assembling mold sections to form complete molds; selecting and using such molder's hand tools as riddles, trowels, slicks, lifters, bellows and mallets in packing and smoothing of molds or mold sections; and directing the pouring of the molten metals.

b. FLOOR MOLDER

A worker who shapes large molds or mold sections by hand on the foundry floor or in a pit, by ramming or packing sand around patterns placed in flasks, and whose work involves most of the following: selecting and assembling appropriate flasks and patterns and positioning patterns in flasks for a variety of molds; determination of appropriate sand blends, and moisture content of sand required for different molds; packing and ramming sand or loam around patterns; drawing patterns and smoothing molds; selecting and setting in position appropriate cores; determination of appropriate gating, venting, reinforcing and facing required for particular mold; assembling mold sections to form complete molds, using such molder's hand tools as riddles, rammers, trowels, slicks, lifters, bellows and mallets in compacting and smoothing of molds; directing the pouring of the molten metal into molds; and operation of crane in lifting and moving of molds or mold sections.

c. HAND COREMAKER

A worker who shapes by hand (on bench or floor)varying types of sand cores placed in molds to form hollows and holes in metal castings, and whose work requires most of the following: selecting appropriate core boxes and work sequence; cleaning core boxes with compressed air or hand bellows, and dusting parting sand over inside of core box to facilitate removal of finished core; packing and ramming core sand solidly into box, using shovels, hands, and tamping tools; selecting and setting vent wires and reinforcing wires into cores; determining approximate sand blends and moisture content of sand required for a particular core; removing core box from core and repairing damage to impressions; baking cores to harden them; and assembling cores of more than one section.

d. WORKING FOREMAN — This definition includes the following job titles: foreman, assistant foreman, group leader, group head, leader, leadman, supervisor.

Performs duties of a supervisory nature in molding or coremaking activities or in the molding and coremaking departments. Regularly performs work requiring manual skill or physical effort which consumes more than 20 percent of the hours worked by this employee in the workweek. Should include all working supervisors in the molding and coremaking departments.

e. NON-WORKING FOREMAN

A person who supervises workers in making, baking, finishing, and setting molds and cores. Determines procedure of work and assigns duties. May set up or inspect equipment preparatory to regular operations. Must possess a detailed knowledge of molding and coremaking.

2. Occupations not included:

a. MACHINE MOLDER

A worker who shapes molds or mold sections on any of several types of molding machines, such as roll-over, jarring, and squeeze machines, and whose work involves most of the following: selecting and assembling appropriate flasks and patterns and positioning patterns in flasks; filling flasks with sand and ramming of sand around pattern with ramming tool or by mechanical means; determination of appropriate sand blends and moisture content of sand required for particular molds; preparing molds for drawing of patterns, and repairing damage to mold impressions in sand; selecting and setting in position appropriate cores; determination of appropriate venting, gating, reinforcing and facing required; assembling upper and lower sections of molds, and guiding or assisting in the pouring of the molten molten metal into the mold.

b. MACHINE COREMAKER

A worker who shapes sand cores, used in molds to produce hollows and holes in castings, using a turn-over-draw machine to compact the sand and to facilitate the removal of the finished core from the core boxes, and whose work involves most of the following: selecting appropriate core box and setting it up on machine table; filling core box with sand of appropriate blend and moisture content; operating machine to compress sand in the core box, stripping box from core; and smoothing core and repairing damages to impressions.

(4) Why didn't you complete your apprenticeship? ______

(5) Did you take any other training to qualify as a journeyman? Yes ☐ No ☐ If yes, describe this training ______

d. Other ☐ ______

Give details of this training: ______

12. Fill out information on training below:

(a) When did you start and finish your training?				(b) Were you training for: molder, coremaker or combination? (state which)	(c) What was the name of the firm in which you qualified in the trade (give name, city, and State)	(d) What was the principal metal cast in this foundry?	(e) For captive foundries: what was the principal product of the plant?	(f) *To Interviewer:* Give date respondent started work for plant listed in 12c and job he held there immediately before starting training.		(g) Was there a union in the plant? If not enter "no." If so, give name.
From		To								
Mo.	Yr.	Mo.	Yr.					Date	Job	

13. a. After you became a qualified journeyman, how long did you work at the firm where you were trained? ______

b. Why did you leave? ______

14. How many months of training, if any, in molding or coremaking did you have in a vocational or trade school as a student *before* being employed as an apprentice or learning the trade in the plant? ______
(List all courses and give month and year began and ended—enter none if none)

15. Have you had any technical schooling since you began working in a foundry? Yes ☐ No ☐ If yes, list courses and give month and year started and ended and hours per week of schooling or total number of hours you attended. (Answer either a or b, *and* c.)

a. Courses taken while in apprenticeship ______

b. Courses taken while qualifying (for those who served no apprenticeship) ______

c. Courses taken after becoming a journeyman molder or coremaker ______

BLS No. 2272A **Appendix C**

Budget Bureau No. 44-5158.1
Approval expires April 30, 1952

UNITED STATES DEPARTMENT OF LABOR
BUREAU OF LABOR STATISTICS
WASHINGTON 25, D. C.

