INTRODUCTION AND GENERAL EXPLANATIONS

INTRODUCTION

The 1939 Census of Mineral Industries, taken as part of the Sixteenth Decennial Census of the United States, marks the completion of a century of systematic decennial censuses of the Nation's mineral industries. The 1939 census is believed to be one of the most extensive and accurate censuses of the mineral industries in the series of 12 begun 100 years ago.

Mining statistics were collected to some extent before 1840 as part of the early censuses of manufactures, although 1840 was the year for which the first census of mineral industries was undertaken. Thereafter censuses were taken for the years 1850, 1860, 1870, 1880, 1889, 1902, 1909, 1919, 1929, 1935,[1] and 1939. The size and quality of these censuses have not been uniform. The earlier censuses particularly were small in scope and were limited by the meager records kept by mine operators and the difficulties of obtaining reports for operations situated in the undeveloped areas of the country.

A carefully planned and relatively comprehensive census was first undertaken in 1880. The censuses of 1889 and 1902 were unusually comprehensive in number of subjects and mineral industries covered. Since then and until the 1939 census the volume of census statistics on the mineral industries has declined considerably. In the 1929 census there was a major reduction in scope by the exclusion from the canvass of crude-petroleum, natural-gas, and natural-gasoline operations.

The results of the 1939 Census are presented in two volumes: Volume I, General Summary and Industry Statistics; and Volume II, State and County Statistics.

New items of information.—In the 1939 census oil and gas operations were restored to the canvass. The 1939 canvass was the first decennial census to include concerns performing oil- and gas-field services on a contract basis, Pennsylvania anthracite strip-pit contractors, concerns performing general contract services for the mineral industries, and companies producing common clay for their own use in manufacturing heavy-clay products. The 1939 census also makes available for the first time complete information on the number of man-shifts and man-hours worked by wage earners, extent of multiple-shift operation, number and type of power loading machines, and expenditures for construction, although earlier censuses, particularly for 1889 and 1902, provided limited statistics on some of these items. Detailed information is made available for more industry classifications for 1939 than for earlier years. The tabulation of more items of information and the compilation of detailed statistics for more individual industries were made possible in part by the extensive use for the 1939 census statistics of machine-tabulation facilities of the Bureau of the Census. The first time that machine tabulations were used for the statistics of the census of mineral industries was for 1919, although they were used to a lesser extent in 1919 and 1929 than for 1939.

Nature of summaries presented.—The general summaries and individual industry reports presented in Volume I contain details of production; value of products; persons engaged; wages; salaries; cost of supplies and materials, fuel, purchased electric energy, and contract work; cost of buildings, machinery, and equipment; man-hours and man-shifts worked by wage earners; multiple-shift operations; days active; number and horsepower rating of power units; number and types of loading machines; and consumption of fuels and electric energy. Separate statistics are presented for operations having different production methods and operating characteristics. State and county statistics are presented in Volume II and such figures for each industry are presented whenever this could be done without disclosing information for individual concerns.

For some industry reports in Volume I comparative tables are presented summarizing statistics for census years as far back as 1880. The nature of some of the inquiries included in the census schedules for the various years, the grouping of operations into industries, and the mineral industries themselves have undergone changes during the history of the minerals censuses; as a result continuous and comparable statistical series cannot be presented for all industries for all census years. The State reports in Volume II cover all mineral operations within the State boundaries, and include comparative statistics for 1939, 1929, and 1919 and principal statistics by industry and by county.

Methods of collection.—Three methods were used to collect statistics in the course of the 1939 survey—the mail canvass in which schedules were mailed by the Bureau of the Census from Washington to cover the great majority of the industries; the enumerative canvass in which the regular field enumerators of the Bureau were employed to cover the stone, clay, and sand and gravel industries; and a cooperative canvass of the bituminous-coal industry undertaken jointly by the Bureau of the Census and the Bituminous Coal Division of the United States Department of the Interior whereby the schedules were distributed and collected through the regional offices of the Bituminous Coal Division. A more detailed discussion of these canvassing methods and reproductions of sample schedules used in the 1939 census are presented in appendix B to Volume II.

SCOPE OF CENSUS

The scope and nature of the 1939 Census of Mineral Industries was to a large extent determined by practical considerations. It is often extremely difficult to draw a clear line of demarcation between mineral production and manufacturing, yet it was desired to cover all mineral enterprise and to duplicate the Census of Manufactures as little as possible. Some mineral commodities are produced by enterprises to which the recovery of minerals is merely incidental and for which the segregation of statistics relating to mining activities is well-nigh impossible. There are many extremely small operations, whose aggregate output is unimportant, that are difficult to locate and keep meager records, if any; the cost of canvassing completely such operations would be prohibitive and not commensurate with results that might be obtained. The disposition of such problems, affecting the scope and coverage of the 1939 census, is discussed in the following paragraphs.

Preparation activities.—Most crude mineral products undergo various treatment processes before they are incorporated into manufactured or fabricated articles or are otherwise consumed. The metallic ores are usually concentrated and then smelted and refined in order that their metal content may be recovered; to an increasing extent ores cannot be marketed

[1] The census of 1935 was not a regular decennial census, but was undertaken by the Bureau of the Census with the cooperation of the United States Bureau of Mines as part of the 1935 Census of Business. This census of business received the major portion of its funds as a project of the Works Progress Administration.

profitably until they are concentrated and some of the impurities eliminated. Usually concentration or preparation is undertaken at or near the mines to avoid the cost of transporting impurities or moisture. Almost all anthracite and a fifth of the bituminous coal is washed and sized before being shipped to consumers. Cement, lime, concrete-products, and clay-products manufacturers frequently operate limestone quarries and sand, gravel, or clay pits in conjunction with their manufacturing plants.

Although preparation activities are, in general, more closely related to manufacturing than to mining, they are commonly considered as being part of the mineral industries, particularly when they are necessary to make the crude minerals marketable. The preparation activities are frequently carried on at the mine or quarry site, and the mines or quarries and the preparation plants are operated together as single units. On the other hand, identical preparation activities may be carried on by manufacturers who purchase crude materials, or by preparation plants operated independently on a custom or toll basis (or preparing purchased ore which is then sold to smelters).

Thus preparation activities have been included within the scope of the mineral industries because preparation plants are usually operated together with mines or quarries and separate records are frequently not kept and it was desirable to cover all activities through the point at which a marketable product is obtained. Moreover, the 1939 statistics are thus rendered more comparable with statistics for previous censuses, which also cover preparation activities.

All blast furnaces; metal smelters; metal and petroleum refineries; plants manufacturing cement, brick, tile, and pottery; and plants engaged in dressing or polishing stone are classed as manufacturing establishments; they were included in the census of manufactures rather than in the census of mineral industries. The concentration of metallic ores, however, is included within the scope of the respective mineral industries whether done at ore-dressing mills operated in association with mines, at custom mills, at mills concentrating purchased ores, or at mills operated in association with smelters. More exacting demands of consumers have resulted in the growth of coal washing and sizing; such processes are included in the statistics for the coal industries whether done at the mine site or at central cleaning and sizing plants. The crushing, grinding, pulverizing, and drying of stone, clay, gypsum, phosphate rock, and other minerals are included in the industries recovering these materials when done at plants operated in conjunction with the quarries, pits, or mines or at custom plants; in the case of such minerals, particularly limestone for cement and lime manufacture and clay for heavy-clay products and cement, most grinding is carried on at the manufacturing plants and is not covered in the statistics for the mineral industries.

With a few exceptions for minor nonmetals, noted in the individual industry reports, this method of handling preparation activities was applied to each industry. The same practice was usually followed in the censuses for 1929 and earlier years.

Noncommercial operations.— Considerable quantities of crushed stone, sand, and gravel were produced by Federal, State, and local governments and institutions, by public utilities, and by operators who produce exclusively for their own use (in highway and building construction) or on contract for a governmental agency. This production is usually incidental to construction or road building, the product does not enter into the usual channels of commerce, adequate separate statistics for these mineral-production activities are seldom available, and statistics for such "noncommercial" producers were not obtained in the censuses of mineral industries for 1939 and earlier years. Statistics are included, however, for operators who devoted only a portion of their activities to such "noncommercial" production. Statistics covering the production of coal and minerals other than stone, sand, or gravel by or on contract for governmental agencies or for use by the producer for further manufacture are also included. Thus, statistics for "captive" coal mines are included.

Small operations.—The production of minerals ranges in scale from the highly mechanized stripping operations of the Minnesota iron ranges and southwestern porphyry copper deposits to hand placer mining of gold from the streams of the Pacific Coast States and the recovery by farmers of very small quantities of natural gas or salable mineral-bearing rocks found on their farms. Numerous prospectors roam the deserts and mountains and stake small claims. There are many small mines and holes that are worked sporadically when mineral prices are high or in seasons when no other employment can be found. A canvass of such operations is a practical impossibility, particularly since their very existence is seldom known beyond their immediate vicinity and their total production is relatively unimportant.

