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PRODUCTIVITY OF LABOR

PRODUCTIVITY OF LABOR IN NEWSPAPER PRINTING

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PRODUCTIVITY OF LABOR IN NEWSPAPER PRINTING

CHAPTER 1.—SUMMARY

THE present study of productivity in newspaper printing deals with composition, stereotyping, and presswork, the three primary mechanical processes in modern newspaper printing. The relative importance of these processes varies considerably. In a newspaper of small circulation composition is by far the largest item in both time cost and labor cost and may represent more than 90 per cent of the total cost of the three processes. As the circulation increases, however, the composition cost, which does not vary with the number of copies printed, declines in comparison to presswork cost, which does vary directly with the number of impressions. Stereotyping usually represents less than 10 per cent of the total cost when the circulation is small and decreases relatively as the circulation increases.

Newspaper printing has for many years been dominated by the daily newspapers. These have only a limited time for the production of a single issue. In addition, competition in the speed with which the buying public is reached is keen, especially in the large cities. Clock-time production thus becomes the important factor, to which both time cost and labor cost are constantly sacrificed.

The data presented in the present study are based on a recent survey by the Bureau of Labor Statistics, supplemented by certain valuable, though limited, information contained in an earlier report by the bureau, then called the Department of Labor, on productivity for the year 1896.[1] During the recent survey detailed production and cost data were obtained for the years 1916 and 1926. Therefore, a summary view of productivity and labor costs in the industry may be had for a period of 30 years—the data being for 1896, 1916, and 1926.

It must be emphasized that such a summary can not produce entirely satisfactory results. In the first place, the basic data for the years prior to 1926 are extremely limited in scope. In the second place, the output of the newspaper industry is not measurable in a simple invariable unit. Not only do newspapers vary among themselves in size and style, but the same paper may undergo great changes in these respects over a period of time. Also, the number of impressions seriously influences both time costs and money costs.

It was necessary, therefore, in the present study to adopt a rather arbitrary unit of measurement in order to make comparisons for the combined processes, and the unit selected is an issue of 10,000 copies of a 4-page paper, containing 59,200 ems of 5½-point type or their equivalent in larger sizes.

[1] U. S. Commissioner of Labor. Thirteenth Annual Report, 1898. Hand and Machine Labor. 2 vols. Washington, 1899.

TREND IN LABOR PRODUCTIVITY AND LABOR COST, 1896 TO 1926

A NUMBER of inventions have speeded up the mechanical production of newspapers since 1896. While the majority of these were intended mainly to reduce the clock time for the operations, so as to shorten the interval between receipt of the news and the distribution of the printed papers to the public, the improvements have also affected labor productivity. Naturally, the adoption of even the most important inventions was gradual, depending on the individual requirements of each establishment and on the existing competition. In consequence, all sorts of conditions existed at the same time throughout the country, and even at the present time some of the older methods are still being used.

COMPOSITION, STEREOTYPING, AND PRESSWORK COMBINED

Productivity.—As no data for stereotyping in 1896 are available, the trend over the 30-year period for unit production by machine methods in the three processes combined can not be determined. A comparison can, however, be made of the unit production in 1896 by the hand method, which included composition and presswork only, and in 1926 by the machine method, which required all three processes. In 1896 composition by the hand method, presswork on hand presses, and folding the printed papers by hand of 10,000 copies of a 4-page newspaper involved an average of 635 man-hours. In 1926 the same number of copies of a printed and folded 4-page newspaper, requiring the combined processes of composition, stereotyping, and presswork, was produced on an average in 174.4 man-hours, an increase in man-hour output of 264 per cent. This meant that where 71 employees were required for 9 hours by the hand method in 1896, only 25 employees for 7 hours were necessary by the machine method in 1926.

The trend for the three processes combined, from 1916 to 1926, is indicated fairly well by the experience of a representative newspaper establishment for which all the necessary data were available. In this establishment it required in 1916, 215 man-hours to turn out 10,000 copies of a 4-page newspaper, while in 1926 the same production required only 158 man-hours, an increase for the 10-year period of 36.5 per cent in man-hour output. Consequently, 27 employees working 8 hours were required in 1916, while 23 employees working 7 hours were necessary in 1926.

The above figures, however, apply only if no more than 10,000 copies are produced from the same four pages. The number of man-hours per unit of production does not expand in the same ratio as the number of units. The time cost for composition remains stationary, regardless of how many copies of the paper are printed. This is important, as composition is by far the largest factor in total time cost. The time cost for stereotyping also remains practically the same, being affected only in a minor degree by the number of presses operated. The time cost for presswork, however, advances in the same ratio as the number of units. Under the hand method of 1896 each additional unit involved 250 additional man-hours, or about two-fifths of the total man-hours for one unit. By the machine method the time cost for presswork is only 1 per cent of the total time cost for the unit, so that duplications of units can be made at comparatively slight increase in time costs.

A PRINTING OFFICE OF THE 16TH CENTURY, WHERE IT WOULD HAVE REQUIRED OVER 6,000 MAN-HOURS TO TURN OUT 10,000 MODERN 4-PAGE NEWSPAPERS, NOW EXECUTED IN THREE SEPARATE DEPARTMENTS, SUCH AS SHOWN IN THE THREE FOLLOWING ILLUSTRATIONS, IN 175 MAN-HOURS

A MODERN COMPOSING ROOM, WHERE COMPOSITION NECESSARY FOR 10,000 FOUR-PAGE NEWSPAPERS REQUIRES 163 MAN-HOURS

In 1916 each additional unit from the same four pages was produced in the representative establishment at a time cost of 1.8 man-hours, and in 1926 of 1.7 man-hours. Man-hour output was consequently determined by the multiples of units produced, as follows:

TABLE 1.—*Man-hour output of specified numbers of copies of a 4-page section in a representative establishment, 1916 and 1926*

Number of copies of a 4-page section printed	Number of man-hours worked in—		Number of copies produced per man-hour in—	
	1916	1926	1916	1926
10,000	215.1	157.5	46.5	63.5
50,000	222.3	164.1	225.0	304.6
100,000	231.2	172.5	432.5	579.9
500,000	303.0	239.0	1,650.3	2,092.0
1,000,000	392.6	322.2	2,546.8	3,103.9

The actual trend of time cost was affected by the production of a larger number of 4-page sections in 1926 than in 1916, caused by increases in the circulation and also in the page contents of the issues. In this establishment the circulation had advanced 25 per cent and the bulk of the issues approximately 108 per cent, resulting in an increase of 150 per cent in the number of units turned out, as against an increase of 93 per cent in the number of man-hours. This was equal to an actual increase of nearly 30 per cent in man-hour output of 4-page sections for the combined processes in the establishment.

Labor cost.—Actual man-hour labor costs are partially regulated by the wage rates; but they are also affected by the amount of overtime involved in the work, as the hourly rate for overtime in newspaper printing is customarily 50 per cent higher than the regular rate. In addition the labor costs per unit are influenced by increases or reductions in man-hour output, so that the trend of labor costs per unit may differ widely from the trend in man-hour labor cost or in basic wage rates.

The absence of data in the 1896 survey for the entire personnel in composing rooms using the machine method, and the omission of the stereotyping process for that period, restricted the use of labor costs for unit production in 1896. Only for composing rooms using the hand method solely, for hand compositors, for line-casting machine operators, and for presswork, were data available for comparison with later years.

Under the hand methods used in 1896 composition and presswork were the only processes required for unit production. The labor cost amounted to $82.74 for composition and $33.33 for presswork, a total of $116.07 for the first unit of 10,000 copies of a 4-page section. Each additional unit was produced at a total cost of $33.33, so that the average cost per unit declined with the increase in unit output. In 1926 the stereotyping process was included. The labor cost for unit production was $215.04 for composition, $11.36 for stereotyping, and $2.76 for presswork, a total of $229.16. The cost for each succeeding unit was $2.76, the cost of the presswork. So, while the labor cost for the first unit was 98 per cent higher in 1926 by the machine method than in 1896 by the hand method, the production of five units in 1896 cost almost $1 more than the production of eight units in 1926.

Like the trend in production, the trend in labor cost for the three methods combined can be determined only for the last 10-year period and through labor costs for 1916 and 1926 in a representative newspaper establishment. The labor cost for the first unit of production in 1916 was $135.77. By 1926 it had advanced to $200, an increase of 47 per cent. Additional units from the same four pages carried labor costs of $1.19 in 1916 and $2.06 in 1926. Actual labor cost per unit was, therefore, like man-hour output, regulated by the number of units produced, as follows:

TABLE 2.—*Labor cost of specified numbers of copies of a 4-page section in a representative establishment, 1916 and 1926*

Number of copies of a 4-page section printed	Total labor cost in—		Labor cost per 10,000 copies of a 4-page section in—	
	1916	1926	1916	1926
10,000	$135.77	$200.00	$135.77	$200.00
50,000	140.55	208.23	28.11	41.65
100,000	146.52	218.52	14.65	21.85
500,000	194.25	300.85	3.89	6.02
1,000,000	253.92	403.76	2.54	4.04

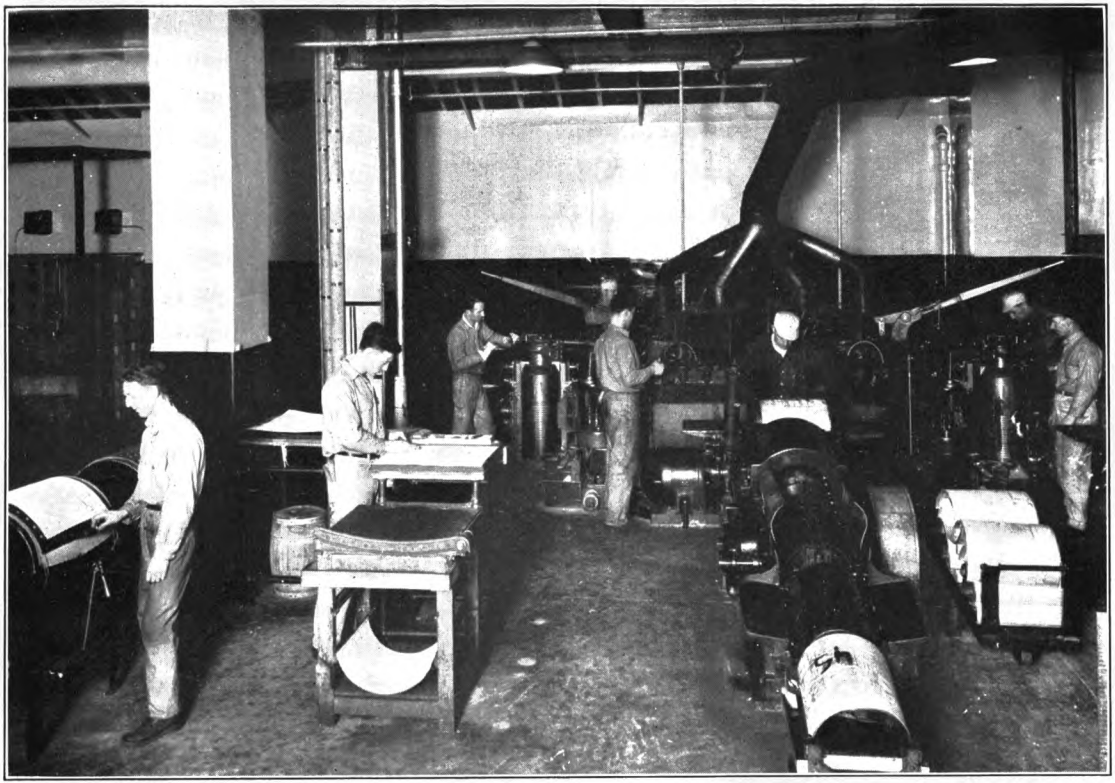
The actual trend in labor cost in this establishment was regulated by the proportionate increase in the number of units turned out in 1926, as compared with the output in 1916. The increase was almost 150 per cent, due both to growth of circulation and to increase in the number of pages printed per issue. The actual labor cost per unit for the establishment was $4.81 in 1916, in 1926 it was $7.27, an increase of 51.1 per cent.

COMPOSITION

Productivity.—By 1896 the evolution from hand composition to machine composition had made some progress, but a number of establishments still existed in which all of the type was set by hand. In 1916 the bulk of the news composition was on machines, and by 1926 a relatively larger portion of it was by that method. Part of the type, however, was still set by hand, so that in a modern composing room both machine and hand methods are in use.

In 1896 the actual type setting by the hand method for the 4-page unit required an average of 350 man-hours in five composing rooms; by the machine method in five other composing rooms an average of about 57 man-hours was necessary, an increase of more than 500 per cent in man-hour output by the machine method over the hand method. Some increase in output of line-casting machine operators has taken place since then, as shown by the trend for this labor group in a typical composing room. In 1896 the specified unit production in this establishment required about 66 man-hours; in 1916 it required 71 man-hours, through the employment of a proportionately larger number of operators to meet the demands of clock-time production speed created by competition. In 1926 the unit was produced in a little over 64 man-hours, an increase in man-hour production of more than 10 per cent over 1916 and of about 3 per cent over 1896.