CONFIDENTIAL

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OCCUPATIONAL MOBILITY OF MOLDERS AND COREMAKERS

Schedule No. ____________

FOR OFFICE USE ONLY

1. Where were you born? ____________ (City or county and State or foriegn country) 2. What year? ______ 3. Were you brought up on a farm? Yes ☐ No ☐

4. What was the highest grade of regular school you completed? ______ 5. How long have you lived in this area? ____________

6. a. Are you married? Yes ☐ No ☐ b. If yes, give date of marriage ____________

7. a. Do you own your own home? Yes ☐ No ☐ b. If yes, when did you buy your home? ____________

8. a. How many children do you have? ______ b. What are their present ages? ____ ____ ____ ____ ____ ____ ____ ____ ____ ____

9. a. In what year did you get your first full-time job? ______ b. What was your job? ____________

c. What did this firm do? ____________ (Give principal product if manufacturing firm or kind of business. If foundry, give principal metal cast.) d. Where was it located? ____________ (City and State)

(To interviewer: If job described in question 9 was in a foundry, do not answer question 10)

10. a. In what year did you get your first job in a foundry? ______ b. What was the name of the plant? ____________

c. Where was it located? ____________ (City and State) d. What did this firm do? ____________ (If captive foundry give principal product)

e. What metal was cast? ____________ (Give principal metals) f. What was your job? ____________ (Job title or description of duties)

11. How did you learn to be a molder or coremaker? *(To interviewer: Check and answer a, b, c, or d, but only one)*

a. Apprenticeship ☐
(1) Did you complete the apprenticeship? Yes ☐ No ☐
(If "yes" answer 2. If "no" proceed to (4).)
(2) Did you get a certificate? Yes ☐ No ☐
(If "yes" proceed to question 12. If "no" answer (3).)
(3) Did you get any other paper when you finished your apprenticeship training? Yes ☐ No ☐
(If "yes" describe ____________)

b. Other more or less formal plant training ☐
Describe this program ____________
____

c. Informal on-the-job training such as workihg as a molder's helper ☐
What kind of work did you do? ____________

16. Work history, 1940 to date. (List present job first and enter length of time in each occupation on more, January 1940 to date, including military service and periods of

(a)				(b)	(c)	(d)
Employment or unemployment				What was the name and the location of the firm in which you worked? (Give city or county and State. If not at work, enter unemployed. If in Armed Forces, enter military service.)	What was your job? (Give job title or brief description of duties. If molder or core-maker, give specialization.)	If this firm was a foundry what metal was cast?
From		To				
Mo.	Yr.	Mo.	Yr.			

17. How many years experience do you have working as a molder or coremaker? ________ 18. How

19. a. How did you happen to get into this trade? ________

____

(To interviewer: If not already answered above ask:)

b. Was any member of your immediate family working in a foundry at the time you got your first four

What job (jobs) did he (they) hold? ________

c. What was occupation and industry of your father's usual or longest job? ________

20. Would you recommend to a young man that he become a molder or coremaker? (To interviewer: determir

____

21. Remarks: ________

____

____

____

Name of Field Representative: ________

Date of interview: ________

a separate line even though the employment was in the same firm or plant.) Account for all periods of 30 days or unemployment. If employed in January 1940, give beginning date of this job.

(e) For captive foundries and for firms which were not foundries give principal product or activity.	(f) Did plant have a seniority system which covered you?	(g) Was there a union in the plant? If so give name.	(h) Reasons for changing jobs: Why did you take the job?	(h) Reasons for changing jobs: Why did you leave this job?	DO NOT USE (i) HO	(j) DEP	(k) A	(l) MS
				//////////////////////				

long would it take you as a qualified molder (coremaker), to become a qualified coremaker (molder)? ______________

dry job? Yes ☐ No ☐ If yes, was it your: father ☐ brother ☐ or other relative? ☐

e why or why not.) ______________

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UNITED STATES DEPARTMENT OF LABOR
BUREAU OF LABOR STATISTICS
WASHINGTON 25, D. C.

CONFIDENTIAL

OCCUPATIONAL MOBILITY OF MOLDERS AND COREMAKERS

ESTABLISHMENT INFORMATION

CONFIDENTIAL

1. Name of plant ____________________

2. Plant address ____________________
(Street and Number)

   City and State ____________________

3. Names and titles of officials interviewed ____________________

   ____

4. *For Captive Foundries Only*

   a. Give industry of plant or principal product ____________________

   ____

   Principal metal cast ____________________

   b. Give production worker
   employment in foundry department ____________________

5. *For Independent Foundries Only*

   a. Give production worker employment in plant ____________________

   b. What is the principal metal cast? ____________________

   c. Does this plant engage in any major manufacturing activities other than the foundry? Yes ☐ No ☐

   d. If yes, give nature of these activities or principal products.