No effort was made to cover completely the extremely small operations. The statistics for 1939 cover, in general, only those operations (and concerns producing crude petroleum, natural gas, and natural gasoline and rendering oil- and gas-field services) whose total value of all products, including services; reported principal expenses—wages, salaries, supplies and materials, fuel, purchased electric energy, and contract work; cost of buildings, machinery, and equipment erected or installed during the year; or cost of drilling and equipping oil wells, gas wells, and dry wells during the year amounted to $2,500 or more. The census figures for 1929 exclude statistics for enterprises whose output was valued at less than $2,500; or, if not engaged in production, whose development work cost less than $2,500.[2] For 1919, "enterprises producing less than $500 worth of products or ... operations confined to development work on which expenditures amounted to less than $5,000 during the calendar year 1919 were ... omitted."[3]

Although these size limitations were generally observed, two exceptions were made, largely to maintain substantial comparability with statistics for earlier census years. For bituminous coal and lignite for 1939 an output criterion of 1,000 tons was substituted for value of all products and services of $2,500; mines and central cleaning plants that produced less than 1,000 tons are covered if they satisfied either of the other conditions (reported principal expenses or cost of buildings, machinery, and equipment during the year amounting to $2,500 or more). The 1929 statistics for the bituminous-coal industry, however, cover only mines that produced at least 1,000 tons, and cleaning plants. Figures for 1919 cover mines that produced 1,000 tons or more or whose cost of development work amounted to $5,000 or more; cleaning plants are also covered by the 1919 statistics.

The second exception is the common sand and gravel industry. The 1939 figures exclude statistics for operations that produced only unprepared sand and gravel. They also exclude operations that produced less than 15,000 tons of sand and gravel unless such operations had reported principal expenses or cost of buildings, machinery, and equipment during the year of at least $15,000. Statistics for operations producing unprepared sand and gravel exclusively were also excluded from the figures for 1929, as were all producers whose output was less than 25,000 tons. These criteria for the common sand and gravel industry for 1929 were also applied to the glass-sand and foundry-sand industries for that year, except that "data for a number of glass-sand and molding-sand (or foundry-sand) enterprises reporting less than 25,000 tons are included."[4] For 1939, however, the general size limitations were applied to glass-sand and foundry-sand operations. The sand industries were not canvassed for census years preceding 1929.

For the mineral industries as a group, the value of products and employment represented by the many small establishments thus excluded constitute negligible proportions of the total value of products and total employment of all operations. The relative importance of these small operations is greater in some industries such as the tungsten-ore and mercury industries, which consist essentially of small-scale operations.

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[2] Fifteenth Census of the United States, "Mines and Quarries: 1929" (U. S. Department of Commerce, Bureau of the Census, 1933), p. 3.

[3] Fourteenth Census of the United States, Vol. XI, "Mines and Quarries: 1919" (U. S. Department of Commerce, Bureau of the Census, 1922), p. 12.

[4] Fifteenth Census of the United States, "Mines and Quarries: 1929," p. 3.

Reports were requested from all companies known to have mineral operations. As a result, schedules were received from many small operations. Tabulations were made of statistics reported for these operations; whenever feasible these statistics are presented as supplementary information in the industry reports in Volume I. The statistics presented for small operations are probably incomplete, however, and should be used with that understanding.

Operations not covered in 1939 census statistics.—With the few exceptions specified below, all companies known to have mineral operations in 1939 were canvassed. Mineral commodities not covered in the various reports were not produced in continental United States during 1939, were produced by operations too small to come within the scope of the census, or were not listed on records available to the United States Bureau of the Census. Exclusions from the statistics of the 1939 census of mineral industries may be summarized as follows:

(1) Certain noncommercial operations (as explained above).

(2) Small operations (except as shown in special tables), including most stripper oil-well and small-scale placer-gold operations, and prospecting when done by individual miners.

(3) Operations producing commercial salt and other products from brines; recovering bromine, magnesium compounds, or other materials from sea water; recovering mineral spring waters; and certain other operations whose activities were considered to be essentially manufacturing. Operations mining rock salt, however, are included. Also included are operations producing potash, natural sodium compounds other than sodium chloride, and lithium minerals from natural brines.

(4) The production of helium, carried on in 1939 exclusively by the Federal Government.

(5) The recovery of minerals, such as earth, used for filling purposes only.

Differences in coverage of 1939 and 1929 censuses.—Except for minor differences resulting from different methods of determining small operations, the following differences exist between the coverage of the 1939 and 1929 censuses of mineral industries:

(1) The 1939 census includes, whereas the 1929 census excludes, the production of crude petroleum, natural gas, and natural gasoline. The "Crude petroleum and natural gas" industry, measured in terms of value of products, was the most important single minerals industry in the United States in 1939.

(2) The 1939 census canvassed for the first time concerns performing oil- and gas-field services on a contract basis, Pennsylvania anthracite strip-pit contractors (however, such concerns were covered in the 1935 survey), and concerns performing general contract services for the mineral industries. The 1889, 1902, 1909, and 1919 censuses asked operators to report, in addition to the cost of contract work, the number of men employed by contractors; the contractors themselves were not canvassed. No such employment statistics were published separately, however, except for 1902; the statistics for that year were largely estimated.

(3) The 1929 census figures for the clay industry exclude statistics for clay mined by clay-products manufacturers and used in their own production. The mining of such clay was included in the 1939 census; it represents the bulk of the common clay and shale mined during the year.

(4) In addition to the industries enumerated above the 1939 Census of Mineral Industries includes, whereas the 1929 census excludes, operations engaged primarily in producing greensand, peat, potash, and rock salt.

(5) The 1939 census presents separately, whereas the 1929 census combines, statistics for operations engaged chiefly in producing the following minerals: Bentonite, diatomite, fire clay, kaolin and ball clay, lignite, molybdenum ore, natural sodium compounds, pyrites, sulfur, titanium ore, tripoli, tungsten ore, and vanadium and uranium ore.

RELIABILITY OF STATISTICS

One of the criteria used in drawing up the various schedules was the ability of the operators to supply the desired information. Some of the inquiries were naturally, answered with a greater degree of accuracy than were others. It was found that reports for the larger operations, for which more detailed and extensive records were kept, were in general more complete and accurate than reports for smaller operations, for which relatively scant book records were kept and for which operators sometimes resorted to estimates based on memory only.

The discussion in the paragraphs which follow is based on experience in handling reports submitted to the 1939 Census of Mineral Industries and is believed to be of use in shedding some light on the reliability of the 1939 statistics presented in these volumes.[a]

Number of operating companies and operations.—The name of the operating company was reported on each schedule, and in compiling statistics duplications arising from the conduct of more than one operation by the same company (often at different locations) were eliminated. Figures for number of operations, particularly number of mines, may not be as accurate because of some uncertainty that each operator had the same notion of what constitutes an operation. An underground mine, for example, may consist of a single opening or a group of openings; some operators may have counted a group of openings as a single mine whereas others may have counted each opening as a mine. In general, however, a "mine" should be interpreted as a group of openings at a given locality in which activities are conducted as a unit or are unified by common management or joint handling of some part of the mining process.

Number of wage earners.—The schedules requested the number of wage earners on the pay roll during the pay-roll period ending nearest the 15th of each month. Since these figures are based directly on pay-roll records, they could be supplied accurately by the great majority of the operators.

In order to obtain a measure of average employment during the year, the sum of the 12 monthly figures for each industry, segment of an industry, or State or county was divided by 12. This is the usual census average that is computed by the Census of Manufactures as well as by the Census of Mineral Industries. It is believed to represent the best annual figure obtainable from available information for most purposes, particularly as an indicator of the relative importance of the industry or State as an employer of labor. It also has the virtue of being similar in nature to averages presented for all census years as far back as 1909. (An alternative average, representing the number of wage earners on active days, was also computed for each industry; this average is discussed at the end of this subsection.)

There are several important limitations that must be placed upon the use of these averages of the 12 monthly figures. The very nature of an average precludes the possibility of indicating peak employment. Thus the average for a particular industry cannot represent the total labor force required by that industry or the total number of different persons that were employed by the industry at any time during the year. Many operations are affected by weather conditions (quarries and open-cut mines in particular) or other factors making for normal operation during only part of the year; the average of the 12 monthly figures is likely to be less than the number of men employed at particular periods of operation or even during all active periods. For example, open-cut iron-ore operations reported about 3,600 wage earners during January and February and 6,000 to 7,000 in July to November. The average of the 12 monthly figures was 5,400. The monthly figures reported for operations producing crushed and broken limestone averaged 24,800 but ranged from 18,300 in January and 18,700 in February to 28,000 in September. These monthly fluctuations reflected both weather conditions and changes in demands.

The average also does not measure the number of wage earners depending upon employment in a given industry as a means of livelihood. In the coal fields, for instance, the men seldom have any source of employment other than the mines in the locality.

Neither does the average of the 12 monthly figures represent the number of continuously employed wage earners. A census is necessarily limited to obtaining simple numbers from company books such as the number of names on the pay rolls. Such procedure cannot take into account the well-known factors

[a] Explanations of the terms used to denote the various items of statistical information may be found in the section entitled "Explanations of terms."

of labor turnover and intermittent employment of individual wage earners. Thus no distinction is made between employees working during the entire pay-roll period and those working only one or two days during the pay-roll period. Similarly, no distinction is made between wage earners working overtime, those working the full prevailing shift, and those working but several hours per day.