In another representative establishment there was a wider variation. In 1896 the type setting on a unit of production on line-casting



A MODERN STEREOTYPING FOUNDRY, WHERE STEREOTYPING NECESSARY FOR 10,000 FOUR-PAGE NEWSPAPERS, TOGETHER WITH THE MOLDING OPERATION, REQUIRES LESS THAN 10 MAN-HOURS

A MODERN PRESSROOM, WHERE 10,000 FOUR-PAGE NEWSPAPERS ARE PRINTED EVERY 2½ MAN-HOURS

machines took a little over 52 man-hours; in 1926 it took less than 44 man-hours, an increase in man-hour output of 19 per cent.

Other operations were also necessary in composing rooms, such as assembling the type, proof reading, and machine adjustments. These did not add to the output. Consequently man-hour production for the entire composing room depended partly on the proportion of nonproductive labor employed therein, and the trend for the entire personnel might vary considerably from the trend for compositors alone.

According to data of the 1896 survey an average of 385 man-hours were required for the composing rooms employing the hand method to turn out four pages of an average modern newspaper. Figures secured during the survey for this study show that in 1916 the same result was attained in a representative composing room in 204 hours by combined machine and hand methods, an increase in man-hour output of nearly 90 per cent. In 1926 only 145 man-hours were necessary in the same establishment for the total composing-room work on four pages, an increase of over 40 per cent in man-hour output during the 10-year interval 1916 to 1926. In other words, it required 40 employees 10 hours by the hand method in 1896 for production equal to four present-day newspaper pages. Using both machine and hand methods the same output was reached in 1916 by 26 employees in 8 hours, and in 1926 by 21 employees in 7 hours.

Labor cost.—According to wage studies by the Bureau of Labor Statistics the average hourly basic wage rates for hand compositors advanced approximately 200 per cent from 1896 to 1926. The increase for machine operators during the same period was about 180 per cent. Hand compositors and machine operators constituted the principal labor groups in composing rooms, but other groups existed with lower or higher hourly rates. These, together with the varying proportion of overtime in the different establishments, affected the actual hourly cost for composition as a whole, resulting in an increase of approximately 350 per cent in the man-hour labor cost between 1896 and 1926.

Labor cost per unit of production is determined by the actual man-hour labor cost and man-hour output. In 1896 the weighted average labor cost for the composing-room work per unit, in the establishments using the hand method, was $82.74. In 1916 it was $126.75, or 53 per cent more, in a representative establishment, using both machine and hand methods, and in 1926 it had risen to $182.71, equal to 44 per cent above the 1916 unit cost; but the weighted average labor cost for several establishments in 1926 was higher than for the single establishment, reaching $215.04. Figured on the average basis, the advance in the labor cost per unit for the 30 years was only 160 per cent, in spite of the 190 per cent increase in basic hourly rates and the 350 per cent increase in actual man-hour labor cost.

The weighted average labor cost in 1896 for setting sufficient type by hand for four pages was $72.16; by the machine method in the same period it was $33.64. As the average labor cost for news operators in 1926 could not be separated from that for hand compositors, the trend of labor cost for unit production by machine operators can be determined only for two individual establishments. In one of them the average labor cost for four pages of news composition was $44.05 in 1896; in 1926 it had advanced to $92.57, an increase of 110 per cent.

In the other establishment the labor cost rose from $33.15 in 1896 to $47.04 in 1926, an increase of only 42 per cent. These extreme differences were caused by the variation in wage rates because of the different geographical location of the establishments, and by the variation in the relative increases in man-hour output.

STEREOTYPING

Productivity.—The survey of 1896 did not cover stereotyping, in which comparatively old style methods were then used. In the survey for this study, however, data were obtained for 1916 and 1926 in a representative establishment using modern methods during both periods. In this establishment 8.9 man-hours were sufficient in 1916 for the stereotyping of four average pages of the newspaper, whereas in 1926 it required 10.6 man-hours, a decrease in page output per man-hour for all employees of nearly 16 per cent.

Stereotyping consists of two separate operations, the molding of matrices and the casting of plates. One matrix is ordinarily molded from each type form, so that four pages require four matrices, but the number of plates cast from each matrix varies according to the number of presses operated for printing the required number of newspapers in the time allotted for that purpose. In the establishment for which the above data on productivity in stereotyping were obtained changes in molding methods, to facilitate clock-time production of matrices, had been made between 1916 and 1926. Increases in page contents and in circulation had raised the number of pages molded daily 115 per cent and the number of plates cast daily 140 per cent, but it was necessary to turn out the increased quantities in practically the same number of clock hours each day as for the previous, smaller production. The change in molding methods had reduced the clock time for the molding operation more than 50 per cent, but it had also reduced the man-hour production of matrices over 29 per cent for the portion of labor actually engaged in that operation.

In 1926 an average of 56.7 plates was necessary for each four pages molded, while an average of 50.8 plates per four pages was sufficient in 1916, as the circulation was smaller and fewer presses were used. Man-hour output of plates for the portion of labor actually engaged in that operation had increased over 10 per cent, but the additional man-hours for the molding operation and for other labor were reflected in a decrease of 6 per cent in man-hour output of all employees. The main object of the changes had, however, been achieved, though at the expense of man-hour production. In 1916 it took eight minutes to deliver the first plate to the pressroom after the form had been received from the composing room; by 1926 the clock time had been reduced to four minutes.

Labor cost.—The hourly wage rates for stereotypers between 1896 and 1926 advanced about 140 per cent, according to wage studies by the Bureau of Labor Statistics. The increase between 1916 and 1926 was around 84 per cent. While the majority of the workers received the basic rates, some were paid more or less per hour. In a representative establishment such differences in hourly rates, together with variations in relative overtime, were reflected in the actual man-hour labor cost, which advanced only 64 per cent in the 10-year period 1916 to 1926. In this case, however, the labor cost for the unit was further increased through the decrease in man-hour production during

the interval. In 1916 the labor cost per unit was $7.83. By 1926 it had risen to $15.23, an advance of nearly 95 per cent, though the increase for the man-hour labor cost was only 64 per cent. The decrease in man-hour output was caused by the change in working methods for the purpose of speeding up clock-time production.

PRESSWORK

Productivity.—In 1896 the rotary press had displaced other presses in the larger newspaper establishments, but in some of the smaller plants the hand press was still used and the newspapers were folded by hand after printing. According to figures for the 1896 survey an average of 250 man-hours were necessary for printing and folding 10,000 copies of a 4-page newspaper in pressrooms using the hand method. The rotary presses of that period advanced man-hour output greatly, reducing the time cost of unit production. The weighted average time cost in 1896 for the unit production in the pressrooms surveyed, in which the machine method was used, was about three man-hours, on the basis of all employees, an increase over the man-hour output by the hand method of more than 8,000 per cent. This meant that while it required 25 employees for 10 hours to produce the unit by the hand method, 3 employees for 1 hour were sufficient by the machine method.

The trend of labor productivity in modern newspaper presswork between 1896 and 1926 is shown by a comparison for a typical pressroom, on the basis of operating time for the machines. In 1896 it required 1.53 man-hours to produce 10,000 copies of a 4-page section of the newspaper, while in 1926 the same number was turned out in 1.32 man-hours, an increase in man-hour output of more than 70 per cent. The large rotary presses are ordinarily operated intermittently, depending on the time allotment for printing the required number of newspapers. Time is necessary for preparing the presses for operation, and the proportion of actual productive man-hours on a machine to total man-hours worked vary considerably. Figures for the 1926 survey give a range of 16.3 to 70.3 per cent. In this pressroom the productive time for the workers presumably maintained nearly the same relation to the total working time during both periods, so it is reasonable to assume that the 13 per cent decrease in man-hours between 1896 and 1926 also applied to the total hours.

The trend between 1916 and 1926 can be more definitely determined through data for another representative establishment, surveyed for this study. In this establishment it required 1.79 man-hours in 1916 to produce 10,000 copies of a 4-page section, while in 1926 the same result was accomplished in 1.66 man-hours. This represented an increase of nearly 8 per cent in output per man-hour.

Labor cost.—The hourly wage rate for pressmen increased about 190 per cent between 1896 and 1926, according to wage studies by the Bureau of Labor Statistics, and approximately 90 per cent between 1916 and 1926. The average labor cost per man-hour during 1896 was 266 per cent more in pressrooms using the machine method than those where the hand method was used. The average man-hour labor cost in machine-method pressrooms rose 136 per cent during the 30 years from 1896 to 1926, a smaller advance than that for the basic wage rate, caused by a relative increase in lower priced labor and variations in relative amount of overtime.

The average labor cost for unit production in hand-method pressrooms during 1896 was $33.33; in machine-method pressrooms during the same period it was only about $1.33, or, due to the tremendous increase in output, 4 per cent of the cost for the hand method. The average unit cost in 1926 by the machine method was $2.76, an increase of 108 per cent over the cost for the machine method in 1896, as compared with an increase in wage rates for pressmen of 190 per cent and an increase in man-hour labor cost of 136 per cent.

The labor cost per unit between 1896 and 1926 in modern newspaper presswork, based on actual operative time for the machines in one representative pressroom, was nearly twice as high as the average labor cost. The unit cost in 1896 was 51.7 cents; by 1926 it had reached $1.615, an advance of more than 210 per cent. The labor cost for the idle-machine time was not included in either case. It would probably have made the complete labor cost from 33 to 50 per cent higher for both periods, but would not have changed the percentage of increase greatly.

A more definite trend of complete unit labor cost for presswork can be determined for the 10 years from 1916 to 1926 from data for another representative pressroom. In 1916 the labor cost per unit in this establishment was $1.19; by 1926 it had advanced to $2.06, an increase of over 72 per cent. The rise in man-hour labor cost for this pressroom during the 10-year interval was about 86 per cent, but the unit cost was modified through an 8 per cent increase in man-hour output.

VARIATIONS IN PRODUCTIVITY AND LABOR COST BETWEEN ESTABLISHMENTS

THE figures cited previously to indicate trend of production are for individual establishments, and while probably quite accurate for that purpose are not representative of average conditions in different plants. A wide variation is created through differences in factory and sales conditions. Labor costs per unit of production also vary greatly in the different establishments, so figures quoted for the trend of a process in a single establishment can not be regarded as representative for the entire process. The number of man-hours required for the production differs, and even where these correspond the prevailing wage rates may be twice as high in one locality as in another.

COMPOSITION

Productivity.—In 1896 hand composition was used exclusively in some newspaper establishments. Unit production (10,000 copies of a 4-page paper) in those surveyed at that time required from 250 to 500 man-hours, giving a weighted average of 385 man-hours. In other establishments machines were used for most of the typesetting, but the data did not cover the total employees in the process. In 1926 the average time for unit production, by combined machine and hand methods and for the entire personnel of each composing room, ranged from 144 to 205 man-hours, with a weighted average of 163 man-hours.

Production on line-casting machines depends considerably on personal ability of the operators, but varies also according to the class of the product, whether news or advertising composition. In 1896 practically only news composition was produced on machines, and the

time required for turning out enough to fill 4 pages ranged from 52 to 66 man-hours, with a weighted average of 57 man-hours.

A tabulation of weekly production records for operators on news composition during 1926 in one establishment showed a range of 46.6 to 50.3 man-hours per unit. The lowest average by one operator for the full five weeks in the tabulation was 40.3 man-hours, but a weekly average as low as 38.5 man-hours was reached by the same individual. The highest average for one operator was 61.6 man-hours.

In another establishment, where unit production in 1896 required an average of 52.3 man-hours, this had been lowered to 43.9 man-hours in 1926, an increase of 19 per cent in man-hour production during the 30 years. These averages for 1896 and 1926 were considerably lower than the general average for 1896, or that shown in the above-mentioned establishment for 1926, respectively. The variations were caused partly by driving the machines in this composing room at a higher speed, but also were probably influenced by the operators there being paid on a production basis. In 1926 the average time requirements for production of the unit for the individual news operators in this establishment for a 2-week period ranged from 39 to 59 man-hours, but some exceptional records existed, such as 18 man-hours, the minimum, and 106 man-hours, the maximum.

In a third establishment the production of a 4-page unit by machine operators in 1926 required an average of 62.1 man-hours. This was nearly 30 per cent more than in the first composing room and 40 per cent more than in the second composing room. One of the important factors in the extended time was the inclusion of advertising composition, from which the news composition could not be separated, and which ordinarily requires more time.

Labor cost.—The labor cost for unit production by the hand method in 1896 ranged from $60.19 to $113.24, making a weighted average of $82.74. The cost in 1926, by combined hand and machine methods, ranged from $182.71 to $270.99, with a weighted average of $215.04, or about 160 per cent more than by the hand method in 1896.