   (1) ____________________

   (2) ____________________

   e. Give total number of product on workers assigned to these activities ____________________

   ____

6. Foundry Employment Detail (for all plants)

(a) Number of hand bench molders ______________
(b) Number of floor molders ______________
(c) Number of hand coremakers ______________
(d) Number of machine molders ______________
(e) Number of machine coremakers ______________
(f) Number of molding department foremen who are fully qualified hand molders:
 (a) Working ______________
 (b) Nonworking ______________
(g) Number of coremaking department foremen who are fully qualified hand coremakers:
 (a) Working ______________
 (b) Nonworking ______________

7. What are the usual sources for obtaining qualified hand molders and hand coremakers? (Indicate order of importance)

a. Hiring qualified men from outside the plant ______________

b. Apprenticeship program ______________

c. On-the-job training, other than apprenticeship ______________

d. Other ______________ explain ______________________________

____

8. (If 7c is a major source of obtaining hand molders and coremakers, answer this question)

a. How many hand molders and hand coremakers have been qualified by this method since June 1949? ______________

b. From what occupations were these men usually selected? ______________

____

9. Apprenticeship

a. Is there an apprenticeship program in the plant? Yes ☐ No ☐

b. If yes, does the program include? (Check appropriate box or boxes)

(1) Molders ☐

(2) Coremakers ☐

(3) Combination program for both ☐

c.* Is the program registered with the Federal Committee on Apprenticeship or State Apprenticeship Council? Yes ☐ No ☐

d. Is the program under joint union-management sponsorship? Yes ☐ No ☐

e. How many molder and coremaker apprentices are now in training? ______________

10. How many molder and coremaker apprentices completed training in the plant from January 1947 to date? ______________________________

11. How many of these apprentices (who finished training from January 1947 to date) are still working in the plant? ________________

12. In World War II when it was necessary to increase production of castings sharply, how were production requirements met, aside from increasing hours of work? (Indicate order of importance)

    a. Hiring experienced molders and coremakers ____________

    b. Increasing the number of apprentices ________________

    c. Increasing the number of helpers per journeyman molder and coremaker employed ____________

    d. Intensive training programs other than apprenticeship ____________

       Explain ____

    e. Installation of additional molding and coremaking machines ________________

    f. Other____________ explain ________________________________

    g. No World War II experience ______________

13. If the plant had to increase its output of castings by 25 percent over its present level in the current mobilization period, to what extent would the methods listed in question 12 be used to meet production requirements? (List methods in order of importance) ________________________________

____

14. Were experienced molders and coremakers actively recruited from outside the local labor market during World War II? Yes ☐ No ☐ If yes, what percentage of all hirings of experienced molders and coremakers were of this group? ______________________

15. How were experienced molders and coremakers hired during World War II? (Indicate order of importance)

    a. General gate hiring _____________

    b. Public employment offices _______________

    c. Private employment offices __________________

    d. Referred by employees of the firm ____________________

    e. Union referral ______________

    f. Direct out-of-town recruitment ________________

    g. Other ____________ explain ____

____

____

Remarks:

Name of Field Representative ____________________

Date of Interview ____________________

Labor - D. C. (BLS 52-2706)

Appendix D -89-

MOLDERS AND COREMAKERS CARD No. 1 "PRIMARY CARD"

(One prepared for each man interviewed)

Schedule number

Personal Data: Place of birth; Year of birth; Raised on farm; Education; Marital status; Home ownership; No. of dependents; Veterans status; Reason for entering trade; Relatives in occup.; Occup. of relative; Father's occupation; Opinion of trade

First job: Year; Occupation; Industry

First foundry job: Year; Location; Type foundry; Metal cast; Occupation

Training: Method; Length; Occupation; Location; Metal cast; Type foundry; Union; Time prior to training; Time prior to qualification; Year of qualification; Time spent in plant; Reason for leaving plant of qualification; Technical schooling

Current job: Year started; Metal cast in this and prior jobs; Type of foundry in this and prior jobs; Union of this and prior jobs; Seniority; Occupation

Number of shifts — Total: Employer; Geographic; Foundry; Occupational

Number of shifts — Voluntary: Employer; Geographic; Foundry; Occupation

Months in jobs in other occupations; Years in civilian labor force when interviewed; Years of experience as molder when interviewed; Opinion as to time to qualify as molder or coremaker

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80

1st POSITION | 2nd POSITION — 519 END-PRINTING

DATE

BRANCH OFFICE NAME — BR. OFF. NO.