Several additional qualifications must be imposed on the monthly figures, and therefore also on the averages of these figures. First, a few men may be counted more than once in a single month if they change employers during the specified pay-roll period or if they work for several employers. This is particularly true of the oil and gas fields, where men may tend wells for several concerns. Second, the pay-roll period ending nearest the 15th of a month may not be typical of that month. In fact, such pay-roll periods tend to be more representative of the early parts of the month than of the later parts of the month; if employment in an operation is increasing, the figures for the pay-roll period specified may understate the average levels of employment prevailing in the respective months. The opposite, of course, may be true for periods of declining employment.

An alternative measure of wage-earner employment is the "Average number of wage earners on active days (excluding shutdown periods)." It was obtained by aggregating figures reported by individual operators for the average number of wage earners employed on active days. The industry average thus obtained is usually greater than the average of the 12 monthly figures, since the former is not influenced by low levels of employment on days when the respective operations were inactive.

The average for active days has several advantages. It approximates the average labor force required by an industry because it refers only to employment on days when the various operations constituting the industry were engaged in production or development work; however, being an average, it does not indicate the maximum number of men employed by the industry at any one time during the year. Another advantage of this average is that it may be related to the average number of full days the operations in an industry were active. In fact, multiplication of days active by average employment on active days will yield approximately the number of man-shifts worked by wage earners on active days.

The average for active days is more nearly comparable than is the average for the 12 monthly figures with the "Average number of men employed" compiled annually for many years by the United States Bureau of Mines and its predecessor in the field of mineral statistics, the United States Geological Survey.

It should be noted, however, that neither average measures the actual amount of labor used in an industry, which is represented only by the number of man-hours worked.

Number of salaried employees, proprietors, and firm members.—The number of salaried employees and the number of proprietors and firm members of unincorporated concerns represent, for 1939, the numbers during the normal pay-roll period ending nearest October 14. This is similar to the period specified in the 1939 schedules of the Census of Manufactures. The number of salaried employees was readily available from pay-roll records. The employment of salaried workers and the number of proprietors and firm members are relatively stable, and the number of such persons reported for a single pay-roll period is believed to represent with reasonable accuracy the typical number for the year.

The schedules requested unincorporated concerns to report the number of proprietors and firm members "regularly performing manual labor" in or about the operation. These figures must be considered approximations, for analysis of the schedules revealed that the inquiry was frequently misunderstood and the word "regularly" lends itself to a variety of interpretations. As a rule proprietors and firm members regularly performing manual labor were reported by the smaller operators, many of whose reports were defective in other respects but who represented only a small part of their respective industries.

Production and value of products.—Quantity and value of products as reported for individual operations are usually a matter of record and can be reported with a high degree of accuracy from even the most elementary of bookkeeping records. In the case of operations producing metallic ores and concentrates, assay, smelter, and refinery reports to the producers could frequently be used as a basis for filling out the census schedules. The smaller operators, however, encountered some difficulty in reporting, especially where the metal content of their ores and concentrates was concerned. Some operators submitted smelter or settlement sheets from which the Bureau of the Census obtained the information needed.

Another source of difficulty arose in connection with breakdowns of products by use. Stone, clay, and sand and gravel operators in particular were asked to report separately the quantity and value of their product intended for different uses. Such separations could not always be made on the basis of available records. They were occasionally estimated and occasionally merely reported in the "Other" category. It is quite possible that a few operators reported their entire product in the category that applied to most of their product. Although the totals are believed quite accurate, the figures for the components are subject to some error.

Not all operators determined value figures on the same basis. Although the selling price of the unprepared product f.o.b. mine, quarry, or well and the selling price of the prepared f.o.b. preparation plant were requested, all accounting systems did not permit the reporting of values in identical terms. Some operators reported market price; others reported cost of production. Several reported prices paid by smelters; such prices are usually determined after the ores and concentrates have reached the smelter. Some mineral products not produced for sale, mainly those of integrated companies, were merely assigned nominal values. Usually careful examination of the individual schedules revealed these deviations from the f.o.b. mine or plant values requested, and the operators were requested to reexamine and if necessary to correct the figures originally submitted.

Reported principal expenses.—The six classes of operating expenditures reported on the schedules are wages, salaries, supplies and materials, fuel, purchased electric energy, and work done by contractors. These are items that have been requested in the censuses of mineral industries for a number of years, and many operators have become accustomed to reporting them. Usually little difficulty is experienced in reporting these items, particularly since pay rolls, invoices, canceled checks, and other records are available to operators.

Cost of buildings, machinery, and equipment.—Little difficulty was encountered by operators in obtaining these items of information. The reporting companies were requested to include installation costs. Some degree of error may exist because costs of labor and materials for some construction or for installation of equipment could not be segregated by operators and were therefore reported only as wages or cost of supplies and materials.

Cost of drilling and equipping oil and gas wells.—Producers of crude petroleum and natural gas and contractors rendering oil- and gas-field services also reported number and footage of oil, gas, and dry wells completed during 1939 and the cost of drilling and equipping these wells. Cost of equipping was divided so as to obtain separate cost figures for "casing," "equipment for flowing or pumping," and "production derrick." Separate data were reported for wells drilled by oil and gas producers and wells drilled by contractors.

For each item of information requested the respondent was carefully advised as to what cost items should be included or excluded. (For instructions to producers see appendix B in Volume II, reproduction of "Crude petroleum schedule," Form 100-MQ-P, inquiry 11 and detailed instructions at end of schedule.)

The desired figures were furnished by all large producers and contractors, although problems were encountered by the smaller concerns whose records were not adequate for the purpose of supplying these figures. In such instances approximate cost figures were developed by special field investigators of the Bureau of the Census working at the offices of the respondents or were estimated on the basis of supplementary information supplied by the companies.

The data collected in a general statistical inquiry such as the census of mineral industries do not, of course, attain the precision of data obtained in detailed cost-accounting

investigations. Nevertheless, the census cost figures are believed to be representative for comparison purposes and supply a bench mark for the measurement of trends.

Man-shifts and man-hours worked.—The increase in recent years in the number of operations keeping labor-time records made it feasible to attempt to procure man-shift and man-hour data for the mineral industries for 1939.

Federal and State legislation enacted in recent years made it necessary for many operators to revise their accounting systems so as to provide the labor-time records required for unemployment insurance and particularly for compliance with the Fair Labor Standards Act, the provisions of which became effective in 1938. Mechanization of operations, especially in the bituminous-coal industry, has resulted in a shift from piece rates to hourly rates. For a number of years prior to 1939 operators in many mineral industries reported statistics on man-shifts and man-hours to the Bureau of Mines. Trade associations have also shown interest in labor-time records. As a result, it was believed that there were many more operators who kept such records for 1939 than for any previous census year.

Nevertheless, many companies kept no records and reported their best estimates; a few did not even report estimates. In such cases the missing figures were estimated by the staff of the Bureau of the Census on the basis of other information contained in the operator's report.[6]

Comparison of the man-shift and man-hour figures for wage earners reported by an operator and other information contained on the schedule of that operator, especially wages paid, permitted some tests of the reasonableness of the man-shift and man-hour figures reported. When the accuracy of these figures appeared to be in doubt, the respondent was requested to reexamine them and to correct them if necessary.

A number of companies that reported man-shifts and man-hours worked by wage earners were unable to provide departmental break-downs or did so only by estimation, with the result that departmental figures are less reliable than the totals. Figures shown for man-shifts worked during the first, second, and third shifts were computed as described in the discussion of "Multiple-shift operation" under "Explanations of terms."

Power equipment.—The 1939 schedules not only sought information on the number and horsepower rating of prime movers and electric motors but also attempted for the first time to obtain complete information on the number, size, and types of power loading machines at mineral-producing operations.

The information requested on the number and horsepower rating of various classes of power units is a traditional census inquiry and was usually supplied with relative ease. The horsepower rating of an engine or motor is often noted on the manufacturer's name plate. The number and type of power loading machines are readily available to the operator and could also be reported without difficulty.

Operators were asked to report separately prime movers and electric motors for driving stationary equipment and those for driving mobile equipment. These separations are subject to some error insofar as some operators may have interpreted the stationary or mobile character of equipment differently, depending upon the comparative ease of portability or frequency of moving equipment from place to place. Some tendency was noted on the part of operators to fail to report internal-combustion engines for driving mobile equipment. Such cases were usually discovered by noting that although the number and type of power loading machines or trucks were reported, no data were reported for number and horsepower of engines used for driving such mobile equipment. In these cases the missing information was obtained by correspondence or, when sufficient other data were available, by estimation.

Fuel and electric energy consumed.—Operators were asked to submit information on the quantity of bituminous coal, anthracite, fuel oil, gasoline and kerosene, and natural gas actually consumed during the year. Records of purchases are usually available, as are inventories at the end of each year. In general, the companies experienced little difficulty in answering this inquiry. The same is true of the number of kilowatt-hours of purchased electricity consumed, usually available from invoices submitted by power companies. Many operators also consumed electricity generated by themselves, and some either kept no record of the number of kilowatt-hours consumed or failed to measure the electricity generated. Such statistics were completed by estimation where necessary.

[6] It should be noted that approximate estimates of man-hours could be made for operations in some industries by the multiplication of three factors: (1) average number of men employed on active days, (2) number of days the operation was active (these two factors yield estimates of man-shifts), and (3) number of hours worked per man per day.