The labor cost per unit for the entire composing room personnel by the machine method in 1896 can not be determined from the data, only the labor cost per unit for machine operators on news composition being separable. This ranged from $23.55 to $44.04, with a weighted average cost of $33.64, a reduction of 53 per cent from the cost for the hand compositors in the same period, which ranged from $52.10 to $105.24 with a weighted average of $72.16.

STEREOTYPING

Productivity.—The time cost for production of the unit varied greatly in the five selected stereotyping rooms of the 1926 survey, depending on the number of presses operated in each establishment. This was principally regulated by the circulation of the respective newspaper, as it required more presses to turn out a large number of copies than a small number in the same clock time. More presses meant more plates per page. The time cost ranged from 3.9 to 13.7 man-hours, with a weighted average of 9.1 man-hours.

Labor cost.—Decided differences existed in the number of man-hours required in the various establishments of 1926 for unit produc-

tion. These resulted in a proportionately wider range of labor costs for stereotyping than for the other two processes—from $4.34 to $16.42, with a weighted average labor cost of $11.36.

PRESSWORK

Productivity.—Printing on hand presses and folding the newspapers by hand, in establishments surveyed in 1896, required from 240 to 270 man-hours per unit of 10,000 copies of a 4-page paper, giving a weighted average of 250 man-hours. Unit production by the machine method in the same period required approximately from 2.3 to 3.2 man-hours, with a weighted average of about 3 man-hours. In 1926 the necessary man-hours ranged from 1.66 to 3.68, with a weighted average of 2.55 man-hours for each unit turned out. As previously pointed out, presswork differs from composition and stereotyping in that it expands with increased output.

Labor cost.—The labor cost per unit for printing on hand presses and folding the printed papers by hand in 1896 ranged from $25.77 to $50.33, giving a weighted average cost of $33.33. By the machine method in the same period it was reduced to an approximate range of from 69 cents to $2.76, with a weighted average of about $1.33, or 4 per cent of the cost for the hand method. In 1926 the labor cost for the machine method ranged from $1.96 to $4.16, resulting in a weighted average of $2.76, or 108 per cent above the average in 1896 for the machine method.

TREND OF EMPLOYMENT

A NEWSPAPER has only a certain amount of time for the mechanical production of each issue, regardless of whether it contains 4 or 60 pages, so the production of a larger number of pages naturally requires more workers. Census figures for the United States do not segregate wage earners employed on newspapers from those employed on periodicals, and accurate comparison for the trend of employment for 1896 can be made only for the total number employed on newspapers and periodicals combined. Between 1889 and 1919 the wage earners employed in manufacturing newspapers and periodicals increased 40 per cent. Between 1919 and 1923 a 4 per cent reduction took place, but the number employed in 1925 exceeded that for 1923 by 1.2 per cent.

Composition.—From an employment standpoint composition is the most important process in the mechanical production of newspapers. Approximately 60 to 70 per cent of the total man-hours for the three processes are taken by it under normal conditions, though in the production of only 10,000 copies of a 4-page newspaper the relation is 95 per cent.

Before the introduction of the linotype it required 16 compositors for approximately seven hours to set sufficient type for four pages of a representative newspaper at that time. Distribution of the type required about one-half that number for the same length of time, while other hands necessary in composing-room work would probably bring the personnel on a 4-page daily newspaper to about 40.

A decided change was created by the evolution from hand composition to machine composition. One machine operator could set approximately four times as much type as one hand compositor. The time previously devoted to distribution of type, about one-fifth of the total time, was reduced to a very small fraction. Three or

four hands were eliminated, out of every five formerly engaged in setting and distributing type. Consequently the adoption of the machine method displaced a great number of typesetters. Others, engaged in assembling the products, in proof reading, or other duties, were still necessary and were not affected materially, while some new vocations were created.

The application of machine methods to composition, however, stimulated the growth of the industry, which soon expanded sufficiently to absorb the displaced workers. In a comparatively short time more compositors were employed than formerly, and the number continued to increase until after the World War. Suspensions and mergers of publications since that time have reduced the number of newspapers and created more or less unemployment, though part of this has in turn been eliminated through further growth in the industry.

The principal reasons for the larger number of composing-room employees, in spite of the increased man-hour output, were the establishment of new publications and, especially, the constantly increasing number of pages in the daily issues. In one typical establishment, for example, the average daily issues consisted of 12 pages in 1896, 24 pages in 1916, and 36 pages in 1926. The Sunday issues contained an average of 48 pages in 1896, of 54 pages in 1916, and of 60 pages in 1926. The number of different editions published daily had also increased through the years. Consequently, 115 per cent more pages were turned out in 1926 than in 1916, and these contained approximately 122 per cent more new type than the 1916 pages. But as the clock time alloted for the composing-room work was no longer in 1926 than in 1916, the demand for larger production was met by the installation of more machines and by the employment of more operators, as well as of other labor, resulting in an increase of 73.5 per cent in total man-hours.

Stereotyping.—From an employment standpoint stereotyping is relatively the least important of the three processes. The ordinary proportion of the man-hours for the three processes devoted to stereotyping does not exceed 10 per cent, and for the production of 10,000 copies of a 4-page newspaper it is only 4 per cent.

The invention in 1900 of the Autoplate equipment, which was rapidly adopted by the larger daily newspapers, revolutionized the casting of stereotype plates. Only 4 employees were required to turn out the same number of plates as 12 formerly produced by the hand method. It served, however, especially to reduce the clock time for plate production, and the facilities afforded through it increased employment of stereotypers.

The two main factors in employment of additional stereotypers, in face of increased man-hour production, were the same as those for composing-room employees, but to these was added the constant growth in circulation. Data for 1896 are not available, but the trend between 1916 and 1926 in a representative establishment reveals the employment of additional men to speed up the clock-time production. The average number of pages per issue advanced approximately 45 per cent during the interval. Together with the additional number of editions published daily in 1926, it resulted in 115 per cent more pages being stereotyped than in 1916. A 15 per cent rise in circulation necessitated the use of more presses to produce sufficient newspapers in the allotted time. Consequently

140 per cent more plates were needed in 1926 than in 1916, and to accomplish this in the required clock time, more equipment had been installed and the working force increased 155 per cent.

Presswork.—In modern newspaper production the proportion for presswork of the total man-hours for the three processes ranges from 20 to 30 per cent. While it represents only 1 per cent in the production of a single unit (10,000 copies of a 4-page paper), the man-hours for the process expand directly with multiple production from the same four pages, while the man-hours for the other two processes remain stationary.

The transition from the hand press to the rotary press permitted 3 hands to accomplish what it had required 250 hands to do. The subsequent expansion of the industry, however, provided a steady growth in pressroom employment, as in the other two processes, though a drop has been experienced in recent years. Presswork was mainly affected by the same issues as stereotyping—new publications, more pages per issue, and increase in circulation. Comparison of similar periods in 1916 and 1926 for a representative establishment shows that the increase in circulation and in bulk of the newspaper had raised the output of pages 150 per cent, which had been accomplished through an increase in employment of 131 per cent.

DEVELOPMENT OF PROCESSES

THE first newspaper which continued publication for an extended period in this country was established in 1704, with an equipment of a few fonts of type and a slow, cumbersome hand press. The large modern newspapers of 1926 were turned out in plants equipped with numerous machines for casting and setting of type, for production of stereotype plates, for printing and folding of the papers, and for other auxiliary processes.

A hundred years after the establishment of the first newspaper the publications were still produced mechanically in the same manner as the first one. Printing was done directly from hand-set type on hand presses, and the printed papers were folded by hand. All of the radical changes which have assisted in creating the modern newspaper have taken place since the beginning of the nineteenth century. The possibilities of steam for motive power influenced the inventions of automatic or semiautomatic machines for direct use in the printing industry, or to produce material for its development, such as the paper-making machine which permitted manufacture of an unlimited supply of cheap paper. The development of the printing press, in the beginning a cylinder press and later a rotary press, with gradually increased speed and the addition of folding and assembling mechanisms, permitted printing of larger and more newspapers per hour. The perfecting of curved stereotype plates as a substitute for type permitted faster production and, through duplication of pages, the installation of sufficient presses to insure printing the required number of copies of the paper in the allotted time. Semiautomatic production for the composing room was effected through line-casting machines, which permitted printing a greater number of pages in the newspaper and reduced the distribution of type. Distribution was later entirely eliminated through the introduction of other composing-room machines.

While many of the inventions or improvements have reduced the operating cost for the publishers, another feature has become even

more prominent. Speed, and more speed, is demanded first of all. The vast importance of modern events, their sudden and frequent occurrence, and the desire of the public for immediate knowledge of such transactions, together with competition and the aim of each newspaper to publish the events in advance of its contemporaries, have resulted in making speed the paramount issue. The shortest possible time between receipt of the news and its publication is an important sales factor. It is often not only a question of minutes, but of seconds. Newspaper publishers naturally try to keep their mechanical production at the lowest possible cost, but on the larger newspapers often sacrifice all for speed. Consequenty development of the various processes has been principally along the line of reduction in clock time, rather than in man time or in money cost.

By 1896, line-casting machines had been installed in the composing rooms and rotary presses in the pressrooms of the larger daily newspapers. The closing year of the century saw the introduction of automatic machines for the stereotyping process, completing mechanization of the three processes. By 1916, improvements had taken place in the machines used and other machines had been added, notably type-casting machines, which practically eliminated distribution in the composing room.

Between 1916 and 1926 the machines were further improved through time-saving and labor-saving devices, though no startling innovation was brought out. The most notable improvement was the adoption in recent years of dry molding in the stereotyping process, which reduced clock time greatly. Attention was directed strongly toward layout of establishments, cooperation between departments, factory management, and building facilities, subjects which were not included in the surveys but which exert immense influence on production. As a result many newspaper publishers have recently established up-to-date and model plants for their products, and applied efficiency methods to the printing processes.

DEVELOPMENT OF THE INDUSTRY

ONLY a few newspapers were published in the early days, and they were mostly weekly issues. They rendered no practical assistance to business, as the inadequacy of transportation confined the influence of each newspaper to a very limited area. There were not many stirring events in any individual community. News from other places arrived infrequently, and interested the people only in a general way. The majority of the settlers had lived long without newspapers, and continued to do so after they were obtainable.

By 1850, the number of newspapers in the United States had risen to 2,302, with an average aggregate circulation for that year of 3,832,306 copies per issue. The population of the country had passed the 23,000,000 mark, but towns were widely separated and travel to and fro was difficult. Less than 10,000 miles of railway existed. While about 11,000 miles of telegraph lines had been erected, the capacity of the wires was limited and the bulk of the news was received by mail. At least 10 days were required for news to reach New York from Europe and three times as long from San Francisco.

Newspapers increased in value as advertising mediums with the growth of the towns, their importance as commercial centers, and their accessibility. Before 1810 the circulation of the most widely read daily did not exceed 900 copies, and only a few of the weekly

or semiweekly newspapers had a circulation of over 600 copies per issue. In 1871 there existed 548 newspapers with a circulation of more than 5,000 copies per issue and 11 newspapers with a circulation of over 10,000 copies per issue.

Expansion of railway and telegraph systems, laying of the trans-Atlantic cable, and the invention of the telephone rendered communication with both surrounding territory and distant parts easy and created an abundant supply of news. The desire of the people for information, the continual growth in population, and the ever-increasing demand for advertising space made it difficult for publishers to print sufficient copies and sufficient pages in each copy to satisfy the public. The difficulties were solved through the introduction and use of machinery in the various departments during the latter part of the nineteenth century, which transformed newspaper publication into an industry requiring elaborate factory processes and was instrumental in creating the great publications of the present day. It was assisted by further developments in facilities for news gathering and for distribution of the printed papers, such as the wireless, the automobile, and finally the airplane.

Number of publications.—By 1896 newspaper publishing had made considerable progress. Figures from the United States census show that 12,658 newspapers were being published in 1889, of which over 10,000 were weekly issuss and only about 1,600 were issued daily. The total number of newspaper publications increased 26 per cent during the following 10 years, and around 12 per cent between 1899 and 1909, reaching nearly 18,000, of which 2,600 were daily, 520 were Sunday, and almost 14,000 were weekly issues. A drop of over 11 per cent took place between 1909 and 1919 and another reduction of about 37 per cent between 1919 and 1925. Returns for 1925 show only 9,869 publications, including 2,116 dailies, 597 Sunday editions, and 6,435 weeklies. The number of daily newspapers thus increased about 31 per cent between 1889 and 1925, while the number of weekly newspapers decreased 40 per cent.

Growth in circulation.—In 1889 the aggregate circulation per issue was nearly 38,000,000 copies, more than 8,000,000 of which were for the daily newspapers. Ten years later it had risen to over 58,000,000 copies, with more than 15,000,000 of these for the daily publications. By 1909 it was above 61,000,000 copies, over 24,000,000 of which were for the dailies. By 1919 it had grown to over 75,000,000, with more than 33,000,000 of these for the daily publications. In 1925 it had reached nearly 81,000,000, over 37,000,000 of which were for the daily newspapers. The aggregate circulation per issue of the daily papers had thus increased 346 per cent between 1889 and 1925, though the increase for the total publications was only 113 per cent.