CUSTOMER NAME — CUST. PUR. ORDER NO.

MAIL PROOFS TO

IMPORTANT — CHECK THE FOLLOWING:

Is this a revision of form in use? YES ☐ NO ☐

What is present form number? ______

May we scrap old electro? YES ☐ NO ☐

Indicate corners to be cut. UPPER LEFT ☐ RIGHT ☐ LOWER ☐ ☐

(Lower left cut cannot be used on type 24-26 punch and similar machines.)

REQUIREMENTS: Stub ☐; Consecutive prepunching ☐; Repetitive prepunching ☐; Prenumbering ☐; Padding ☐; Proofs required ☐

INTERPRETATION: 45-Numerical ☐; 60-Alphabetical ☐; 80-Printing punch ☐; Bill Feed Five lines per inch ☐ Six lines per inch ☐; End Printing LEFT ☐ RIGHT ☐; Typewriter spacing ☐

If card is to be printed on both sides, check style. BOOK ☐ TUMBLE ☐

2nd POSITION | 1st POSITION — 519 END-PRINTING

IF CARD IS TO HAVE MARK SENSING, INDICA

(* Must not be used for ink mark sensi

SCALE APPROXIMATELY D

SIZE; ACTUAL CARD SIZE 3-1/4

SHORT CARD LAYOUT INSTRUCTIONS

1) DETERMINE SHORT CARD COLUMN NUMBERS BY REFERRING TO GUIDE AND COLUMNS PRINTED BELOW. USABLE COLUMN RANGE IS ESTABLISHED BY THE CAPACITY LOCATION ON EACH SIDE OF GUIDE. EXAMPLE: ON A 30-COLUMN CARD, USABLE COLUMNS ARE 26-55.

2) CUT OUT THE STRIP OF COLUMN NUMBERS.

3) PASTE THE STRIP ON THE LAYOUT FORM IN DESIRED LOCATION FOR THE SHORT CARD.

4) RULE ENDS OF SHORT CARD 2 1/2 COLUMNS BEYOND THE STRIP OF COLUMN NUMBERS.

5) DETERMINE MARK SENSE POSITIONS, IF ANY, BY ASSOCIATING STRIP NUMBERS WITH CARD LAYOUT POSITIONS. EXAMPLE: ON 30 - COLUMN CARD, M. S. POSITIONS 9-18 ARE USABLE.

SHORT CARD COLUMN GUIDE — CARD CAPACITY (COLUMNS)

Schedule number | Year of birth | Years of marriage | Year in which first child was born | Year in which home was purchased

Data on each specific job: Number | Duration | Year of termination | Personal status at time of shift: Age, Homeowner, Marital status, Dependents | Location | Occupation | Metal cast | Principal product | Seniority | Union | Reason for leaving | Reason for taking next job | Type of shift | Direction of movement | XXXXXXXXXXXXXXXXXXXXXX

Personal and training data and facts on current job, gang-punched from card #1: Raised on farm | Education | Occupation of first job | Industry - first job | Method | Length | Union | Time in plant after qualifying | Occupation | Metal cast in this and prior jobs | Kind of foundry experience in this and prior jobs | Union affiliation of this and prior jobs | Seniority | Years of experience as molder when interviewed | Years in civilian labor force when interviewed

0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80

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4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 ... 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4

MOLDERS AND COREMAKERS CARD No. 2 "EXCESS CARD"

(One prepared for each job)

5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 ... 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5

6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 ... 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6

7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 ... 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7

8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8

9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80

1st POSITION | 2nd POSITION — 519 END-PRINTING

DATE

BRANCH OFFICE NAME — BR. OFF. NO.

CUSTOMER NAME — CUST. PUR. ORDER NO.

MAIL PROOFS TO

IMPORTANT — CHECK THE FOLLOWING:

Is this a revision of form in use? YES ☐ NO ☐

What is present form number? ______

May we scrap old electro? YES ☐ NO ☐

Indicate corners to be cut. UPPER LEFT ☐ RIGHT ☐ LOWER ☐ ☐

(Lower left cut cannot be used on type 24-26 punch and similar machines.)

REQUIREMENTS: Stub ☐ Consecutive prepunching ☐ Repetitive prepunching ☐ Prenumbering ☐ Padding ☐ Proofs required ☐

INTERPRETATION: 45-Numerical ☐ 60-Alphabetical ☐ 80-Printing punch ☐ Bill Feed Five lines per inch ☐ Six lines per inch ☐ End Printing LEFT ☐ RIGHT ☐ Typewriter spacing ☐

If card is to be printed on both sides, check style. BOOK ☐ TUMBLE ☐

2nd POSITION | 1st POSITION — 519 END-PRINTING

IF CARD IS TO HAVE MARK SENSING, INDICA

(* Must not be used for ink mark sensi

HORT CARD LAYOUT INSTRUCTIONS

1) DETERMINE SHORT CARD COLUMN NUMBERS BY REFERRING TO GUIDE AND COLUMNS PRINTED BELOW. USABLE COLUMN RANGE IS ESTABLISHED BY THE CAPACITY LOCATION ON EACH SIDE OF GUIDE. EXAMPLE: ON A 30-COLUMN CARD, USABLE COLUMNS ARE 26-55.