INDUSTRY CLASSIFICATIONS

Each of the operations for which a schedule was obtained was classified in one of the industries for which statistics are presented. The industry classification of any operation was determined from the product of chief value produced by that operation during the year. Industry classifications are generally based on single products (bituminous coal), relatively homogeneous products (natural sodium compounds), or joint products (crude petroleum and natural gas). The combination of statistics for operations engaged in producing unrelated products was avoided wherever possible. Some minerals, however, constituted the chief product of but few operations; in such cases it was necessary to combine statistics for producers of several categories of products in order not to disclose confidential information for individual operations.

Industry and commodity classifications.—Much of the published statistical information regarding the production of minerals is based upon a commodity classification which permits the presentation of figures for particular mineral commodities. All production figures for a given commodity are aggregated whether or not the commodity was produced as a major product, a secondary product, or a byproduct of an operation. For instance, the estimated recoverable silver content of domestic direct-shipping ores and concentrates produced in 1939 was 62,800,000 fine ounces. Of this amount, only 31,000,000 fine ounces, or 49.3 percent, were contained in products of operations classified in the silver-ore industry. About 20.9 percent was contained in products of the copper-ore industry; 15.0 percent, in products of the lead-ore industry; 11.3 percent, in products of the gold industry; 3.3 percent, in products of the zinc-ore industry; and 0.2 percent, in products of other industries, chiefly the tungsten-ore industry. About 96.6 percent of the copper, 75.2 percent of the lead, 82.4 percent of the zinc, and 84.8 percent of the gold was contained in products of the copper-ore, lead-ore, zinc-ore, and gold industries, respectively. In the following tabulation the estimated recoverable quantities of the major nonferrous metals are distributed according to the industry in whose products they were contained. Figures are for 1939.

METAL	PERCENT OF TOTAL FOR ALL INDUSTRIES					
	Gold	Silver-ore	Copper-ore	Lead-ore	Zinc-ore	All others
Copper	0.4	2.2	96.6	0.7	0.1	[1]
Lead	2.8	5.0	1.8	75.2	15.2	0.2
Zinc	0.3	0.8	4.7	11.6	82.4	0.2
Gold	84.8	2.5	11.1	1.1	0.5	[1]
Silver	11.3	49.3	20.9	15.0	3.3	0.2

[1] Less than 0.05 percent.

The virtue of a commodity classification lies in the fact that it measures the complete output of an individual commodity, thus presenting a comprehensive view of total production in the United States. Because of the usefulness of such information for many purposes, statistics dealing with aggregate production of individual minerals are presented in the general summary in Volume I.

A serious deficiency of a commodity classification, however, is that it does not permit the relation of operating statistics in mining to the aggregate output of the respective mineral commodities. It is not possible to classify operating statistics such as employment, labor time, expenses, and power equipment on a commodity basis when some operations engage in producing more than one commodity; separate records of operating statistics for each commodity are seldom kept. For purposes

of relating production to other operating statistics it is extremely difficult, if not impossible, to allocate accurately such figures as those for employment and power equipment as reported for individual mines to the production of copper, lead, zinc, gold, and silver when those mines are working complex ores containing all of these metals.

It is thus clear that if operating statistics are to be related to production it is necessary for practical reasons to treat each operation as a unit and to classify it according to its product of chief value. For most analytical purposes the industry classification of production is the more useful one.

Problems of classification.—The use of industry classifications gives rise to classification problems. It is first necessary to determine for each operation its principal product. Single-product operations offer no difficulty in this respect. Operations producing more than one product and furnishing separate information on each product can also be classified with relative ease; such operations are classified according to the product of chief value. The glass-sand industry, for example, consists of operations engaged chiefly in recovering glass-sand although some of these operations produced considerable quantities of sand used for purposes other than the manufacture of glass.

Operations engaged in producing complex ores and concentrates provided difficult problems of classification. Nonferrous-metal operations in the western States mined complex ores having an assay content of several metals and deriving their value from several of the recoverable metals. Thus the value of the ores and concentrates was not in itself sufficient for the proper classification of such operations. Although the operations reported the assay content of each of the metals in their ores and concentrates, these figures did not in themselves permit classification because of the dissimilar unit values and dissimilar recovery ratios for each metal. It was therefore necessary to determine the metal of chief value by first determining the recoverable quantity of each metal and then multiplying by the market price of that metal. It is obvious, of course, that the industry in which a given operation was classified depended at least in part upon the market prices of the refined metals; the same operation may have been classified in one industry in 1929 and in another in 1939. For example, between 1929 and 1939 there was a substantial increase in the price per ounce of newly mined domestic silver. Some of the complex ores valued chiefly for their content of some metal other than silver in 1929 were valued chiefly for their silver content in 1939 as a result of this price increase.

A careful segregation of secondary products, byproducts, and joint products was considered important. First, such products are frequently important in the economic situation of individual operations and industries; sometimes the aggregate value of all such products of a given operation exceeded the value of the operation's principal product. Knowledge of the nature and importance of such products is necessary to the analysis of production in relation to other operating statistics. Second, a complete and detailed listing of secondary products, byproducts, and joint products is essential to the determination of the total output of any single product during the year.

Differences between 1939 and 1929 industry classifications.— The industry classifications used for 1939 are more detailed than those used for 1929. Separate figures are shown for 1939 for bituminous coal and for lignite. The "Molybdenum, vanadium, and titanium" category was split into "Molybdenum ore," "Vanadium and uranium ore," and "Titanium ore." The "Clay" classification used for 1929 was broken down into "Fire clay," and "Kaolin and ball clay." The "Fuller's and filtering earths" industry was divided into "Fuller's earth" and "Bentonite." The "Sulfur" and "Pyrites" industries for 1939 are equivalent to the 1929 "Sulphur and pyrites" industry. The natural-abrasives industry classifications used for 1929 were modified for 1939. "Millstones and pulpstones" was eliminated as a separate classification and statistics for operations that produced these abrasive stones in 1939 are included in figures for the "Natural abrasives" industry together with statistics for operations of the type classed as "Abrasive materials" in 1929. The "Silica" industry of 1929 was abandoned—the producers of diatomite and diatomaceous earth in 1939 are classified separately in the "Diatomite" industry, the producers of tripoli in 1939 are also classified separately in the "Tripoli" industry, and producers of other siliceous materials in 1939 have been distributed among other industries, chiefly "Sandstone" and "Miscellaneous stone."

TYPES OF OPERATIONS

Most mineral operations were engaged in production work throughout the year or for most of the year and were engaged in development work coincidentally. Other operations had some products but were engaged principally in development, assessment, repair, or maintenance work; their products were obtained in the course of development work or by production work during a portion of the year. A relatively small number of operations had no products during the year but expended considerable sums on development, assessment, repairs, or maintenance. The census statistics are presented separately for three broad types of operations:

(1) Producing operations. All statistics presented without specific reference to the type of operation represent operations that had products. These are comparable with census figures for producing operations for earlier years.

(2) Contract-service operations. These are operations conducted by contractors for the account of others and devoted principally to development of mineral properties. Operations conducted by contractors engaged principally in mineral production for the account of others (for example, operations of Pennsylvania anthracite strip-pit contractors) are not included with "contract-service operations" but rather with "producing operations." Oil- and gas-field service operations are by far the most important of the contract-service operations and statistics for them are presented separately from the statistics for general contractors engaged in work for mineral industries other than crude petroleum and natural gas. It should be noted that a number of companies that produced minerals or engaged in development work for their own account also performed work on contract for other concerns. Separate detailed statistics for such incidental contract work are seldom available but are included with the other statistics for the companies' operations. Amounts received for work performed for others are included in the totals for value of products and are shown separately in tables 6 and 7 of the General Summary and in the detailed statistics for the individual industries in Volume I.

(3) Nonproducing operations (other than contract-service operations). The statistics for operations that neither produced minerals nor performed work for others are always clearly distinguished throughout the volumes from statistics for producing operations. Many of the operations that had no products were engaged in development work. It should be noted, however, that mines undergoing development often produce some minerals; such mines were classed as producing mines, regardless of the quantity of minerals produced.

The statistics for the first broad type are frequently subdivided to distinguish between operations with different characteristics. The nature of these distinctions varies for the individual industries; they are made where significant differences in operating characteristics occur and where the statistics for the break-downs are considered to be useful for analytical purposes.

For some industries separate statistics are presented for operations using underground mining methods and those using open-cut methods. Anthracite, for example, is mined underground, stripped from open pits, shoveled from culm banks, or dredged from stream beds, and separate statistics are presented for these types of operations. Production methods of stone quarries differ according to whether they produce crushed and broken stone or dimension stone; accordingly, separate statistics are presented in the stone industries for operations producing chiefly crushed and broken stone and for those producing chiefly rough-dimension blocks or slabs. In the "Natural gasoline" industry statistics are presented separately for absorption plants, compression plants, charcoal plants, and plants using a combination of methods. The statistics for "Oil- and gas-field services" recognize 17 different types of services.

PERIOD COVERED

The census schedules for 1939 covered activities during the calendar year that ended on December 31, 1939. Beginning with the 1889 census the statistics refer in general to the calendar years 1889, 1902, 1909, 1919, and 1929.