Increase in bulk of issue.—The increases in bulk affected mainly the daily and Sunday newspapers. In 1896 the daily issues contained on an average 12 pages while the average Sunday issues consisted of 48 pages. By 1916 the average size of the daily issues had risen to 24 pages and of the Sunday issues to 54 pages. In 1926 increases had been made to 36 pages for the daily issues and to 60 pages for the Sunday issues, equal to an increase of 200 per cent over the 1896 size for the daily newspapers and of 25 per cent for the Sunday newspapers. The majority of the newspapers had also changed the width of the pages during the interval, adding one extra column of type, thus increasing the type content per page about 10 per cent.

CHAPTER 2.—PRODUCTIVITY AND LABOR COST IN 1916 AND 1926

IMPORTANCE OF CLOCK-TIME PRODUCTION

THE mechanical production of newspapers has developed into as much of a factory operation as the manufacture of automobiles or of textiles, and consequently the industry has to cope with typical factory problems, such as improvements of processes and materials and reduction of waste, while in addition it is affected by the limited time for production. In the larger cities, where competition is keen, time has become the most important factor, all other considerations being dominated by it.

During the past 10 years there has been no revolution in processes in newspaper manufacturing, but the processes existing in 1916 have been constantly improved. While to a certain extent the aim of the large daily newspapers has been to increase man-hour output or to reduce man power, their main objective has been the reduction of clock time in the interval between receipt of the news and publication thereof, and the majority of improvements have been made with that end in view.

A daily newspaper has a 24-hour limit for production, but where both a morning and an evening edition are prepared in the same establishment, the limit for each is only 12 hours. As this time limit includes the preparation of copy, both news and advertising, the actual clock time for mechanical production is greatly curtailed, and this shortening of the time allotment ordinarily necessitates a comparatively larger working force. In the processes where actual productive work is intermittent this would involve additional man-hours and would lessen the man-hour output. As a weekly publication has seven times 24 hours for the production of each issue, it can ordinarily perform the work with a relatively small personnel, though often requiring comparatively more man-hours than are required for the same amount of work on a daily newspaper.

COMPARISON OF PRODUCTIVITY IN A REPRESENTATIVE NEWSPAPER ESTABLISHMENT IN 1916 AND 1926

In the present study by the Bureau of Labor Statistics records were obtained from one modern newspaper establishment for selected period in 1916 and in 1926, permitting a comprehensive comparison for the different operations during the two periods and showing the progress for a decade in a printing office where a large morning newspaper was published every day of the week. While the development in this establishment represents, of course, only the changes on one specific newspaper, it may be considered typical of the development in the industry during the past 10 years, since the equipment and the working methods in the plant were up to date for the periods studied. As the number of pages published daily had practically doubled during the decade, rendering a complete daily paper useless as a measure of comparison, a 4-page section was selected as the basic unit. Data for both 1916 and 1926 were converted to this unit, and the results

were tabulated separately for each of the three common processes on all modern newspapers—composition, stereotyping, and presswork—and also for the three processes combined. Other processes, such as photo-engraving and electrotyping, were not considered as they existed on some but not on all newspapers. Manufacture of color or rotogravure supplements were also excluded for the same reason, and distribution of the printed papers was not taken into consideration.

COMPOSITION

A comparison for the composing room of the production of four average pages during a selected period in 1916 and in 1926 is presented in Table 3:

TABLE 3.—*Man-hours worked in production of four pages of composition on a representative newspaper, 1916 and 1926, and per cent of increase in output per man-hour*

Occupation	Man-hours worked to produce 4 pages of composition in—		Increase in output per man-hour
	1916	1926	
Productive labor:			*Per cent*
Machine operators	53.5	43.7	
Hand compositors	37.7	28.7	
Total	91.2	72.4	25.9
Nonproductive labor:			
Machinists	7.2	4.0	
Machinists' helpers	4.2	2.6	
Proof readers	23.6	19.8	
Make-ups	20.7	14.4	
Laborers	45.5	27.2	
Supervisory employees	11.9	4.8	
Total	113.2	72.8	
All employees	204.3	145.2	40.7

The output of the composing room was nearly 115 per cent more pages in the 1926 period than in the 1916 period. In neither period did all of the pages consist entirely of newly set type, as the number of pages printed in the main edition each day was only 50 per cent of the total number of pages in all the editions for the day, but the actual increase in type set was 122.7 per cent. The number of line-casting machines had been increased 50 per cent, and other labor-saving devices had been added, while the number of workers had been increased, as shown by a 73.5 per cent increase in man-hours. The increase in type production per man-hour for all composing-room employees was 40.7 per cent.

The output per man-hour for machine operators on news composition alone had risen 10.6 per cent, partly through substitution of new and improved machines for the older styles used in 1916, while the man-hour output was also boosted greatly through setting a relatively larger proportion of advertising matter on machines during the 1926 period, so that the increase for total productive labor was nearly 26 per cent. In 1916 nonproductive labor constituted 55.4 per cent of all employees in the composing room, but by 1926 it had

been reduced to 50.1 per cent. This reduction and the decrease in man-hours for the unit production, resulted in an increase of 40.7 per cent in man-hour output for the composing room.

STEREOTYPING

A comparison for the stereotyping of the production of four average pages during a selected period in 1916 and in 1926 is shown in Table 4:

TABLE 4.—*Man-hours worked in production of a 4-page section in stereotyping on a representative newspaper, 1916 and 1926, and per cent of decrease in output per man-hour*

Occupation	Man-hours worked to stereotype a 4-page section in—		Decrease in output per man-hour	
	1916	1926	Pages	Plates
Productive labor:			*Per cent*	*Per cent*
Molders	1.5	1.5		
Packers	1.2	2.3		
Autoplate operators	1.6	1.7		
Cylinder tenders	1.6	1.7		
Metal-pot tenders	1.0	.9		
Shaver tenders	1.0	.9		
Total	8.0	9.2	13.0	2.9
Nonproductive labor:				
Jobmen	.6	1.3		
Supervisory employees	.4	.2		
Total	1.0	1.5		
All employees	8.9	10.6	15.8	6.0

The 4-page section used as the unit of production involved the molding of one matrix for each page and the casting therefrom of the number of plates required for the number of presses operated, the number of presses operated fluctuating according to the page contents of the issues and the circulation demands.

During the interval between the two periods the dry-flong method had been substituted for the wet-flong method in molding. New machinery in large quantities had been installed because of the new method and the 115 per cent increase in pages, which also necessitated an increase of 187.7 per cent in man-hours in the molding operation. The principal reason for the change to dry flong was the saving effected in clock time for the molding operation—more than 50 per cent—but it also reduced the man-hour output of matrices by the labor actually engaged in the work 29.3 per cent.

Autoplate equipment was used during both periods for the casting of the plates. The capacity of the equipment had been doubled during the decade, though in neither period was the total capacity in use all of the time. More presses were operated in 1926 than in 1916, necessitating casting of 56.7 plates for each four pages instead of 50.8 plates as formerly, an increase of 11.6 per cent in plate casting per unit, or 139.9 per cent in plate output for the establishment. Man-hour output of plates by the actual foundry workers had advanced 10.3 per cent, but the increase in proportionate man-hours for packers and job men effected a decrease of 6 per cent in man-hour output of plates for the entire stereotyping room.

The increase of 115 per cent in pages, and of 155.3 per cent in man-hours in stereotyping in order to obtain the desired clock-hour speed for the process, that having become the most important factor, resulted in a decrease of 15.8 per cent in man-hour production of the 4-page unit. In 1916 eight minutes were required to deliver the first plate to the pressroom after receipt of the form from the composing room; by 1926 the time had been reduced to four minutes.

PRESSWORK

As only an insignificant portion of time was required to turn out one 4-page section, the unit of production used here for presswork is the printing of 10,000 copies of an average 4-page section. A comparison of the output for the pressroom during a selected period in 1916 and in 1926, on such basis, is presented in Table 5:

TABLE 5.—*Man-hours worked in the pressroom on 10,000 copies of a 4-page section of a representative newspaper, 1916 and 1926, and per cent of increase in output per man-hour*

Occupation	Man-hours worked to print 4-page section (10,000 copies) in—		Increase in output per man-hour
	1916	1926	
Productive labor:			*Per cent*
Pressmen in charge	0.18	0.15	
Journeymen	1.04	.93	
Flyboys	.38	.35	
Total	1.61	1.43	12.2
Nonproductive labor:			
Laborers	.10	.17	
Supervisory employees	.09	.05	
Total	.19	.23	
All employees	1.79	1.66	7.8

Practically all of the 1916 equipment was still in use during 1926, but as the number of pages in the daily issues had grown from a minimum of 14 and a maximum of 24 to a minimum of 18 and a maximum of 52—an increase of nearly 115 per cent—and the circulation had risen 40.8 per cent, new, larger, and faster presses had been added so that the increased output could be handled in the same clock time. The page capacity had been increased 128 per cent and the speed capacity nearly 7 per cent. The maximum page capacity, however, was not used continuously during either period.

The operation of more presses necessitated additional press crews, while the operation of larger presses called for larger crews, and consequently the number of man-hours had increased 131.4 per cent in the decade. As the number of 4-page sections printed had risen 149.6 per cent in the same time, the result was an increase of 7.8 per cent in the man-hour output of 4-page sections, approximately 1 per cent higher than the increase in speed capacity for the equipment. Actual operation of the presses was intermittent, and the productive man-hours of the press crews in 1916 constituted only 55 per cent of their total man-hours; by 1926 the proportion was still less, averaging 50 per cent.

The use of larger presses and the printing of larger newspapers affected also the clock-time production of 4-page sections. As the man-hours for the pressmen in charge equaled the clock time for presses, the increase in clock-time production of 4-page sections was 25.5 per cent.

COMBINED PROCESSES

The number of man-hours actually required during the selected periods in 1916 and 1926 for composition and stereotyping on an average 4-page section of the newspaper, and for presswork on 10,000 copies, is given in Table 6:

TABLE 6.—*Man-hours worked in the composition, stereotyping, and presswork on 10,000 copies of a 4-page section of a representative newspaper, 1916 and 1926, and per cent of change in output per man-hour*

Process	Man-hours worked in—		Increase in output per man-hour
	1916	1926	
			Per cent
Composition	204.3	145.2	40.7
Stereotyping	8.9	10.6	[1] 15.8
Presswork	1.8	1.7	7.8
Total	215.1	157.5	36.5

[1] Decrease.

The production of 10,000 copies of an average 4-page section in this establishment during the 1916 period required 204.3 man-hours for the composition, 8.9 man-hours for the stereotyping, and 1.8 man-hours for the presswork. During the 1926 period only 145.2 man-hours were necessary for the same amount of composition, a decrease of 29 per cent, but the man-hours for stereotyping had risen to 10.6, an increase of 19.1 per cent. The man-hours required for the presswork had been reduced to 1.7 hours, or 5.5 per cent. The total man-hours involved in all three processes had been lowered to 157.5, or 26.8 per cent.

RELATION OF PROCESSES TO TOTAL OUTPUT

Composition, stereotyping, and presswork are but steps in the preparation of the final product of the newspaper plant. Consequently the total man-hours devoted to the production of a specific unit, such as 10,000 copies of a 4-page section, actually constitute the time equivalent for the output of such a unit, if that quantity only is published. A vast difference is created in duplications of that unit. Composition remains stationary, regardless of how many units are printed, as each page is complete in itself. Stereotyping on a large daily newspaper also remains practically stationary (subject to the number of presses operated) whether 100,000 or 5,000,000 copies are printed, though it would require proportionately fewer man-hours if such a small number of copies as 10,000 of a 4-page section were desired. In that case only 2 plates for each page would be necessary, or 8 plates for the 4 pages, instead of the 51 or 57 plates required in the selected establishment to turn out within the time limit the number of copies required for its large circulation.

Consequently, production of subsequent units means only the additional man-hours for the presswork thereon. These man-hours increase proportionally to the number of units printed, and the total man-hour production of an establishment is therefore regulated by the total number of copies printed and the number of pages contained therein. In the selected establishment, for instance, the man-hour production for the three processes was 1,346.5 copies of 4-page sections during the 1916 period. The total-man hours for the three processes had increased 92.7 per cent by the 1926 period. The total output had increased 149.6 per cent in the same time, so that the man-hour production had changed to 1,743.8 copies, an increase of 29.5 per cent. In spite of the higher man-hour production there had been no reduction of employees. The growth in circulation and page contents, together with clock-time requirements, had necessitated additional workers, as shown by the increases in man-hours for the various processes—73.5 per cent for the composing room, 155.3 for the stereotyping room, and 131.4 for the pressroom.