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5) DETERMINE MARK SENSE POSITIONS, IF ANY, BY ASSOCIATING STRIP NUMBERS WITH CARD LAYOUT POSITIONS. EXAMPLE: ON 30 COLUMN CARD, M. S. POSITIONS 9-18 ARE USABLE.

SCALE APPROXIMATELY D

SIZE; ACTUAL CARD SIZE 3-¼

SHORT CARD COLUMN GUIDE — CARD CAPACITY (COLUMNS)

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80

Table E-1.--Calculation of estimated separation of molders and coremakers because of retirement or death, 1952-62

Age	Estimated employment, 1952 (1)	5-year period 1952-57: Separation rate[1/] per 1,000 in the labor force (estimated) (2)	5-year period 1952-57: Number of separations (estimated) (1) x (2) (3)	10-year period 1952-62: Separation rate[1/] per 1,000 in the labor force (estimated) (4)	10-year period 1952-62: Number of separations (estimated) (1) x (4) (5)
All age groups	62,500	144.5	9,030	288.6	18,307
19 - 24 years	417	11.3	5	23.8	10
25 - 29 years	2,882	12.6	36	33.0	95
30 - 34 years	9,028	20.7	187	52.5	474
35 - 39 years	8,681	32.5	282	78.9	685
40 - 44 years	7,465	47.9	358	119.9	895
45 - 49 years	5,972	75.6	451	174.2	1,040
50 - 54 years	6,458	106.7	689	250.0	1,615
55 - 59 years	8,646	160.5	1,388	458.3	3,962
60 - 64 years	7,465	354.7	2,648	678.5	5,065
65 years and over . .	5,486	544.3	2,986	814.1	4,466

1/ Based on separation rate for total males adapted from abridged table of working life for 1947 in "Tables of Working Life," Bureau of Labor Statistics, Bulletin 1001.

Table E-2.--Distribution of molders and coremakers, by city and race, February - March 1952

City of employment	All molders and coremakers		Race					
			White except those of Mexican extraction		Molders of Mexican extraction		Negroes	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
All cities	1,800	100.0	1,594	88.6	79	4.4	127	7.0
Boston	180	100.0	175	97.2	--	--	5	2.8
Chicago	222	100.0	193	86.9	--	--	29	13.1
Cleveland	204	100.0	189	92.6	--	--	15	7.4
Detroit	212	100.0	174	82.1	--	--	38	17.9
Los Angeles	245	100.0	161	65.7	79	32.2	5	2.1
New York	260	100.0	250	96.2	--	--	10	3.8
Philadelphia	269	100.0	251	93.3	--	--	18	6.7
Pittsburgh	208	100.0	201	96.6	--	--	7	3.4

Table E-3.--Educational level of molders and coremakers, by age, February - March, 1952

Age group	All molders and coremakers	Highest grade completed				
		0 - 4	5 - 8	9 - 12	Over 12	Not reported
All ages	1,800	268	896	604	26	6
	Percent					
Total	100.0	100.0	100.0	100.0	100.0 1/	100.0 1/
19 - 24 years	0.7	--	0.2	1.7	--	--
25 - 29 years	4.6	--	2.6	9.8	3.8	--
30 - 34 years	14.5	1.1	9.0	27.8	26.9	16.7
35 - 39 years	13.9	1.5	10.5	24.2	23.1	--
40 - 44 years	11.9	5.2	13.3	12.9	11.5	16.7
45 - 49 years	9.6	8.6	11.4	7.1	15.4	--
50 - 54 years	10.3	11.2	13.0	6.1	3.8	16.7
55 - 59 years	13.8	26.9	16.0	5.6	--	--
60 - 64 years	11.9	25.7	13.7	2.8	11.5	50.0
65 - 79 years	8.8	19.8	10.3	2.0	3.8	--
Under 45 years	45.6	7.8	35.6	76.3	65.4	33.3
Over 45 years	54.4	92.2	64.4	23.7	34.6	66.7

1/ Totals do not add to 100.0 because of rounding.