For 1902 to 1929, however, operators were permitted to submit reports covering activities during their business or fiscal year most nearly corresponding to the calendar year. Thus the

1929 schedules read: "This report should relate preferably to the calendar year 1929; but it may be made to cover the business or fiscal year ending within the period from April 1, 1929, to March 31, 1930. It should, in either case, cover a full year's operations if the plant was active during the entire year."[7] The 1919 schedules state: "Reports are required on this schedule for all mines and quarries that were in operation for development or productive purposes during any portion of the year ending December 31, 1919, but the statistics may pertain to the business year which most nearly conforms to the calendar year."[8] The schedules for 1909 carried a virtually identical statement, whereas the 1902 schedule merely requested that "the information returned on this schedule should cover the business year of the establishment most nearly conforming to the year ending December 31, 1902."[9] The 1889 schedules called only for information for "the year ended December 31, 1889."[10]

Census schedules for 1840, 1850, 1860, 1870, and 1880 requested statistics covering the 12-month period ending on May 31 or June 1 of the respective years.

EXPLANATIONS OF TERMS

The paragraphs which follow are intended to provide general explanations and definitions of the items of information presented repeatedly in the various reports. For some industries, however, these items may have somewhat different meaning and may require special explanations; in such cases all necessary explanations are made in the individual industry reports affected, usually in footnotes to the appropriate tables or in the introductions.

Number of operating companies.—An operating company is defined as a company actually engaged in exploiting or developing a mineral property. Each corporation, proprietorship, partnership, or cooperative that engaged in operating or developing mineral properties was counted as a single operating company. Companies owning or controlling mineral properties but not actually exploiting or developing them were not counted.

No two companies were considered operating companies of a single property at the same time, but if ownership of a property changed during the year each of the companies was counted. No company, however, was counted more than once.

No statistics on the number of operating companies were compiled for 1929 and earlier census years except 1909 and 1902. The 1929 census presents instead the number of enterprises, an "enterprise" representing "one or more mines or quarries, all within the same county, operated under a common ownership or under unified control, or for which only one set of books of account was kept, and for which a single report was made..... The number of enterprises shown in the tables is equivalent to the number of individual reports tabulated, and does not represent the number of individual operators."[11]

Number of operations.—An operation is an individual mineral property operated as a unit. It may be a mine, a quarry, a preparation plant, or a mine or quarry operated together with a plant. Thus a mine and a preparation plant operated as a unit are considered a single operation for such purposes as classification by size and other characteristics. Several openings constituting a single working or management unit are considered as single mines. Wherever possible separate figures are presented on number of mines or quarries and number of preparation plants. Generally, respondents were requested to submit a separate report for each operation. Crude petroleum and natural gas companies were asked to submit separate reports for their oil-well or gas-well operations in each State segregating statistics for oil-well operations from statistics for gas-well operations. Each concern engaged in performing work on contract for the mineral industries was requested simply to submit one report covering all its contract work.

Wage earners.—Wage earners were defined for census purposes as employees who performed manual labor; used tools; operated machines and equipment; handled materials and products; cared for mines, quarries, wells, shops, yards, and plants; or performed similar tasks. Gang and straw bosses and foremen who devoted most of their time to such tasks were classed as wage earners, as were "contract miners" (men who undertake mining work at a stipulated price per ton, yard, carload, or other unit of measurement) and the men engaged by them. Employees not actually on the pay rolls but paid indirectly through such employees as superintendents and foremen and workers paid under the "split-check system" were also counted as wage earners. No distinction was made between time and piece workers. Clerical workers were classed as salaried employees even though performing their work at the mine, quarry, or well site. Thus employees were classified as wage earners on the basis of the type of work performed rather than on the basis of method or frequency of their compensation.

The "Number of wage earners (average for the year)" was computed by dividing the sum of the 12 monthly figures by 12. Operators were requested to report, for each month, the number of wage earners who actually received pay during the pay-roll period ending nearest the 15th of the month. Thus the monthly figures, and therefore the average for the year, include part-time as well as full-time workers.

The 1935, 1929, 1919, and 1909 schedules called for the number of wage earners employed on the 15th of each month. The number of workers working on any single day is likely to be lower than the number of names on the pay roll because of temporary absenteeism for illness or some other cause and because of labor turn-over. It is believed, however, that this difference does not materially affect comparability of the statistics for the 5 years.

The average numbers of wage earners shown for 1939, 1935, 1929, 1919, and 1909 were computed in the same manner and are therefore similar in nature. Wage-earner employment for 1902, however, was presented in terms of full-time equivalents (300-day workers) and is therefore low relative to the 1909-39 averages. For 1880 and 1889, however, the figures are high relative to the 1909-39 averages, for they represent the average numbers of wage earners employed when operations were active.

An alternative measure of average employment is presented for 1939—the "Average number of wage earners on active days (excluding shut-down periods)." Each operator was requested to report the average number of wage earners employed on active days (usually for each shift) worked by each department of his operation. Aggregation of these specific figures for all of the operations constituting an industry yielded the average for the industry. (In the cases of bituminous coal and lignite, departmental figures for average number of men employed on active days on each shift were not requested. The average for each operation was computed by dividing the number of man-shifts worked by wage earners on active days by the number of days the operation was active during the year; aggregation of the averages for the respective operations yielded the industry averages.) The industry average represents average wage-earner employment during the number of days represented by the "Average number of equivalent full days operations were active"; multiplication of these factors results in an approximation of the number of man-shifts worked by wage earners on active days.

Salaried employees.—The distinction between wage earners and salaried employees is based upon the character of the work done rather than upon method of payment. Salaried employees include officers of corporations, engineers, metallurgists, other professional and technical men, managers, superintendents, other supervisory personnel, and clerical employees of all grades. Employees at central offices are included. They were usually included in the reports for the related mines or preparation plants; when this was not done, a special central-office schedule was used to complete the record. In a few instances some manual workers were reported engaged at central office buildings and laboratories; such workers were classed, when reported separately, as salaried employees. This was done principally because corresponding man-shift and man-hour figures were not reported.

[7] Fifteenth Census of the United States, "Mines and Quarries: 1929," p. 411.
[8] Fourteenth Census of the United States, Vol. XI, "Mines and Quarries: 1919," p. 438.
[9] Mines and Quarries: 1902 (U. S. Department of Commerce and Labor, Bureau of the Census, 1905), p. 1089.
[10] Report on Mineral Industries in the United States at the Eleventh Census: 1890 (U. S. Department of the Interior, Census Office, 1892), p. 791.
[11] Fifteenth Census of the United States, "Mines and Quarries: 1929," p. 4.

The number of salaried employees for 1939 represents the number receiving pay during the normal pay-roll period ending nearest October 14. The schedule for 1929 requested the number of salaried employees as of December 14 or the nearest representative day; the 1919 and 1909 schedules, as of December 15 or the nearest representative day. Schedules for earlier years specified no date. Because of the relative stability of employment of salaried employees and the fact that operators were given the option of selecting a more representative day than the one specified on the schedule, the figures for the various years are probably equally representative.

The census schedules for 1929 requested separate statistics for principal officers of corporations and for other salaried officers and employees. The 1919 census asked for four classes of salaried employees, by sex: salaried officers of corporations, superintendents and managers, technical employees (engineers, chemists, etc.), and clerks and other subordinate employees. The 1909 census distinguished three classes of salaried employees, also by sex: salaried officers of corporations, superintendents and managers, and clerks and other salaried employees. The 1902 census obtained separate figures for general officers; superintendents, managers, foremen above ground, surveyors, etc.; foremen below ground; and clerks. Schedules for 1889 requested figures for office force, by sex, and foremen and overseers; the 1880 census obtained figures for "number of administrative force."

The distinctions made between various categories of salaried employees in the 1929, 1919, 1909, and 1902 censuses were not maintained in the 1939 census because of the difficulties of drawing clear lines of demarcation.

Proprietors and firm members.—Owners and partners of unincorporated concerns, regardless of function or method of compensation, were reported as proprietors and firm members; they were not included among wage earners or salaried employees. In the case of cooperative concerns, however, the members performing manual labor were classed as wage earners provided that there were more than three. Many proprietors and firm members regularly perform manual labor in or about their operations and such proprietors and firm members are shown separately and represent part of the working force of the mineral industries.

As in the case of salaried employees, the number of proprietors and firm members represents the number during the normal pay-roll period ending nearest October 14 for 1939, on December 14 or on the nearest representative day for 1929, and on December 15 or on the nearest representative day for 1919 and 1909. Comparability between the figures for the various years, however, is not appreciably affected by these differences in the selection of reporting dates.

Production.—Because of differences in the nature of products and units of measurement and because of diversity of activities, it is not possible to present comparable statistics on quantities of products for the several industries. The individual industry reports, however, contain as detailed production statistics as may be shown for the respective industries. Whenever available information has permitted, separate figures are shown for quantity of crude material produced, quantity of crude material treated, and quantity of prepared product produced during the year. In the case of the metals considerable detail is also presented on estimated recoverable metal content of ores and concentrates.

Value of products.—Figures for total value of all products represent selling values assigned by operators to all their products at points of production, receipts for services rendered to others, and value added by preparing crude materials recovered before 1939 or by others; they do not necessarily indicate market values of products or actual revenue derived from sale of products. Where an operation consumed part of its own production, as in the use of coal for fuel at coal-mine power plants, the value of the material consumed is included in the value of products. The respondents were asked to exclude selling expenses and cost of delivery to purchasers from the value of products at points of production.