The man-hours for presswork on 10,000 copies of a 4-page section were only approximately 1 per cent of the total man-hours for the three processes. Consequently the increase in the total man-hours through printing additional units was small, and the man-hour output increased rapidly as the number of units advanced. A tabulation, showing the relative changes of total man-hours and of man-hour output through duplications of units, is given in Table 7:

TABLE 7.—*Man-hour production of composition, stereotyping, and presswork on specified numbers of copies of a 4-page section of a representative newspaper in 1916 and 1926*

Number of copies of a 4-page section printed	Number of man-hours worked in—		Number of copies produced per man-hour in—		Increase in output per man-hour
	1916	1926	1916	1926	
					Per cent
10,000	215.1	157.5	46.5	63.5	36.6
20,000	216.9	159.2	92.2	125.7	36.3
30,000	218.7	160.8	137.2	186.6	36.0
40,000	220.5	162.5	181.4	246.2	35.7
50,000	222.3	164.1	225.0	304.6	35.4
100,000	231.2	172.5	432.5	579.9	34.1
150,000	240.2	180.8	624.5	829.8	32.9
200,000	249.2	189.1	802.7	1,057.7	31.8
500,000	303.0	239.0	1,650.3	2,092.0	26.8
1,000,000	392.6	322.2	2,546.8	3,103.9	21.9

In this establishment the man-hours for presswork on 10,000 copies in 1916 were 1.8, so that each additional 10,000 copies required only 1.9 man-hours more than the total number of hours for all three processes. While 10,000 copies required 215 man-hours, 500,000 copies involved only 303 man-hours, and an additional 500,000 copies only 90 man-hours more. In 1926 the presswork was performed with 0.1 man-hour less, making only a minor difference in proportionate increase, but the one-fourth reduction in total man-hours for the three processes accentuated the differences, making considerable variation in man-hour output. Another factor made still more of an actual change. The growth of circulation and the

more voluminous newspapers printed in 1926 were responsible for the production of a greater number of sections in that period than in 1926. Consequently, the actual increase would not be based on the same number of total copies produced, as listed in the table, but would be raised proportionately.

MODERN AVERAGE PRODUCTION

COMPOSITION.—The preceding data refers only to the trend of man-hour output, and can not be taken as representative of production for the industry as a whole. Considerable fluctuation exists in the number of man-hours required for each process, as shown by a comparison of data for several newspaper plants. Four of the establishments included in the survey for this study furnished records which afforded a comparison of the man-hours required for the composition on an average 4-page section of the respective newspapers. As the pages of the four newspapers differed in dimensions, and consequently contained varying amounts of type, the data for three of them were converted so as to correspond with that of the fourth one, thus placing all of them on a uniform basis. The comparison given in Table 8 shows an average of 162.69 man-hours for composition in the production of the 4-page section taken as the base.

TABLE 8.—*Number of man-hours worked in specified processes in the production of four pages in several modern newspaper establishments in 1926*

Establishment [1]	Number of man-hours worked on a 4-page section			Per cent of average		
	Composition	Stereotyping	Presswork (10,000 copies)	Composition	Stereotyping	Presswork
No. 1	145.19	10.63	1.66	89.2	116.4	65.1
No. 2	144.12	3.88	2.37	88.6	42.5	92.9
No. 3	156.14	5.69	2.69	96.0	62.3	105.5
No. 4	205.30	13.65	2.35	126.2	149.4	92.2
No. 5	----------	11.82	3.68	----------	129.4	144.3
Average	162.69	9.13	2.55	100.0	100.0	100.0

[1] The figures for the three processes are not for identical establishments.

Stereotyping.—Records from five establishments permitted a similar comparison for stereotyping. The man-hours required for stereotyping a 4-page section of each newspaper varied greatly, principally because of the different number of presses operated, which regulated the number of plates cast for each page. The number cast was 14.2 for establishment No. 1, 2.8 for No. 2, 6.2 for No. 3, 12.8 for No. 4, and 13.7 for No. 5, giving an average of 10.7 plates per page. As shown in Table 8 an average of 9.13 man-hours was required for the stereotyping of the 4-page section chosen as the unit.

Presswork.—Records obtained in five newspaper plants afforded a similar comparison of the man-hours required in each establishment for the presswork on each 10,000 copies of the basic 4-page section. Differences, created by the number of papers printed, the number of hours per issue, and the number of hands per press, are shown in the comparison presented in Table 8. An average of 2.55 man-hours is given for presswork on 10,000 copies of the 4-page section used as the base.

No attempt has been made to present combined man-hour output for any establishment except the one selected to show the trend between 1916 and 1926. Different types of establishments were selected so as to obtain a fair average for comparison within the processes and not for the entire output of each establishment; therefore the figures for the three processes can not be combined, since the data are not for identical establishments.

UNION WAGE RATES IN THE UNITED STATES

WAGE rates advanced generally in all industries during the period between 1916 and 1926, and newspaper publishing was no exception. According to data published in the union wage studies by the Bureau of Labor Statistics, increases in the average union hourly wage rate for the principal workers ranged from 83.2 to 96.4 per cent, as shown in Table 9:

TABLE 9.—*Average basic union wage rates in newspaper publishing, 1916 and 1926, by occupation*

Occupation	Rate per hour		Per cent of increase	Occupation	Rate per hour		Per cent of increase
	1916	1926			1916	1926	
Hand compositors, day	$0.582	$1.120	92.4	Stereotypers, day	$0.540	$0.992	83.7
Hand compositors, night	.657	1.249	90.1	Stereotypers, night	.618	1.138	84.1
Machine operators, day	.578	1.135	96.4	Pressmen, day	.553	1.013	83.2
Machine operators, night	.657	1.260	91.8	Pressmen, night	.591	1.155	95.4

COMPARISON OF LABOR COST IN A REPRESENTATIVE NEWSPAPER ESTABLISHMENT IN 1916 AND 1926

ACTUAL LABOR COSTS AND UNION WAGE RATES

Union wage rates were not the same in all localities, and increases therein were also different. The hourly rate for 1916 in the establishment selected as representative of the trend of production exceeded the average hourly rate, and the percentage increases varied somewhat from the average increases for the country. But basic hourly wage rates for the principal occupation in each process and average actual man-hour cost for the entire process were very different. While the principal occupation constituted the largest group of workers in a process, and while these workers were paid a certain rate during the regular shift, each process required a number of other workers, some of whom were paid a higher and others a lower rate, so that the average actual man-hour rate was dependent on the proportion of such workers. In addition, a higher hourly rate was paid, ordinarily 50 per cent, for overtime; therefore the proportion of overtime in the total man-hours had considerable influence on the actual labor cost for the unit.

COMPOSITION

For comparison of actual labor costs in the representative establishment studied the same units were taken as in the comparison of production. The actual labor cost during the selected periods in 1916 and 1926 for composing-room work on four average pages is presented in Table 10:

TABLE 10.—*Labor cost for composition on four pages of a representative newspaper, 1916 and 1926, by occupation*

Occupation	Composition on 4 pages—		Per cent of increase	Occupation	Composition on 4 pages—		Per cent of increase
	1916	1926			1916	1926	
Productive labor:				Nonproductive labor—Continued			
Machine operators	$37.99	$62.91	65.6	Make-ups	$15.50	$20.43	31.8
Hand compositors	29.17	41.16	41.1	Laborers	9.92	13.60	37.1
Total	67.16	104.07	55.0	Supervisory employees	11.27	9.02	[1] 20.0
Nonproductive labor:				Total	59.59	78.64	32.0
Machinists	5.68	5.70	.4				
Machinists' helpers	1.26	1.29	2.4	All employees	126.75	182.71	44.1
Proof readers	15.95	28.60	79.3				

[1] Decrease.

While the hourly wage rate for both machine operators and hand compositors in this establishment had advanced 100 per cent during the interval, the increase in actual hourly earnings for the two occupations was only 95 per cent, because of reduction in overtime. The actual man-hour earnings for all employees had risen 102.9 per cent, but as 30 per cent fewer man-hours were required in 1926 than in 1916 for composing-room work on the unit, the increase in the labor cost of unit production was only 44 per cent.

STEREOTYPING

A comparison of labor costs in the same establishment for stereotyping four average pages during the selected periods in 1916 and 1926 is presented in Table 11:

TABLE 11.—*Labor cost for stereotyping four pages of a representative newspaper, 1916 and 1926, by occupation*

Occupation	Stereotyping on a 4-page section—		Per cent of increase	Occupation	Stereotyping on a 4-page section—		Per cent of increase
	1916	1926			1916	1926	
Productive labor:				Nonproductive labor:			
Molders	$1.38	$2.15	56.2	Jobmen	$0.47	$1.89	300.7
Packers	.96	3.19	232.0	Supervisory employees	.83	.76	[1] 8.1
Autoplate operators	1.31	2.36	80.4				
Cylinder tenders	1.28	2.36	84.7	Total	1.30	2.65	103.9
Metal-pot tenders	.80	1.30	61.8				
Shaver tenders	.80	1.21	51.1	All employees	7.83	15.23	94.4
Total	6.53	12.51	91.4				

[1] Decrease.

The hourly wage rate for stereotypers in this establishment increased only 70 per cent between 1916 and 1926. The rise in the actual hourly rate for productive labor was a little less—67.5 per cent—and the advance in actual man-hour earnings for all employees was still less—only 63.7 per cent. As it required over 19 per cent more man-hours in 1926 than in 1916 for the stereotyping on the unit, the increase in labor cost of unit production mounted to 94.4 per cent.

PRESSWORK

A comparison of the labor costs in the same establishment, during the selected periods in 1916 and 1926, for printing 10,000 copies of a 4-page section, is presented in Table 12:

TABLE 12.—*Labor cost for presswork on 10,000 copies of a 4-page section of a representative newspaper, 1916 and 1926, by occupation*

Occupation	Printing 4-page sections (10,000 copies)		Per cent of increase	Occupation	Printing 4-page sections (10,000 copies)		Per cent of increase
	1916	1926			1916	1926	
Productive labor:				Nonproductive labor:			
Pressmen in charge	$0.16	$0.22	36.5	Laborers	$0.03	$0.16	407.1
Journeymen	.76	1.25	64.0	Supervisory	.11	.14	27.3
Flyboys	.13	.29	120.1	Total	.14	.30	115.0
Total	1.06	1.76	66.9	All employees	1.19	2.06	72.5

The hourly wage rate for journeyman pressmen in this establishment rose 90 per cent between 1916 and 1926. The increase in their actual hourly earnings was only 83.3 per cent, but that in the actual man-hour earnings for all employees was closer—85.6 per cent. As the number of man-hours required in 1926 for the presswork on the unit was 7.3 per cent smaller than in 1916, the increase in labor cost for printing 10,000 copies of a 4-page section was 72.5 per cent.

COMBINED PROCESSES

The actual labor costs during the selected periods in 1916 and 1926 for composition and stereotyping on an average 4-page section of the newspaper, and for the presswork on 10,000 copies, is presented in Table 13:

TABLE 13.—*Labor cost for composition, stereotyping, and presswork on 10,000 copies of a 4-page section of a representative newspaper, 1916 and 1926*

Process	Labor cost in—		Per cent of increase
	1916	1926	
Composition	$126.75	$182.71	44.1
Stereotyping	7.83	15.23	94.4
Presswork	1.19	2.06	72.5
Total	135.77	200.00	47.3

Labor costs for the combined processes in the production of 10,000 copies of a 4-page section increased 47.3 per cent between 1916 and 1926, but the output of additional sections increased the labor costs only by the comparatively small amounts for presswork thereon. Consequently, the labor cost for each additional 10,000 copies was only $1.19 more in 1916, or $2.06 more in 1926. A tabulation of the labor costs for various multiples of the unit during the two periods is presented in Table 14:

TABLE 14.—*Labor cost for composition, stereotyping, and presswork on each specified number of copies of a 4-page section of a representative newspaper in 1916 and 1926*

Number of copies of a 4-page section printed	Labor cost in—		Per cent of increase	Number of copies of a 4-page section printed	Labor cost in—		Per cent of increase
	1916	1926			1916	1926	
10,000	$135.78	$200.00	47.3	100,000	$146.52	$218.52	49.2
20,000	136.97	202.06	47.5	150,000	152.48	228.81	50.1
30,000	138.16	204.12	47.7	200,000	158.45	239.11	50.9
40,000	139.36	206.17	47.9	500,000	194.25	300.85	54.9
50,000	140.55	208.23	48.2	1,000,000	253.92	403.76	59.0

The actual increase in labor cost for the selected establishment was regulated by the number of 4-page sections produced therein at each specific period, the increase in such sections during the interval making the increase in labor cost per unit smaller than if there had been no change in the total number of pages produced.

The total labor cost for each 10,000 copies of a 4-page section during the 1916 period was $4.81. During the following 10 years the total man-hours increased over 92 per cent. The total labor cost for the composing room advanced over 250 per cent, that for the stereotyping room over 315 per cent, and that for the pressroom over 330 per cent, making an increase in weighted labor costs for the three processes combined of 277.1 per cent. But the total output of 4-page sections had increased 149.6 per cent during the period, making the actual labor cost for the three processes combined for each 10,000 copies $7.27, an increase of only 51.1 per cent.