Table E-4.--Opinions of molders and coremakers about the occupation as a career for young men, by educational level

Recommendations	All molders and coremakers		Highest grade completed									
			0 - 4		5 - 8		9 - 12		Over 12		Educational level not reported	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
All recommendations .	1,800	100.0	268	100.0	896	100.0	604	100.0	26	100.0	6	100.0
Yes	590	32.8	113	42.2	290	32.4	178	29.5	7	26.9	2	33.3
No	922	51.2	104	38.8	475	53.0	326	54.0	15	57.7	2	33.3
Yes with reservation	259	14.4	46	17.2	117	13.1	91	15.1	3	11.5	2	33.3
Undecided	29	1.6	5	1.8	14	1.6	9	1.5	1	3.8		

Table E-5.--Method of qualification of Negro molders and molders of Mexican extraction by year of qualification

Year of qualification	Negro and Mexican molders	Qualifying by apprenticeship	
	Number	Number	Percent
All periods	206	84	40.8
1892-1915.	13	3	23.1
1916-29	51	16	31.4
1930-39	24	10	41.7
1940-45	57	25	43.9
1946-52	61	30	49.2

Table E-6.--Distribution of job changes by molders and coremakers making specified number of changes, 1940-52

Number of changes	All molders and coremakers		Job changes	
	Number	Percent	Number	Percent
All changes	1,800	100.0	2,128	100.0
None	973	54.0	0	--
One change	266	14.8	266	12.5
Two changes	257	14.3	514	24.2
Three changes	127	7.1	381	17.9
Four changes	61	3.4	244	11.5
Five changes	48	2.7	240	11.3
Six changes	33	1.8	198	9.3
Seven changes	12	0.7	84	3.9
Eight changes	8	.4	64	3.0
Nine changes or more .	15	.8	137	6.4

Table E-7.--Time as journeymen spent in plants of qualification, by year of qualification

Year of qualification	All molders and coremakers		Duration of employment as journeymen in plant of qualification			
	Number	Percent	Less than 1 year	1-5 years	6-10 years	More than 10 years
All periods	1,800	100.0	24.9	36.8	16.1	22.2
1915 and earlier . . .	376	100.0	29.8	35.6	12.5	22.1
1916-29	500	100.0	24.2	33.0	11.0	31.8
1930-34	129	100.0	18.6	22.5	17.1	41.8
1935-39	149	100.0	19.5	32.9	13.4	34.2
1940-45 1/	357	100.0	24.6	25.8	35.9	13.7
1946-52 1/	284	100.0	25.7	68.3	6.0	0.0
Year of qualification not reported	5	100.0	20.0	0.0	20.0	60.0

1/ The low proportion of workers who remained more than 10 years is due to the fact that many men in the group qualifying between 1940-45 (and none of the men who qualified in the period 1946-52) had not been qualified journeymen for 10 years at the time of the interview.

Table E-8.--Job changes of molders and coremakers, by homeownership at time of change, 1940-52

Homeownership at time of change	Number of job changes made by men in specified homeownership status at time of change	Number of man-years worked during period by men in specified homeownership status	Job changes per man-year made by men in specified homeownership status
All job changes	2,128	18,000	0.118
Homeownership	643	6,894	.093
Nonhomeownership	1,485	11,106	.134

Table E-9.--Duration of jobs of molders and coremakers which were terminated during period, by seniority coverage of job, 1940-52

Duration of job	Total		Covered by seniority at time of termination		Without seniority at time of termination		Seniority status not reported	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
All jobs	2,128	100.0	1,146	53.8	842	39.6	140	6.6
Less than 1 year . .	560	100.0	280	50.0	241	43.0	39	7.0
1 - 2 years . . .	534	100.0	260	48.7	230	43.1	44	8.2
2.1 - 5 years . . .	566	100.0	302	53.4	230	40.6	34	6.0
5.1 - 10 years . . .	265	100.0	169	63.8	83	31.3	13	4.9
More than 10 years	203	100.0	135	66.5	58	28.6	10	4.9

Table E-10.--Duration of jobs of molders and coremakers, 1940-52, by nature of job termination

Duration of job	Nature of job termination			
	All terminations		Voluntary	Involuntary
	Number	Percent		
All jobs	2,128	100.0	65.5	34.5
Less than 1 year	560	100.0	69.6	30.4
1 - 2 years	534	100.0	65.7	34.3
2.1 - 5 years	566	100.0	65.9	34.1
5.1 - 10 years	265	100.0	60.4	39.6
Over 10 years	203	100.0	59.1	40.9

Table E-11.--Distribution of molders and coremakers by metals worked with, 1940-52

Principal metal cast in present job	All molders and coremakers		Percent of other metals worked with			
	Number	Percent	No other metal	Other ferrous	Other non-ferrous	Both other ferrous and other non-ferrous
All metals	1,800	100.0	46.1	13.8	21.5	18.6
Gray iron	781	100.0	58.7	14.2	15.2	11.9
Steel	332	100.0	52.7	19.9	7.5	19.9
Malleable iron	49	100.0	63.3	18.4	12.2	6.1
Aluminum	143	100.0	43.3	11.9	27.3	17.5
Copper and copper alloy	424	100.0	22.2	8.0	42.7	27.1
Other nonferrous	71	100.0	14.1	16.9	26.8	42.2