The value of products of an operation covers, in general, the value at the mine, quarry, or well of crude materials produced in 1939, regardless of whether the crude material was shipped in 1939 or held as a stock pile; value added during 1939 by milling or otherwise preparing crude material, regardless of whether the crude material was produced in 1939, taken from a stock pile, or purchased; receipts for miscellaneous services performed for other operations, such as stripping overburden or shop work; and value of electric energy generated at the operation and sold to others. The values of all secondary products and byproducts are included. The object was to include all activities and only those activities for which operating statistics were reported.

The individual industry reports present, whenever feasible, break-downs of the over-all value figures. Separate figures are frequently shown for value of major products, value of secondary products and byproducts, value of electric energy sold, and receipts for services performed for others. When practicable, the values of major products are further subdivided to provide specific information on the mine, quarry, or well value of crude materials produced in 1939, preparation-plant value of materials mined or quarried and prepared in 1939, and value added in 1939 by preparing materials mined or quarried before 1939 or by others, including receipts for custom milling.

The nature of the value-of-products figures varies somewhat among the various industries. Prevailing production patterns and marketing practices of the respective industries differ, and the schedules used to canvass the industries were devised to take into account these differences and the abilities of the operators to supply information accurately. Figures for total value of all products, however, may be compared directly insofar as they represent aggregates, in terms of dollar volume, of all activities of all operations in a given industry or geographic area.

It should be noted, particularly with respect to the industries producing metallic ores and concentrates, that the values reported by an operation do not represent the market values of the desired minerals contained in or recoverable from the operation's products. For instance, the value of merchantable iron ore (direct-shipping and beneficiated ore) produced by the iron-ore industry represents the value of the ore and not the value of the metallic iron to be obtained from the ore.

Reported principal expenses.—The important expenses incurred by the mineral industries in the conduct of their operations in 1939 and reported to the Bureau of the Census include wages, salaries, supplies and materials, fuel, purchased electric energy, and contract work done by others. No information was requested concerning other important expense items such as taxes, depletion, depreciation, royalties, rent, interest, and insurance; accordingly, profits or losses cannot be calculated by deducting the sum of the reported principal expenses from the value of products.

The schedules also called for information on cost of erecting new buildings, major alterations of existing structures, and new and used machinery and equipment installed during the year. Oil-well and gas-well operators and oil- and gas-field contractors were also requested to report costs of drilling and equipping oil wells, gas wells, and dry holes. These expenditures, representing depreciable capital additions, are of a different nature from, although partly duplicated in, the expenditures enumerated above; they are therefore presented separately and are not referred to by the term "reported principal expenses."

Wages and salaries.—Figures for wages and salaries represent total payments during the year to wage earners and salaried employees, respectively. Operators were requested to "include all salaries, wages, bonuses, commissions (and profits when paid to employees) before deductions for Social Security, insurance, dues, etc. If board or rent was furnished as part compensation of employees, its value should be included as wages and salaries. Report net wages only; if the cost of smithing, and of explosives, fuses, lamp fuel, and similar.... supplies used in production or development work was charged to employees and deducted from their wages, report the amount of wages after such deductions."

Wages and salaries, which are aggregates for the year, are not similar in nature to figures for average numbers of wage earners and numbers of salaried employees, which are measures

of employment during specific pay-roll periods. Accurate calculation of average annual earnings cannot be made because of the nature of the employment averages.

Supplies and materials.—Figures represent the cost of supplies and materials, including transportation costs, actually used or consumed during the year for production, development, and maintenance rather than the cost of supplies and materials purchased during the year. The term "supplies and materials" refers to such items as explosives, fuses, lumber and timber used for supports or repairs, track ties, rails, tools or parts used for maintenance and repair of buildings and equipment, iron and steel for blacksmithing, lubricating oils, water for boilers and other purposes, containers for products, and materials for mixing, blending, or reacting with products. Explosives and similar supplies sold to employees are included.

Commodities purchased for resale in the condition in which purchased (but not supplies sold to employees for use in production or development work) and items chargeable to capital-asset accounts are not included in supplies and materials. Crude materials recovered and treated at the same operation are, of course, also excluded.

Fuel.—Operators were asked to report the quantity and cost, including transportation cost, of all fuels actually consumed during the year for production, development, and maintenance of the operation. Fuels produced by an operation and consumed at that operation are included. No distinction was made between fuels used for heat and those consumed in the operation of power equipment.

The cost of fuels covers all fuels consumed. Quantity figures, however, are shown separately for bituminous coal, anthracite, fuel oils, gasoline and kerosene, and natural gas; no quantity figures were tabulated for other fuels.

Electric energy.—The cost and number of kilowatt-hours of purchased electric energy represent all purchased electric energy consumed during the year, whether to operate power equipment, for light, or for heat. Electric energy generated by the reporting companies is presented in two categories: that consumed by the generating company and that sold to others. The latter is treated as a product of the operation, and its value is included in the value of the operation's products. No separate cost data were obtained for the former; such costs are duplicated in other cost statistics presented, principally cost of fuel.

Contract work.—Some classes of work, such as stripping overburden, exploratory and test-hold drilling, drilling wells, building, repairing, and dismantling derricks and rigs, sinking shafts, tunneling, pumping, hauling, and shop work, are frequently done on a contract basis. Payments to concerns engaged in such activities on a contract basis are included as one of the expenses operators were asked to report. Payments reported by operators as wages or salaries are not included, nor are payments to "contract miners" (miners who undertake to recover mineral products at a stipulated price per ton, yard, carload, or other unit of measurement) and the men engaged by them; such contract miners and their men are classed as wage earners and their compensation is included in "Wages."

Although contract work is generally done by concerns that are not engaged in producing minerals, such is not always the case. A number of mineral-producing concerns reported receipts for work done for others; such receipts are included in the value of the operation's products. The cost of contract work as reported by one producer is therefore included in receipts for contract work as reported by another in some cases.

Concerns engaged exclusively in operating mineral properties were regarded as operating concerns and were requested to submit an operator's report rather than a contractor's report.

Cost of buildings, machinery, and equipment.— Census schedules requested information on the total cost during the year for new buildings, major alterations to old structures, and new and used machinery installed. Operators were instructed to "Report all permanent additions and major alterations made on contract or by your own employees which were charged during the year to capital-asset accounts and which are of the type for which depreciation accounts are ordinarily maintained. Exclude expenditures for replacements that are in the nature of maintenance. Exclude construction of company houses and similar construction not used for mineral production or related activities." All labor and installation costs are included; the cost of land purchased is excluded.

Figures cover only construction and installations during the year. Thus, if work on new construction or major alterations was begun before 1939 or was not completed by the end of 1939, the operators were asked to report only that part of the cost that related to work actually done in 1939.

Separate statistics were obtained for building construction and for machinery and equipment. Construction figures cover new construction and major alterations of buildings and other structures. Machinery and equipment for these buildings are excluded unless they represent integral parts of the buildings. The cost of old equipment and material used in this construction is also excluded unless they were purchased from others. Figures for machinery and equipment were further subdivided into new machinery and equipment installed in 1939 and installations of machinery and equipment purchased in a "used" condition. Both movable and fixed equipment are included, but not equipment reported under cost of construction.

To some extent duplication exists between costs of buildings, machinery, and equipment and other expenses reported, particularly wages, salaries, cost of supplies and materials, and payments for contract work. For instance, the cost of construction may duplicate wages and cost of supplies and materials or cost of contract work, since installation of machinery and equipment may have been done by employees on the mine pay roll.

In the census of 1929 information was obtained on the cost of machinery and equipment, but without a separation of new and "used" equipment. The 1929 figures exclude, whereas those for 1939 include, installation costs.

Cost of drilling and equipping oil and gas wells.—Oil-well and gas-well operators and contractors rendering oil- and gas-field services were asked to report costs of drilling and equipping oil wells, gas wells, and dry holes (including wells abandoned before completion) completed in 1939. Costs of wells completed in 1939 but begun in 1938 were to be included, but not costs of wells begun in 1939 that were not yet complete at the end of the year.

The inquiry called for the number of wells of each type (oil, gas, and dry) completed during 1939 and the total footage drilled for these wells. Four categories of costs were specified on the schedule; other costs such as taxes and interest on investment were not to be reported. The four categories are cost of drilling, cost of casing, cost of equipment for production, and cost of production derrick. The last three together are designated "cost of well equipment" as distinguished from "cost of drilling."

Oil-well and gas-well operators were requested to report separately for wells "drilled by own company" and those "drilled on contract." Some of the work done on wells "drilled by own company," however, may have been done by contractors; conversely, the operators may have done some or all of the equipping and even some of the drilling of wells "drilled on contract." Operators were therefore asked to report, for oil, gas, and dry wells drilled by themselves and on contract, the "total amounts paid to (or due) contractors for drilling and/or equipping wells" completed during 1939.