MODERN AVERAGE LABOR COSTS

JUST as the trend of production in a single establishment can not be taken as representative of production of the industry as a whole, so the trend of labor costs, shown in the foregoing data for a single establishment, does not indicate representative labor costs for the processes. In addition to variations in the number of man-hours required in the different establishments for the production of a specified unit, there is a difference in the prevailing wage rates in the localities in which the establishments are situated.

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Composition.—A comparison of labor costs in four modern newspaper plants for composing-room work on an average 4-page section of the respective newspaper, converted to a uniform page size, is presented in Table 15:

TABLE 15.—*Labor cost in specified processes in the production of four pages in several modern newspaper establishments in 1926*

Establishment [1]	Labor cost on a 4-page section			Per cent of average		
	Composition	Stereotyping	Presswork (10,000 copies)	Composition	Stereotyping	Presswork
No. 1	$182.71	$15.23	$2.06	85.0	134.1	74.6
No. 2	195.56	4.34	2.34	91.0	38.2	84.8
No. 3	211.00	4.99	3.28	98.1	43.9	118.8
No. 4	270.99	16.42	1.96	126.0	144.5	71.0
No. 5	----------	15.80	4.16	----------	139.1	150.7
General average	215.04	11.36	2.76	100.0	100.0	100.0

[1] The figures for the three processes are not for identical establishments.

The respective labor cost for composition on an average 4-page section ranged from $182.71 to $270.99 in the four establishments, giving an average of $215.04 for the unit.

Stereotyping.—A similar comparison of labor costs for stereotyping on an average 4-page section in five modern newspaper plants is also presented in Table 15.

The variations created through differences in the number of man-hours required in each establishment are decidedly noticeable, and together with differences in hourly wage rates for the workers create a range of $4.34 to $16.42 in the labor cost of stereotyping a 4-page section, with an average cost of $11.36.

Presswork.—The labor costs in five modern newspaper plants for presswork on each 10,000 copies of an average 4-page section of the respective publications, are also shown in Table 15.

The differences created through considerable variation in the hourly wage rates, together with the diverse number of man-hours for the unit production, are very marked in this process also. The cost of presswork on each 10,000 copies of a 4-page section ranges from $1.96 to $4.16, giving an average labor cost of $2.76.

As the data were secured for comparison within the processes, and not for comparison of the entire output of each establishment, the labor costs for the three processes can not be combined, as the figures are not for identical establishments.

CHAPTER 3.—PRODUCTIVITY AND LABOR COST IN 1926 AS COMPARED WITH 1896

PRODUCTIVITY AND LABOR COST IN COMPOSING ROOMS

FROM the standpoint of time cost, composition is the most important process in the mechanical production of a modern newspaper, since approximately 60 to 70 per cent of the total man-hours for the three processes are for it. The bulk of the composition is produced on line-casting machines, and consequently the operators on these machines constitute the most important labor group, not only in the composing room, but also in the entire establishment. The relative production of machine operators is therefore of vital interest, and the labor cost of their work is an important factor.

AVERAGE PRODUCTION OF MACHINE OPERATORS IN A REPRESENTATIVE COMPOSING ROOM DURING 1926

A GOOD comparison of actual accomplishments is afforded by a tabulation of individual production of line-casting machine operators on news composition in the establishment selected as a representative modern newspaper plant. Figures, showing the number of man-hours required to produce sufficient news type to fill four pages of the newspaper, are presented in Table 16:

TABLE 16.—*Man-hours required for production of four pages of news composition on line-casting machines in specified periods, 1926*

Period	Average man-hours required by—		
	Day force	Night force	
		Regulars	Substitutes
First week	48.8	48.8	49.4
Second week	47.2	48.3	50.3
Third week	47.4	48.6	48.5
Fourth week	50.2	46.6	47.9
Fifth week	46.9	48.6	47.7
All 5 weeks	48.1	48.2	48.8

Considerable variation existed in the average production for the individual news operators, due partly to personal ability and partly to differences in idle time because of shop conditions or machine trouble. The lowest average for the full five weeks for the production of the unit by one operator was 40.3 man-hours, but weekly averages for the same individual ranged as low as 38.5 man-hours. The highest average for one operator was 61.6 man-hours.

COMPARISON OF MAN-HOURS AND LABOR COST FOR MACHINE OPERATORS IN REPRESENTATIVE COMPOSING ROOMS IN 1896, 1916, AND 1926

Records for 1916 and 1926 of the representative establishment which were obtained during the survey for this study afforded a comparison of output over a 30-year period, as data for 1896 for

machine composition for the same establishment had been secured during a former survey.[1] The data for all three years were converted to a unit composed of machine composition sufficient to fill four pages of the newspaper as published in 1916 or 1926, and the result is presented in Table 17:

TABLE 17.—*Man-hours worked and labor cost for machine operators in composition of four pages of a newspaper, 1896, 1916, and 1926*

Occupation	Year	Man-hours worked			Labor cost		
		Number	Per cent of change, compared with—		Amount	Per cent of change, compared with—	
			1896	1916		1896	1916
Linotype operators	1896	66.1			$44.045		
Linotype and Intertype operators	1916	71.0	+7.4		50.297	+14.2	
Linotype, Intertype, and Monotype keyboard operators	1926	64.3	−2.7	−9.5	92.573	+110.1	+80.1

In 1896 the machine operators consisted entirely of linotype operators. In 1916 part of them operated linotypes and part of them intertypes, there being no difference as far as either production or labor cost was concerned. In 1926 monotype keyboard operators were included, and as the average production for these operators is ordinarily higher than that for operators on line-casting machines, the man-hours per unit may be reduced slightly; but as the man-hours for monotype operators amounted to less than 5 per cent of the total man-hours for the group, the variation could not have been great.

It required 66.1 man-hours for the linotype operators in 1896 to produce sufficient type to fill four pages of the newspaper. The production was presumably, as in the two succeeding periods, corrected matter and probably consisted entirely of news composition, as very little advertising composition was set on machines at that time. In 1916 the same amount of news composition required 71 man-hours, an increase of 7.4 per cent, as competition and the consequent necessity for speed in publishing necessitated a larger force of operators than would otherwise have been required. In 1926 a similar output was produced in 64.3 hours, nearly 10 per cent less than in 1916 and 3 per cent less than in 1896.

The labor cost for the unit, which was $44.045 in 1896, had in 1916 increased to $50.297, or 14.2 per cent. By 1926 the labor cost had advanced to $92.573, or 110 per cent above the 1896 labor cost, which was less than the actual increase in man-hour labor cost, as the unit was turned out in shorter time.

Data for linotype news operators during 1926 were also obtained for another morning newspaper establishment which had been included in the 1896 survey, but which differed essentially from the first establishment in that the operators were paid a piece rate instead of a time rate. This permitted a second comparison for an individual establishment, of production and labor cost for linotype composition during the two periods, which is presented in the statement following:

[1] U. S. Commissioner of Labor. Thirteenth annual report, 1898. Hand and Machine Labor. 2 vols. Washington, 1899.

Man-hours worked and labor cost for linotype operators in composition of four pages of a newspaper, at piece rate, 1896 and 1926

Number of man-hours worked:	
1896	52.3
1926	43.9
Per cent of decrease	16.1
Labor cost:	
1896	$33.152
1926	47.037
Per cent of increase	41.9

As the page on this newspaper varied in size from that published in the previous establishment, the data for production and labor cost have been converted to that of four pages containing the same amount of type as for the first establishment. Details could not be obtained for working methods during the 1896 period, but they were presumably much the same as in the later period. About one year previously the composing room had been installed in a new building, which was considered up to date then, and the equipment was probably modern at that time (though it would not be considered so now), consisting of linotypes of the early single-magazine style. The 1926 survey was made about one year after the establishment had again been located in a new plant—a splendid example of present-day factory style—where new, modern equipment had been installed. The machines were equipped with multiple magazines, electrically heated metal pots, and automatic metal feeders. They were driven at a higher speed than ordinarily provided by the manufacturers, producing an average of 6½ to 7 lines per minute of operating time, with a maximum of 7½ lines. Each operator went to the copy cutter's desk for copy, took his own product to the bank, set and inserted his own corrections, and inserted all heads in his takes. A decrease of 16.1 per cent in man-hours in production of the 4-page unit had been effected between the two periods. Two of the operators were employed on the day shift, but the man-hours for these aggregated only 3 per cent of the total man-hours. The rest of the operators were employed on the night shift. In the 1926 period great variation existed in the individual records for the operators. According to data secured for daily production for two weeks, one operator required an average of 18 man-hours to turn out the unit chosen, the minimum record, and another required 105.8 man-hours, the maximum record; but the average time required by the majority of the operators ranged from 39 to 59 man-hours.

The labor cost for the unit had increased 41.9 per cent by the 1926 period. It was regulated in this establishment by the amount of composition produced, as the operators were paid on a piecework basis. During the 1896 period the rate was 14 cents per 1,000 ems, presumably for either 5½, 6, or 7 point type. In 1926 varying amounts were paid, according to the size of type. The rate for 5 or 6 point type was 17 cents per 1,000 ems for night work and 16 cents for day

work. The rate for 7-point type was 21 cents for night work and 19 cents for daywork. The rate for 8-point type was 1 cent per 1,000 ems higher than for 7-point, and that for 10-point 2 cents per 1,000 ems more than for 8-point. Additional line-age was allowed for difficult matter, such as mixed faces, tabulations, etc., so that all production and pay was based on straight news composition.

Data for still another establishment permitted a general analysis of machine production for the selected period in 1926. This was also a morning newspaper, where the operators were paid on a time basis, as in the first establishment. Approximately 80 per cent of the man-hours were on night work and the remainder on daywork. Most of the type consisted of 5½, 6, and 8 point type, but some heads and display type were produced on the linotype and intertype machines. All the other sizes were converted to 6-point ems for computation. The pages of this newspaper contained a different number of ems than the pages in the other two publications, so the man-hours and labor costs were computed for the amount required for four pages of the newspaper issued in the first establishment (the original unit). It required 62.1 man-hours to produce such a quantity in this composing room, nearly 3 per cent less than in the first composing room, or 40 per cent more than in the second one. The difference was partly caused by the location of this newspaper plant in an old building, which did not allow such an efficient arrangement of the work as in the other two modern establishments. The increase in man-hours was also reflected in the labor cost for the unit, which amounted to $89.94, or 3 per cent less than in the first composing room, but 90 per cent more than in the second one.

PRODUCTIVITY AND LABOR COST IN PRESSROOMS

COMPARISON OF MAN-HOURS AND LABOR COST FOR PRESSWORK IN A REPRESENTATIVE PRESSROOM IN 1896 AND 1926

AS ONE of the pressrooms included in the present study had also been included in the 1896 investigation,[1] it is possible to compare machine production therein during the two periods. The data for the 1896 period covered only the number of man-hours required in the actual operation of the presses by the press crews, or productive labor in the process, to print a certain quantity of newspapers, together with man-hours for the nonproductive labor during the same clock time, and the respective labor costs for both groups. No account was taken of the preparatory time involved, which would have approximately doubled both man-hours and labor costs. The data were converted to the unit previously used for presswork, 10,000 copies of an average 4-page section of a newspaper, and corresponding data were prepared from the 1926 records. The results are presented in Table 18:

[1] U. S. Commissioner of Labor. Thirteenth annual report, 1898. Hand and Machine Labor. 2 vols. Washington, 1899.

TABLE 18.—*Man-minutes worked and labor cost for presswork (operating time only) on 10,000 copies of a 4-page section of a newspaper, 1896 and 1926*

Occupation	Man-minutes worked			Labor cost		
	1896	1926	Per cent of decrease	1896	1926	Per cent of increase
Pressmen in charge	9.9	6.6	33.0	$0.087	$0.164	89.3
Journeymen	47.3	36.6	22.7	.309	.816	164.4
Flyboys	16.8	12.5	25.3	.056	.186	234.0
Total productive labor	73.9	55.9	24.6	.451	1.166	158.5
Laborers	15.8	18.5	[1] 17.3	.035	.289	717.5
Supervisory employees	2.0	5.2	[1] 164.5	.030	.159	431.3
Total nonproductive labor	17.7	23.7	[1] 33.8	.066	.449	585.2
All employees	91.6	79.4	13.3	.517	1.615	212.6

[1] Increase.