Table E-12.--Location of training of molders and coremakers by city of employment, February - March 1952

City of employment	All molders and coremakers		Location of training										
	Number	Percent	New England	Middle Atlantic	East North Central	West North Central	South Atlantic	East South Central	West South Central	Mountain	Pacific	Other countries	Not reported
All cities .	1,800	100.0	9.8	38.0	32.6	1.6	0.3	1.5	0.4	0.3	9.3	5.8	0.4
Boston . . .	180	100.0	87.8	0.6	1.6	-	-	0.6	-	-	-	8.3	1.1
Chicago	222	100.0	0.5	1.8	87.7	3.1	.5	.5	-	-	0.5	4.9	.5
Cleveland .	204	100.0	.5	5.4	85.3	-	-	2.9	-	-	-	5.4	.5
Detroit	212	100.0	.5	3.3	84.4	0.5	-	5.2	-	-	-	6.1	-
Los Angeles .	245	100.0	2.0	3.3	9.8	6.9	-	2.0	2.9	1.2	67.8	3.7	.4
New York . .	260	100.0	3.1	78.8	2.3	-	.8	.4	-	-	.4	13.5	.7
Philadelphia.	260	100.0	.7	92.1	1.5	1.1	.4	.4	-	.4	-	3.0	.4
Pittsburg . .	208	100.0	.5	95.6	1.0	-	1.0	-	-	.5	-	1.4	-

Table E-13--Job changes of molders and coremakers involving changes in geographic area, by marital status at time of change, 1940-52

Marital status at time of change	Number of job changes made in specified marital status at time of change	Number of man-years worked during period in specified marital status	Job changes per man-year made in specified marital status
All job changes	322	18,000	0.018
Married	259	18,729	.016
Not married	63	2,271	.028

Table E-14.--Job changes of molders and coremakers involving changes in geographic area, by homeownership at time of change, 1940-52

Homeownership at time of change	Number of job changes made in specified homeownership status at time of change	Number of man-years worked during period in specified homeownership status	Job changes per man-year made in specified homeownership status
All job changes	322	18,000	0.018
Homeownership	54	6,894	.008
Nonhomeownership . . .	268	11,106	.024

Table E-15.--Distribution of molders and coremakers in foundries surveyed, by city of employment, February - March 1952

City	Number of foundries surveyed	Number of production workers in foundries surveyed	Number of molders and coremakers in foundries surveyed	Number of molders and coremakers in sample
All cities	195	26,629	3,788	1,800
Boston	21	1,355	326	180
Chicago	27	3,487	425	222
Cleveland	29	4,730	666	204
Detroit	19	2,835	339	212
Los Angeles . . .	32	3,620	491	245
New York	27	2,892	490	260
Philadelphia . . .	24	2,818	503	269
Pittsburg	16	4,892	548	208

PUBLICATIONS OF THE BUREAU OF LABOR STATISTICS ON MANPOWER AND OCCUPATIONAL OUTLOOK

Studies of employment trends and opportunities in the various occupations and professions are made available by the Occupational Outlook Service of the Bureau of Labor Statistics.

These reports are for use in the vocational guidance of veterans in counseling young people in schools, and in guiding others considering the choice of an occupation. Schools concerned with vocational training and employers and trade unions interested in on-the-job training have also found the reports helpful in planning programs in line with prospective employment opportunities.

Unless otherwise designated, bulletins are for sale by the Superintendent of Documents at the prices indicated. Address your order to the Superintendent of Documents, Government Printing Office, Washington 25, D. C., with remittance by check or money order. Currency is sent at sender's risk. Postage stamps are not accepted.

Those reports which are listed as free may be obtained directly from the U. S. Department of Labor, Bureau of Labor Statistics, Washington 25, D. C., as long as the supply lasts.

Occupational Outlook Bulletins

Occupational Outlook Handbook -- Employment Information on Major Occupations for Use in Guidance.
Bulletin No. 998 (1951 Rev. Ed.). Illus. $3.

Includes brief reports on more than 400 occupations of interest in vocational guidance, including professions; skilled trades; clerical, sales, and service occupations; and the major types of farming. Each report describes the employment trends and outlook, the training qualifications required, earnings, and working conditions. Introductory sections summarize the major trends in population and employment and in the broad industrial and occupational groups, as a background for an understanding of the individual occupations.

The Handbook is designed for use in counseling, in classes or units on occupations, in the training of counselors, and as a general reference. Its 575 pages are illustrated with 103 photographs and 85 charts.