To a considerable extent the cost of drilling and equipping wells duplicates "reported principal expenses" and "cost of buildings, machinery, and equipment during the year." The cost of drilling includes cost of labor, supplies, water, fuel, and power used in such operations as erecting and dismantling drilling rig and derrick, drilling hole, running and cementing casing, and hauling materials. Machinery and tool charges or rentals are included, but not the value of materials salvaged after use. The cost of well equipment includes costs of delivering and installing equipment chargeable to the wells and necessary for production. The value of equipment salvaged was to be deducted, but the cost of salvaging was to be included. (See Appendix B in Volume II, reproduction of "Crude Petroleum Schedule," Form 100-MQ-P, for detailed instructions to producers.)

Active and inactive days.—Active days are those in which an operation was engaged in production or development

work. Days that mines or quarries are active are days during which a mine or quarry is actively engaged in producing or preparing to produce crude mineral products; days that preparation plants are active are days during which a plant is engaging or preparing to engage in preparation activities.

Inactive days are those during which an operation is not engaged in production or development work and employs only such wage earners as watchmen, inspectors, repairmen, and other maintenance men.

Man-shifts worked.—The 1939 schedules sought information on the total number of man-shifts worked by wage earners at all mineral operations except crude petroleum, natural gas, and natural gasoline (man-hour figures were obtained from these operations, for which man-shift records are not usually kept). A man-shift was defined as the work of one man during one shift, although the length of the shift may vary according to the practice prevailing at the individual operation or department of the operation. Parts of shifts were recorded in terms of equivalent full shifts.

Separate figures are shown for man-shifts worked on active days and on inactive days. Numbers of man-shifts worked on active days were also broken down by departments, with separate figures for mines and quarries and for preparation plants. The figures for mines and quarries were in turn separated to provide information for surface employees and for employees engaged in mining or quarrying; for the latter class of employees, an additional distinction was made between those working in underground mines and those working in open-cut mines and quarries.

Man-shifts worked underground relate to wage earners engaged in mining and development work, such as drilling, blasting, loading, and hauling, whose duties were confined wholly or chiefly to underground activities. Open-cut and quarry wage earners are those whose duties were confined wholly or chiefly to surface production activities, such as stripping overburden, drilling and blasting, loading, hauling, shifting track, and dump-spreading. "Surface" men are those at surface repair and blacksmith shops, yards, hoist houses, tipples, power plants, etc. Figures for preparation plants cover wage earners whose duties are concerned wholly or chiefly with preparing the crude product of the mines or quarries; wage earners at auxiliary shops serving preparation plants are included. The break-downs of man-shifts discussed above cannot be shown for all industries for the nature of the productive processes of some industries did not permit classification of wage earners under each of the general headings.

Man-hours worked.—In addition to statistics on the number of man-shifts worked by wage earners, the 1939 schedules also requested information on the number of man-hours worked by wage earners. A man-hour was defined as the work of one man during one hour. The nature of the man-hour statistics is similar to that of the man-shift statistics. For a description of the various categories of wage earners for whom separate figures were obtained see the discussion under "Man-shifts worked."

Multiple-shift operation.—The reports for many of the industries contain tables distributing operations according to the number of shifts worked per day and distributing active-day man-shifts according to whether they were worked during the first, second, or third shift.

The "first" shift for any individual operation is the shift during which the operation was active most days, regardless of the particular hours worked. Thus if a mine was active 100 days during a shift lasting from 8 a.m. to 4 p.m. and 150 days during a shift lasting from 4 p.m. to midnight, the latter shift is considered the "first" and the former the "second." An operation is classified as a one-shift operation if neither its mine (or quarry) nor preparation plant was active more than one shift per day during any part of the year. If either the mine (or quarry) or preparation plant of an operation was active during two shifts per day for any part of the year and neither was active during more than two shifts on any day of the year, the operation was classed as a two-shift operation; if active during three shifts per day during any part of the year, as a three-shift operation. A shift during which only such men as watchmen and maintenance men were employed is not considered as a shift during which the operation was active; man-shifts worked during such shifts, however, are classed as active-day man-shifts if the operation was active on any other shift during the day.

The numbers of active-day man-shifts worked during the first, second, and third shifts are calculated rather than reported figures. Individual operations reported the number of full days (parts of days were reduced to equivalent full days) that each shift was active and the average number of wage earners employed on each shift during active days (for bituminous-coal and lignite operations, number of men employed on each shift during the normal pay-roll period ending nearest October 14). These figures were reported (except for bituminous-coal and lignite operations) for each department for which total man-shifts and man-hours worked by wage earners were reported (see "Man-shifts worked"). The number of man-shifts worked during the first shift was computed for each department of each operation by multiplying the number of days that department was active during the first shift by the average number of wage earners employed in that department during the first shift on active days. The same procedure was followed to compute the number of man-shifts worked during the second and third shifts. The departmental figures were then aggregated so as to yield separate totals for each shift for mines (or quarries) and preparation plants.

An additional computation was frequently necessary. The sum of the computed numbers of man-shifts worked during the first, second, and third shifts did not generally coincide with the reported total number of active-day man-shifts. Accordingly, the computed man-shift figures were adjusted so that their sum would equal the reported total number of active-day man-shifts. This adjustment was usually small; the method of adjustment was such as to have no effect on the proportion of man-shifts worked on each shift as indicated by the originally calculated figures.

Days active during year.—The number of days mines or quarries were active for production or development work during each month was requested for all operations except those producing bituminous coal, crude petroleum, and natural gas. Parts of days were counted as full days. The sum of the 12 monthly figures reported for each operation indicates the total number of days in the year during which the mine or quarry was active.

These sums do not take into account preparation-plant activity (except for natural-gasoline plants and preparation plants reported separately) and make no distinction between days during which the operation was active for several shifts or only for a portion of a shift. The figures were used to classify operations according to class intervals of number of days active; summaries are presented for most industries for operations falling into the various class intervals.

In order to derive over-all measures of days active, the average number of equivalent full days operations were active was computed for industries for which appropriate data were available. The average for each industry is essentially a weighted average of the number of full days each department of each operation was active during each shift, with wage-earner employment as the weighting factor. The total number of man-shifts worked by wage earners on active days was divided by the sum of the average number of wage earners employed during active days in each shift at each department of each operation in the industry[12] to yield the "average number of equivalent full days operations were active." For some industries separate computations were made for mines or quarries and for preparation plants.

Average hourly earning of wage earners.—Figures for average hourly earnings of wage earners were computed by dividing wages by the total numbers of man-hours worked by wage earners regardless of occupational differences, overtime work, prevailing regional rates of pay, or other factors affecting the hourly wage rates of individual wage earners. Thus average hourly earnings should not be considered as representing even approximately hourly wage rates, which vary with such factors as specific occupations, degrees of skill and experience, local labor-market situations, and prevalence of overtime rates.

[12] Same as "Average number of wage earners on active days (excluding shut-down periods)."

Hours worked per shift.—The average number of hours worked per shift in any industry is an average of the prevailing length of shift worked at the various departments of the various operations comprising the industry. It represents the average number of hours worked per wage earner per shift, and was computed by dividing the total number of man-hours worked by wage earners on active and inactive days by the total number of man-shifts worked by wage earners on active and inactive days.

Hours worked per week.—The number of hours in the full-time workweek of wage earners, exclusive of overtime, was requested of operators. If the length of the standard workweek changed during the year, the workweek prevailing for most of the year was to be reported. Most mining enterprises came under the provisions of the Fair Labor Standards Act, which set the maximum standard workweek at 44 hours for the first 10 months of 1939.

In many industries operators reported separate figures for wage earners working underground, in open cuts or quarries, and, for some industries, in preparation plants. In such cases the figure reported for the department at which most man-hours were worked was selected as representing the operation. The figures were used to classify the respective operations according to class intervals of prevailing full-time workweek. Summaries are presented for most industries for operations falling into the various class intervals.

Output per man.—Ratios of output per man-shift and per man-hour worked by wage earners were prepared for many of the mineral industries. The varied nature of the production statistics and lack of homogeneity of products of industries or even of individual operations created numerous problems and required special handling for the several industries.

For industries whose products were fairly homogeneous, the ratios were computed by dividing the aggregate output by man-shifts or man-hours worked. The complex ores mined and treated by the nonferrous-metals industries, however, made this procedure undesirable. Copper ores, for instance, contain considerable and varying quantities of gold, silver, lead, and zinc, and the output of copper ores and concentrates divided by the number of man-shifts or man-hours worked would have limited significance as a measure of valuable products produced per man-shift or per man-hour. For these industries separate ratios were computed for mining labor requirements per ton of ore mined, preparation-plant labor requirements per ton of ore and tailings treated, and value of all products per man-hour worked at mines and mills. Thus statistics on physical output per unit of labor could not be presented for each industry in identical terms.

Figures for output per man-hour were also computed for individual operations, and the operations in some industries were classified according to class intervals of output per man-hour; summaries are presented for operations grouped according to these intervals.

Aggregate horsepower rating of power equipment.—The aggregate horsepower rating of power equipment represents the horsepower rating of prime movers and of electric motors driven by purchased electricity. Information was also obtained on the horsepower rating of electric motors driven by electricity generated by the reporting company, but this horsepower rating is not included in the aggregate figures because it is approximately duplicated in the horsepower rating of the prime movers that drive generators.

Equipment temporarily idle because in need of repairs was included. Motor-generator sets and rotary converters, whose principal function is the transformation of electric energy, were not reported. Operators were asked not to report trucks used for hauling products to consumers and locomotives owned by railroads. Rented or borrowed equipment, however, was reported.