In 1896 the equipment consisted of 1 sextuple press, capable of printing twelve 4-page sections per cylinder revolution; 6 quadruple presses, each capable of printing eight 4-page sections per cylinder revolution; 1 triple press, capable of printing six 4-page sections per cylinder revolution; and 2 double presses, each capable of printing four 4-page sections per cylinder revolution. This would give a total production of seventy-four 4-page sections per cylinder revolution if each press was used at full plating capacity. Such was, however, not always the case, but the portions used were regulated by the number of pages in the daily issue. If, for instance, the issue contained 12 pages, the full plating capacity of the triple press could be utilized, but only one-half of the capacity of the sextuple press and three-fourths of the capacity of each quadruple press. If the issue contained 16 pages, the full plating capacity of the entire equipment could be used, except one-third of the triple press. If it contained 20 pages, on the sextuple press and the triple press only five-sixths of such capacity could be utilized, and on each quadruple press only five-eighths, while the double presses could not be used at all, thus reducing the possible production to forty-five 4-page sections per cylinder revolution. The data secured were for the production of a 48-page issue, which permitted of the use of the entire plating capacity of the presses to give the maximum production.

The sextuple press was at that time the largest style manufactured and quadruple presses were the sizes most commonly found in large newspaper pressrooms. The sextuple press was operated by a crew of 11, each quadruple press by a crew of 8, the triple press by a crew of 6, and each double press by a crew of 5. No information however, was given as to the total man-hours for each press crew. All preparatory time was omitted in the data, only the time when the presses were actually operated being considered. The presses were presumably run at a maximum speed of 12,000 cylinder revolutions per hour, judging from the production attained, but some time was, of course, lost in changing of rolls and through the usual operating delays, and this was not specified nor deducted. Steam was used for motive power, and proportionate man-time for both an engineer and firemen were included in the original data, but has been eliminated from this compilation.

By 1926 the equipment had been greatly enlarged, consisting of sextuple, octuple, and decuple presses, which had a total productive capacity of two hundred and forty 4-page sections per cylinder revolution, and which could be operated in many different combinations according to requirements. Except for the Sunday morning issue, only part of the equipment was used at one time, and the entire plating capacity was seldom used, but the necessary equipment was operated as quadruple units, sextuple units, octuple units, or decuple units. The number of hands in each press crew was regulated by the size of the unit, regardless of whether the entire plating capacity for this or only a portion of it was used. For a quadruple press the crew consisted of 7 or 8 hands, for a sextuple press, of 8 or 9 hands, for an octuple press, of 11 or 12 hands, and for a decuple press, of at least 14 hands. The presses contained numerous improvements, which were not invented when the early styles of 1896 were built. Some of them were provided with magazine reels for the paper rolls, with newspaper conveyors on the deliveries, with automatic tension control, or with other labor-saving devices. Electric roll hoists were used and the ink fountains were supplied by the use of air pressure. Electricity had supplanted steam as the motive power, permitting a push-button system of press control and more flexibility in arrangement. The presses were operated at various maximum speeds according to type of machine, so that on one part of the equipment one hundred and twelve 4-page sections could be produced at the rate of 12,000 per hour, on another part 32 sections at the rate of 13,200 per hour, and on the remainder, 96 sections at the rate of 18,000 per hour, clock time.

For the purpose of comparison with the 1896 period, similar data, consisting of the man-time required for the press crews, or productive labor, in the actual operation of the presses, were prepared from the 1926 records. This operative time consisted of the combined time from the starting to the stopping of the presses on the various editions each day, including the time consumed in changing paper rolls or in other operating delays. As the number of these productive man-hours for the productive labor constituted 49.3 per cent of the total man-hours for the group, a similar proportion of the total man-hours for the nonproductive labor was added, making a total of 1 hour and 19.4 minutes in 1926 for the production of ten thousand 4-page sections, as against 1 hour and 31.6 minutes in 1896, or a decrease of 13.3 per cent in man-hours. For productive labor alone the decrease was nearly 25 per cent, but a decided increase in proportionate man-hours for nonproductive labor was responsible for the smaller decrease in total man-hours.

The labor cost involved in production of the unit (ten thousand 4-page sections) was 51.7 cents in 1896, based on productive time for all employees. In 1926 it had risen to $1.615, an advance of 212.6 per cent, caused especially by the general increase in wages throughout the country between the two periods, but augmented by the increase in man-hours for the nonproductive labor. It must, however, be remembered that this cost, as well as the man-time in the table, covers only the productive time, and that the actual labor cost for the unit in this pressroom was practically double the amount in 1926 and presumably also in 1896. The same condition also applies to the man-hours.

CHAPTER 4.—DEVELOPMENT OF COMPOSITION

HAND COMPOSITION

TYPE SETTING BEFORE 1850

THE use of movable types had its start in Europe about the middle of the fifteenth century. At the beginning of the sixteenth century, composition, the process of setting type for printing, had passed the experimental stage and was in practical use. Its progress remained stationary from then until the middle of the nineteenth century, when typesetting machines began to appear. Hand composition is a manual operation. The single types are picked up, one by one, from their compartments in the type case and assembled side by side into lines. Spaces, pieces of metal similar to type but less than type-high, are placed between the words, and sometimes between the letters, to fill out each line to the desired length, an operation called justifying. When the small tray in which the types are assembled, called a composing stick, is filled, the contents are transferred to another and larger tray, called a galley, where the job is gradually built up. A stick will hold about 13 lines of 12-point type, while a galley will hold approximately a column. A proof of the type set is taken and compared with the original copy for errors, and any errors are corrected in the galley. The type is made up into pages, extra leads, rules, or blank slugs being inserted where needed. Each page is inclosed in a metal frame, known as a chase, locked firmly in it by wedges, and delivered to the pressroom for printing. Such assembling of the types requires both an extensive special knowledge of practically all educational subjects and considerable dexterity of the hands. After printing, the type is distributed by hand, and the spacing materials are replaced in the respective compartments of a case or other container.

It can be readily seen that hand composition is naturally slow. In A Collation of Facts Relative to Fast Typesetting, compiled by William C. Barnes and others, and published in 1887, it was stated that 40 years previous "the printer who could set 1,200 ems per hour was deemed a fairly quick hand; at 1,400 he was fast; 1,700 was wonderful, and 2,000 ems an hour was considered among the physical impossibilities."

SIZE AND MEASUREMENT OF COMPOSITION

Size of type is determined by the height of the face of capital letters, including the slight projection, or shoulder, at the foot of each letter, which provides a small separation between the lines. In former days each size of type was known by a specific name, but the modern distinction is based on the point system, in which 72 points practically equal one inch, or 996 points 35 centimeters. Correctly figured, a point is 0.0138 inch, slightly less than one seventy-second inch. The body of 12-point type is twelve seventy-second inch high, while the width from right to left varies according to the width of the letter or character. A number of older compositors still use the names of the former system and, as these are often found in references to the industry, a table of equivalents is presented as Table 19.

TABLE 19.—*Type size equivalents*

Point size	Former name	Point size	Former name
3½	Brilliant.	20	Paragon, or 2-line long primer.
4½	Diamond.	22	2-line small pica.
5	Pearl.	24	2-line pica.
5½	Agate.	28	2-line English.
6	Nonpareil.	30	5-line nonpareil.
7	Minion.	32	4-line brevier.
8	Brevier.	36	2-line great primer.
9	Bourgeois.	40	Double paragon.
10	Long primer.	42	7-line nonpareil.
11	Small pica.	44	Canon, or 4-line small pica.
12	Pica.	48	4-line pica.
14	English, or 2-line minion.	54	9-line nonpareil.
16	2-line brevier.	60	5-line pica.
18	Great primer.	72	6-line pica.

An em is the unit by which composition is measured. It is not a fixed uniform measure, but varies according to the size of the type. In each case it is the quantity of type which occupies a space in a line equal to the height of the type body, or slightly more than the height of the capital letters. A 12-point em is, consequently, 12 points in height and 12 points in width. This size, previously called pica, is frequently, though not always, meant when the word "em" is used without a designated size.

Alphabets of the same point size, and even of the same class, do not always contain the same number of ems, as the letters may be proportionately wide or narrow, called fat or lean, respectively. If the differences are very pronounced, the styles are called extended or condensed. Wide letters required fewer pick-ups from the case for a certain number of ems, while narrow letters called for more. Some difference was also created by variations in the length of the line, the shorter lines requiring more transfers from the stick to the galley. An ordinary newspaper line of 6-point type, 25 ems wide, contains an average of 40 types. In continuous setting it would require setting and spacing each line inside of 60 seconds to attain a rate of 1,500 ems an hour. This would mean approximately 40 pick-ups from the case and the justifying of a line every 60 seconds.

TYPE ARRANGEMENT OF NEWSPAPERS

Until 1760 newspapers in the Colonies were printed on half sheets of varying sizes and shapes, the earlier size being ordinarily 7 by 9 or 10 inches, but about that time most of the Boston journals began printing a whole sheet, 15 by 19 inches, regularly. Half sheets contained from 3,000 to 7,000 ems, according to the size of type used, and whole sheets double that amount, which is equal to the contents of one and two columns in the ordinary newspaper of the present day. Long primer (10-point type) was commonly used. A page ordinarily contained 2 columns, each 3 inches in width, though at times it was set in a single wide column. In 1827 and for some time afterward leading New York daily newspapers were about 24 by 35 inches, but later changed to 35 by 59 inches. The New York Herald, when established in 1835, was a 4-page paper 30 by 24 inches, containing 4 columns per page, closely set in minion (7-point type). The penny papers, first introduced in 1833, came out in reduced sizes, but many of the important papers retained the large sizes,

called blanket sheets, for a number of years. In 1853 the Journal of Commerce in New York published a sheet containing 2,057 square inches. Daily composition on these blanket sheets often exceeded 700,000 ems.

In 1880 minion (7-point type) was commonly used on newspapers for reading matter, and nonpareil (6-point) or agate (5½-point) for advertisements. The 1880 Census of the United States gives the average and aggregate ems of type set per issue on newspapers in this country during that year: Average: Daily, 74,147 ems; weekly,[1] 57,197 ems; aggregate: Daily 66,140,266 ems; weekly,[1] 490,753,756 ems.

Modern newspaper pages are divided into columns varying from 2 to 2¼ or 2⅙ inches in width. The latter size was for a number of years the standard on newspapers, with seven columns per page, but conservation of paper and standardization have resulted in almost general adoption of 8 columns, each 12, 12½, or 13 ems pica in width. The common basis of measuring space in a newspaper column is the agate, or 5½-point, line. As there are 14 agate lines in one inch, each inch of space is figured as 14 agate lines, regardless of how many actual lines of reading matter it contains. Type may be set solid or leaded. When solid, the lines of type are set close against each other. When leaded, thin strips of metal, usually 2 points or one-thirty-sixth of an inch in thickness, are placed between the lines. All leads more than 2 points in thickness are called slugs.

RECORDS OF PRODUCTION

Many compositors became very efficient. A table published in Barnes's Collation of Facts Relative to Fast Typesetting gives the best records for the period ending 1886. This table is reproduced here, with additional columns showing net production of corrected output, as Table 20:

TABLE 20.—*Best records for hand setting of type*

Name	Place	Date	Type	Size[a]	Measure[b]	Hours	Gross amount		Corrected type	
							Total	Per hour	Total	Per hour
Alex. Duguid	Philadelphia	Mar. 27, 1886	Nonpareil	17⅞	28	1½	3,416	2,277⅓	3,316	2,210⅔
Jos. W. McCann.	do	do	do	17⅞	28	1½	3,347	2,231	3,197	2,131⅓
Wm. C. Barnes	New York	Sept. 10, 1885	do	16	29	[c] 1	2,160	2,160		
Do	Philadelphia	Mar. 18, 1886	do	17⅞	28	1½	3,220	2,146⅔	3,157½	2,105
Jos. W. McCann.	New York	June 4, 1885	Minion	15⅝	25	[c] 3	6,350	2,116⅔	6,037½	2,012½
Alex. Duguid	Cincinnati	Dec. 29, 1885	do	16	22½	[c] 1	2,093	2,093		
Thos. C. Levy	Philadelphia	Mar. 27, 1886	Nonpareil	17⅞	28	1½	3,119	2,079⅓	3,012¾	2,008½
Geo. Arensberg	New York	Feb. 19, 1870	Minion	17	23⅝	[c] 1	2,064	2,064		
Ira Sommers	do	June 4, 1885	do	15⅝	25	[c] 3	6,075	2,025	5,787½	1,929⅙
Jos. Farquahar	Rochester	Mar. 1, 1886	Brevier		25	[c] 1	2,025	2,025	1,959	1,959
Jos. W. McCann.	New York	Dec. 15, 1885	Minion	15⅝	25	4	8,062½	2,015⅝	7,762½	1,940⅝
Wm. C. Barnes	do	do	do	15⅝	25	4	7,951	1,987¾	7,376	1,844
W. H. Van Bibber.	Memphis	Feb. 19, 1886	Brevier	12⅔		3			4,935	1,645

[a] The number of ems contained in the lower case alphabet (26 letters).
[b] The number of ems contained in each line of type set.
[c] Sticks were emptied by assistant.

[1] Includes weekly periodicals.