Employment Outlook in Electric Light and Power Occupations.
1948. 49 pp. Bulletin No. 944 — 30 cents

Employment Outlook in Railroad Occupations.
1949. 52 pp. Illus. Bulletin No. 961 — 35 cents

Employment Outlook for Engineers.
1949. 119 pp. Illus. Bulletin No. 968 — 60 cents

Effect of Defense Program on Employment Outlook in Engineering.
(Supplement to Bulletin No. 968.) 1951. 10 pp. — 15 cents

Effect of Defense Program on Employment Situation in Elementary and Secondary School Teaching.
(Supplement to Bulletin No. 972.) 1951. 14 pp. — 15 cents

Employment Outlook in Petroleum Production and Refining.
1950. 52 pp. Illus. Bulletin No. 994 — 30 cents

Employment Outlook in Men's Tailored Clothing Industry.
1951. 32 pp. Illus. Bulletin No. 1010 — 25 cents

Employment in Department Stores.
1951. 23 pp. Illus. Bulletin No. 1020 — 20 cents

Employment Outlook in Accounting.
1952. 32 pp. Illus. Bulletin No. 1048 — 20 cents

Employment Outlook for Earth Scientists.
1951. 38 pp. Illus. Bulletin No. 1050 — 30 cents

Employment Outlook in the Merchant Marine.
1952. 38 pp. Illus. Bulletin No. 1054 — 30 cents

Employment Outlook in Electronics Manufacturing.
1952. 30 pp. Illus. Bulletin No. 1072 — 25 cents

Employment Outlook in Printing Occupations.
Reprinted from the 1951 Occupational Outlook Handbook.
1953. 31 pp. Illus. Bulletin No. 1126 — 25 cents

Employment Outlook in Air Transportation.
Reprinted from the 1951 Occupational Outlook Handbook.
1953. 22 pp. Illus. Bulletin No. 1128 — 20 cents

Employment Outlook for Mechanics and Repairmen.
Reprinted from the 1951 Occupational Outlook Handbook.
1953. 26 pp. Illus. Bulletin No. 1129 20 cents

Employment Outlook in Metalworking Occupations.
Reprinted from the 1951 Occupational Outlook Handbook.
1953. 39 pp. Illus. Bulletin No. 1130 30 cents

Employment Outlook for Technicians. A Report on Draftsmen, Engineering Aids, Laboratory Technicians, and Electronic Technicians.
1953. 29 pp. Illus. Bulletin No. 1131 25 cents

Employment Outlook in the Automobile Industry.
1953. 33 pp. Illus. Bulletin No. 1138 25 cents

Employment Outlook for Physicists.
1953. 24 pp. Illus. Bulletin No. 1144 25 cents

Employment Outlook in the Industrial Chemicals Industry.
1954. 33 pp. Illus. Bulletin No. 1151 30 cents

Employment Outlook in Banking Occupations.
1954. 42 pp. Illus. Bulletin No. 1156 30 cents

Special Reports

Occupational Outlook Information Series for States. 1940 Census information. Specify State desired. Supply exhausted for Arizona, California, Colorado, Connecticut, Florida, Illinois, Michigan, New Jersey, New York, Pennsylvania, and Texas. Veterans Administration Pamphlet 7-2. 1947. Each 10 cents.

Tables of Working Life. Length of Working Life for Men.
Aug. 1950. 74 pp. Bulletin No. 1001 40 cents

Employment, Education, and Earnings of American Men of Science.
1951. 48 pp. Bulletin No. 1027 45 cents

Employment and Economic Status of Older Men and Women.
May 1952. 58 pp. Bulletin No. 1092 30 cents

Federal White-Collar Workers - Their Occupations and Salaries, June 1951.
(1952.) 43 pp. Bulletin No. 1117 15 cents

Negroes in the United States: Their Employment and Economic Status. 1952. 60 pp.	Bull. No. 1119	30 cents
The Mobility of Tool and Die Makers, 1940-1951. (1952.) 67 pp.	Bull. No. 1120	35 cents
Occupational Mobility of Scientists. A study of Chemists, Biologists, and Physicists with Ph. D. Degrees. 1953. 63 pp.	Bull. No. 1121	35 cents
Manpower Resources in Chemistry and Chemical Engineering. 1953. 112 pp.	Bull No. 1132	50 cents
Scientific Research and Development in American Industry. A study of manpower and Costs. 1953. 106 pp.	Bull No. 1148	50 cents
The Mobility of Electronic Technicians, 1940-1952. (1954.) 79 pp.	Bull. No. 1150	50 cents
Occupational Planning and College. A leaflet addressed to college college men or those planning to go to college. 1954. 20 pp.		10 cents

Miscellaneous Reports

Employment Opportunities for Counselors in Secondary and Elementary Schools. May 1951. 26 pp.	Free
Employment Opportunities for Student Personnel Workers in Colleges and Universities. May 1951. 26 pp.	Free
Elementary and Secondary School Principalships. May 1951. 11 pp.	Free
Employment, Education, and Income of Engineers, 1949-1950. November 1952. 48 pp.	Free

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