Horsepower figures are in terms of horsepower ratings, which in many cases are indicated by the manufacturers of the equipment on name plates. All figures for power equipment relate to equipment in use or available for use on January 1, 1940, and therefore do not include equipment used for a portion of 1939 and sold or junked during the year.

The census schedule for 1929 instructed operators to "give figures as of the end of the period covered by this report." Thus the figures for 1929 may include some equipment reported by operations that discontinued business before the end of 1929. The 1919 schedules did not specify the date as of which the number of units and horsepower rating of power equipment was to be reported.

Stationary and mobile power equipment.—Except for oil- and gas-field operations, units of power equipment and their horsepower ratings were classified according to whether they were for use for driving stationary or mobile equipment. "Stationary equipment" refers to stationary or fixed installations such as generators, compressors, ventilating fans, crushing and screening equipment, "mother" conveyors, etc. "Mobile equipment" refers to mobile or portable equipment such as power shovels, draglines, locomotives, cutting machines, tractors, trucks, etc.

Prime movers.—Prime movers include steam engines and turbines, internal-combustion engines, water wheels and turbines, and any other equipment that may have been available for producing mechanical power from such sources as fuel (utilizing heat energy) and water power, but not from electric energy. Prime movers, in addition to being classified according to whether they were driving stationary or mobile equipment, were also classified according to whether or not they were for driving generators. Separate figures were also obtained for prime movers ordinarily idle but held for emergency or stand-by equipment. Although these figures are shown separately, they are also included in the figures for prime movers "Driving generators" and "Not driving generators."

The 1939 schedules requested operators to report the brake horsepower of gasoline engines. The schedules for earlier years did not make this specification, and it is quite possible that the horsepower rating of trucks and tractors used for hauling in or about the operations was reported, in some instances, in terms of S.A.E. or N.A.C.C. horsepower ratings, which may be considerably less than the rated brake horsepower. It is also likely that the 1939 statistics are more complete than those for earlier years because of the apparent tendency of operators not to report engines or motors for driving mobile equipment and the greater opportunity in the case of the 1939 schedules for discovering and correcting such omissions (see "Reliability of statistics," subsection entitled "Power equipment").

Electric motors.—Two classes of electric motors were distinguished—those driven by purchased electricity and those driven by electricity generated by the reporting company. The horsepower rating of the latter class is approximately duplicated in the horsepower of prime movers driving generators, and has therefore been excluded from the aggregate horsepower rating of all power equipment.

In some industries, particularly those producing stone, a number of electric motors were driven by electricity generated at nearby manufacturing establishments of the reporting companies. In the 1939 census such motors were classified as electric motors driven by energy generated by reporting companies; this was done in order to avoid duplicating the horsepower rating of prime movers driving generators as reported in the Census of Manufactures. For 1929 such electric motors were classified as driven by purchased energy.

Power loading machines.—Operators were requested to report, in addition to the number of units and horsepower rating of all power equipment, the number of units of each type of power loading machine classified by kind of power used and, for some types, by dipper or bucket capacity, by horsepower rating of scraper hoists, or by working height required. The numbers of units reported represent units in use or available for use on January 1, 1940. All power loading machines, whether stationary or mobile, were reported. Emergency, stand-by, and idle equipment (including equipment temporarily idle because in need of repairs) was included. Only junked equipment was excluded.

In general, the inquiry on the various schedules was adapted to the practices of the particular industry. Operators that had machines of a type not enumerated on the schedule

were asked to specify the type in order to permit proper classification.

DUPLICATION OF STATISTICS OF CENSUS OF MANUFACTURES

The difficulty of determining a clear line of demarcation between mineral production and manufacturing and the desire of the Census of Manufactures to maintain comparability with its statistics for earlier years have resulted in some overlapping in the statistics for the mineral industries and the manufacturing industries. Such duplication exists mainly between mineral industries producing nonmetallic minerals other than fuel and manufacturing industries producing manufactured articles from these minerals. The mineral industries particularly concerned in this duplication are the clay and stone industries, although others such as "Feldspar," "Fluorspar," "Gypsum," and "Natural sodium compounds" are also involved. Some of the statistics for contractors shooting oil and gas wells are also included in figures of the Census of Manufactures.

The practice of the Census of Manufactures for most industries is to treat as a single manufacturing "establishment" all activities carried on within the same county by a single operating unit whose chief activity is manufacturing. The manufacture of cement and lime is frequently conducted at or near the limestone quarry and the pit from which the clay entering into cement is recovered. In such cases limestone quarries and clay pits operated in conjunction with cement or lime plants are covered in statistics of the Census of Manufactures as well as in statistics of the Census of Mineral Industries. The same situation exists in the case of common clay and shale pits or mines, for the manufacture of heavy-clay products usually occurs in the vicinity of the clay pits operated in conjunction with the plants and supplying the basic raw materials used by the plants.

The duplication discussed above for the stone and clay industries does not exist in the case of 1919 census statistics. For that year statistics for limestone quarries and clay pits operated in conjunction with plants manufacturing cement, lime, brick and tile, and pottery were included only in the Census of Manufactures. For 1929 this type of duplication exists only for limestone quarries operated together with cement or lime plants; the 1929 census of mineral industries did not cover "the mining of clay and the manufacture of clay products at the same locality when carried on in the same establishment."[13]

A number of manufacturing plants engage in producing polished or dressed dimension stone; their raw materials—rough dimension blocks or slabs—are often obtained from quarries operated in conjunction with the dressing and polishing plants. Some statistics for such stone-dressing and polishing plants are included in the figures of the census of mineral industries for 1929 and earlier years. For 1939, however, stone dressing (except for a small amount of rough dimension-stone trimming) and polishing have been excluded from statistics of the Census of Mineral Industries although statistics for some dimension-stone quarries have been included in the 1939 statistics of the Census of Manufactures.

These differences in the practices followed for the various census years reflect increased effort in the successive mineral-industries censuses to cover all mineral-production activities in the country and, conversely, to exclude manufacturing activities.

The extent to which the statistics published by the 1939 Census of Manufactures duplicate those of the 1939 Census of Mineral Industries is indicated for each mineral industry in table 30 of the General Summary in Volume I. Caution should be exercised in combining value statistics of the two censuses, whether to eliminate duplication or for other purposes. Final products of one industry may be raw materials of another; the products of the mineral industries, in general, enter into the products of manufacturing industries. As a result the value of manufactured articles includes the cost of mineral and other commodities entering into their production.

[13] Fifteenth Census of the United States, "Mines and Quarries: 1929," p. 4.

DIFFERENCES BETWEEN CENSUS AND BUREAU OF MINES STATISTICS

The United States Bureau of Mines compiles annual statistics on quantities and values of mineral commodities. The decennial censuses of mineral industries obtain statistical information covering a great variety of items, including quantity and value of mineral production. There are, however, differences in magnitude and nature of quantity and value figures published by the two bureaus.[14]

These differences stem largely from differing objectives and methods in the collection and compilation of statistics, although naturally some differences occur as a result of the fact that operators do not always report identical figures to the two bureaus even when the schedules call for information of an identical nature.

One of the statistical objectives in the compilation of census data is to present comparable figures for production, employment, time worked, expenses, power equipment, etc. Thus quantity and value figures for a particular mineral produced by a particular industry do not necessarily represent the total production during the year of that particular mineral; many operations are engaged to some extent in producing minerals other than that of chief value, either as joint products, secondary products, or byproducts. A considerable quantity of molybdenum, for instance, is contained in some ores mined chiefly for their copper content. The total value of products of the copper-ore industry includes the value of this molybdenum but excludes the value of copper contained in ores and concentrates of operations engaged principally in producing materials valued chiefly for their content of some metal other than copper. This value of products of the copper-ore industry is directly comparable with other census statistics, but it does not cover all ores and concentrates produced in 1939 that were valued chiefly for their copper content.

The statistics of the Bureau of Mines, however, are not related to industry classifications. Quantities and values for a particular mineral, regardless of where that mineral was produced, are shown by the Bureau of Mines. Such figures are not always closely related to statistics presented in the industry reports of the Bureau of the Census.

The general summary presented in Volume I covers all mineral industries and includes a table showing the quantity and value of the production in 1939 of individual minerals, regardless of the industry in which produced. Although statistics of the Bureau of Mines are more closely related to these figures than to figures for individual industries, there are still some fundamental differences. Census figures refer to actual production during the year, whereas the Bureau of Mines sometimes reports marketed production, sales, or shipments during the year, which are influenced by changes in producers' stocks and include materials marketed, sold, or shipped by operations that had no production during the year. The Bureau of Mines figures also sometimes include statistics for small operations not included in the census; this factor, however, is usually unimportant.

One of the major reasons for some of the differences between the figures of the two bureaus is that census statistics are based on reports submitted by producers whereas the Bureau of Mines sometimes obtains information from purchasers, transportation companies, or other sources.

A comparison of census statistics on mineral products with those of the Bureau of Mines is presented in table 10 of the General Summary in Volume I.

[14] The statistics of the Bureau of Mines are based on commodity classifications. For discussion of such classifications see "Industry and commodity classifications" under "Industry Classifications."