These records can not be considered as average production, even of experts, as they were made in tournaments, ordinarily conducted for short periods daily and under specific rules, or as a result of wagers, also involving few hours. The average speed in setting type did not exceed 1,500 letters, or 1,000 ems per hour. There were, however, many who did not participate in contests, but produced excellent averages in lengthy periods of regular work. Data for a couple of such instances, are given by Barnes as follows: Robert Bonner, employed on the American Republican of New Brunswick, N. J., in 1846, set in 24 consecutive hours 32,997 ems solid minion (7-point), 25 ems wide, from reprint copy, or an average of 1,374⅞ ems per hour. The following extract is from the Daily Press of Troy, N. Y., for December 13, 1873:

> Fred W. Schneider, a compositor employed on this paper, in the year ending to-day set and distributed in 312 days, 10 hours per day, 3,234,203 ems, an average of 10,366 ems per day; highest day's work 17,485; in 38 consecutive days he set an average of 12,000 ems per day, and for 5 weeks he averaged 70,000 ems per week. He had no department[2] and his work was straight matter from the hook.

As compositors were paid according to the number of ems set, more attention was directed to speed in setting of type than in distributing the used material. Distribution was considerably faster than setting. The following records are cited by Barnes: F. S. More, of Cleveland, Ohio, distributed, in 1868, 5,040 ems solid nonpareil (6-point) without a break-line,[3] in 52½ minutes, later 4,060 ems minion (7-point) in 40 minutes—a rate of 6,000 ems an hour. This was remarkably fast as the average compositor will throw in but little over 4,000 ems an hour, and very few reach 5,000. William Beatty, of the Toledo Evening Bee, could set about 1,800 ems an hour and could distribute nearly 6,000 ems an hour, with average speed of 5,000.

Ringwalt [4] also gives some examples of fast hand setting. In 1845 John J. Hand, compositor on the American Republican, New York, lacked only 32 ems of setting 32,000 ems solid minion (7-point) in 24 hours. In 1852 Thomas T. Sutliffe, compositor on New York Courier and Enquirer, set in one hour 2,487 ems solid nonpareil, all paragraphs run in. In 1853 Charles McDonnell, compositor on Portsmouth Tribune, set 8,240 ems in 4 hours, or 2,060 per hour. In 1858 William Mink, compositor on Pittsfield (Mass.) Eagle, set 10,046 ems solid minion in 4 hours and 45 minutes. In 1870 Andrew W. McCartney, compositor on Chicago Evening Post, set and corrected 95,600 ems in 4 days of 6½ hours each and 2 days of 7 hours each, a total of 40 hours.

LABOR COST AND WORKING CONDITIONS

During the first stages of the printing business the method of paying the workers therein was probably similar to the method employed in any other business during its infancy—that of established daily wages. It is not known just what wages were paid to compositors, but they were probably about the same as for other skilled help, quoted by Timperley [5] at 6d. per day in London about 1512. Hand compositors were later paid by the page, until about 1775, when

[2] The material measured did not include any pick-ups of standing matter.
[3] A break line is a short line at the end of a paragraph.
[4] Ringwalt, J. Luther: American Encyclopedia of Printing, Philadelphia, 1871.
[5] Timperley, C. H.: Dictionary of Printers and Printing. London, 1839.

payment by ems or by letters was adopted. After piecework was established, the prices paid in London were regulated by the size of the type set, interruption for make-up, imposing, and correcting being more frequent with large type than with small type. In 1785 before a proposal was made by the workers in London to establish a fixed price, the prevailing rate per 1,000 letters appears to have been 4d. for English (14-point), 3½d. for long primer (10-point), and 3¼d. for brevier (8-point). In Scotland during the same period 4d. was paid for long primer, but only 2½d. for brevier. Type was measured by ascertaining the number of ems of a specific type contained in a space of given size, if set solid, and multiplying the result by two, as the average width of the letters were judged one-half that of the letter M. Methods of measurement and rates of pay in this country were probably very similar.

In 1810 the master printers agreed to a scale for London of 6d. per 1,000 for ordinary letters, including English and brevier, but 6¼d. for minion (7-point) and 7d. for nonpareil (6-point), all solid type, with ¼d. additional per 1,000 for leaded type. Foreign language and other special items ranged from ¼d. additional to double rate. This scale was amended in 1816 to ¾d. less per 1,000 for all material copied from print.

While this scale was specifically for job work, the same rates presumably prevailed also for newspaper work, for which nothing special was given until a committee report in 1820 (published by Timperley in his Dictionary of Printers and Printing) gave the following scale:

Abstract of the scale for news compositors

Morning papers: £2 8s. 0d. per week, 3s. 10d. per galley, 11½d. per hour.
Evening papers: £2 8s. 6d. per week, 3s. 7d. per galley, 10½d. per hour.
Sunday papers, having galleys of various lengths: 8½d. per 1,000, or 10d. per hour.

The galley on morning papers consisted of 120 lines long primer and 40 after lines, or 88 lines minion and 30 after lines. Twelve hours on, including lunch time, and 12 hours off, was the original agreement, but 10 hours were specified for evening papers.

From the time of the Revolution, to about 1850, compositors on newspapers in this country were paid for the amount of work performed and not for the time spent in the composing rooms. This time was especially irregular for compositors on morning newspapers. While the majority of the type for the issue was set up by midnight, there was always a possibility in seaboard cities that some ship might arrive late in the evening, carrying important news from abroad. Consequently the compositors either had to hang around the office or had to go home subject to being called, so that such late news could be included in the forthcoming edition of the paper.

There was no uniformity in the prices paid, though the rates on morning papers were on the average higher than those on the evening papers, on account of night work. The ordinary piece rate paid in New York in 1800 was 25 cents per 1,000 ems, but the majority of the compositors were paid at the rate of $7 per week. Apprentices worked 11 or 12 hours daily until 1830, when the State legislature fixed the maximum daily working time at 10 hours for mechanics without special agreements. The earnings of New York compositors in 1803 were around $8 or $9 per week. An interesting tabulation of hours and wages ranging back to 1833 can be found in a publica-

tion by this bureau (then called the Department of Labor) on Wages in Commercial Countries.[6] A later publication on Wages and Hours of Labor,[7] covered the period of 1890 to 1903, and the bulletins of the Bureau of Labor Statistics on Union Scale of Wages and Hours of Labor, brings the information up to date. These sources show the variation in wages and hours, according to localities. Where piecework was performed, considerable variation existed according to individual ability. Ringwalt states that in 1864 the office of the Sacramento Union contained, in proportion to the number of men employed, more rapid compositors than any other office in the country. The paper was set in solid type, and the average earnings of each compositor amounted to $1 for each working hour. The men received 75 cents per 1,000 ems.

According to De Vinne,[8] compositors in New York during 1862 received 35 cents per 1,000 ems on morning newspapers and 31 cents on evening papers. The scale of 1867 called for 50 cents per 1,000 ems on morning newspapers for common or straight matter, with one and one-half price for difficult work. It guaranteed 2 hours' continuous composition between 1 and 5 p. m., and 5 hours' continuous composition between 6 and 12 p. m. Compositors working after 3 a. m. were to be paid 40 cents per hour, in addition to pay for all matter set, and compositors working at night only, to be paid 55 cents per 1,000 ems. Weekly wages were fixed at $24 for 6 days, and daily hours at 10, with 2 of them between 1 and 5 p. m., except for compositors working all night, who were to be paid $22 for 6 nights of 8 hours each. The rate for evening newspapers was 45 cents per 1,000 ems, with a guaranty of 3 hours' continuous composition between 3 a. m. and 12 m., and 4 hours between 12 m. and 5 p. m. The rate for overtime work was 35 cents additional per hour. Weekly wages were fixed at $20 for 6 days. De Vinne estimates that for New York evening newspapers the actual labor cost in 1871 per 1,000 ems would be: Compositors, for matter delivered on galleys, 45 or 46 cents; make-up and stone work, 3 to 6 cents; proof reading and superintendence, 15 cents or more; total, 63 to 80 cents.

At the time the linotype was introduced, wages were practically everywhere on a piece basis, with the price per thousand ems set regulated by the union scales. The publishers were required to give employment at typesetting for a fixed minimum number of hours each working-day, generally 6 or 7, but varying according to locality. Distribution ordinarily brought the working-day up to 10 hours. Employers often stipulated a fixed amount of production as a condition of employment, as in one city in 1888 hand compositors were required to set a minimum of 40,000 ems per week of 59 hours, or 678 ems per hour.

TYPE FOUNDING

WHILE each printer designed and cast his own type during the early days, type founding soon developed into a separate industry and the type used in this country during the colonial period was practically all imported from Europe. The first type cast here appears to have been by a printer in Germantown, now a part of Philadelphia, Pa., about 1735, but the operation was not of any importance. A later attempt was made in Connecticut in 1769,

[6] U. S. Commissioner of Labor, Fifteenth annual report, 1900. 2 vols. Washington, 1900.
[7] U. S. Commissioner of Labor, Nineteenth annual report, 1904. 2 vols. Washington, 1905.
[8] De Vinne, Theodore L., The Printers Price List: New York, 1871.

followed by several other attempts. The first successful type foundry was started in Germantown in 1783. The metal was poured into hand molds by spoons, a slow and cumbersome process, and it required considerable skill for a workman to produce 400 letters per hour. The first type-casting machine invented in the United States was patented by William Wing, of Hartford, Conn., in 1805. It cast 20 or 30 types at a time, all projecting from a shank like the teeth of a comb.

In 1834 Daniel Bruce, jr., of New York, invented a force pump for filling hand molds with molten metal, which doubled the output and made it possible to cast larger type. This encouraged him to renew his efforts to manufacture a type-casting machine, and four years later a machine was patented by him which employed the force-pump principle and would cast an average of 40 letters of 14-point type or smaller per minute. Further improvements were developed, and in 1843 a better machine was patented by him which would turn out 100 letters per minute.

The product of the Bruce machine, however, required finishing by hand. Another style, which cast the type by direct steam pressure without the pump, and also finished the type automatically, was invented by Henry Barth, of Cincinnati, Ohio, in 1885. Both of these machines are used by the type foundries of the present day, but the product is no longer employed in newspaper printing except by a few small country weeklies. Henry Barth also devised the kerning machine for cutting down type bodies to special sizes, as well as a power shaving machine for leads. The introduction of the linotype in 1886 brought type founding back into the printing plant, though only partially and in a different style from that used by the early printers.

TYPESETTING MACHINES

EARLY INVENTIONS

DURING the early part of the nineteenth century typesetting was a slow process. While the adoption of stereotyping permitted duplication of each page and, consequently, the printing of several copies of the same page at one time, the number of pages in each issue was limited by hand composition and was not sufficient to meet the demand. Attempts were made to overcome this condition by inventing a mechanical substitute for the compositor. The first typesetting machine was patented in 1822 in England, by William Church, of Boston, Mass., in connection with a type-casting machine which would produce an entire font of type at one time. The types were arranged in inclined channels, ejected on a horizontal plane by the operator of the keyboard, and pushed to a collecting tube by rocking arms, which were moved by a clock mechanism released by depression of the keys, forming a continuous line. The line was divided and justified by hand.

The first American patent for a typesetting machine was issued in 1842 to J. H. Young and A. Delcambre for the Pianotype, which had been brought out in England two years previously and was used in a small way in that country and in France. The type was released by the keyboard operator from the tubes into converging inclined grooves, sliding to a stand, where a second operator justified them into lines. An English type-distributing machine was patented in

the United States in 1843 by its inventor, F. Rosenborg. It was practically a reversed composing machine, operated by means of a keyboard.

A number of different ideas were projected, both in England and the United States, but type-composing machines did not come into practical commercial use until 1853, when patents were issued both here and in England to W. H. Mitchel, of Brooklyn, N. Y., for a typesetting machine, followed a year later by patents for a distributor. The composing machine was provided with vertical tubes for the types which, on striking the keys, were ejected by plungers, conveyed on belts or tapes to a traveling band, and by it to the receiving point, where a second operator divided them and justified the lines. More than 100 different machines were invented before 1885. Nearly all of these set type, but not with sufficient economy over hand setting, and the majority disappeared as quickly as they were brought out. Prominent among these were the Alden typesetter and distributor of 1857, the Empire, and the Thorne, all using type supplied by the foundries. The two last named were the only practical typesetting machines in the United States in 1885.

EMPIRE COMPOSING MACHINE

The Empire, brought out under that name in 1880, was previously known as the Houston, the Greene, and the Burr. The types were arranged in vertical tubes, from which they were ejected by a pusher, actuated by a finger key. They were passed down the channels of a guide plate to a common point, and pushed forward from there to the end of the line previously composed. Two men and one boy were required for the operation, the boy taking care of the distributor which was a separate machine. The output ranged from 4,000 to 6,000 ems per hour, but the machine did not become very popular and less than 200 had been placed in use when manufacture ended in 1904.

THORNE COMPOSING MACHINE

The Thorne was the first combined setting and distributing machine. The type was contained in vertical tubes around a rotating disk, upon which they were dropped when released by the keys. They were carried, in the order of their release, by a traveling band to the assembling point, where they were formed into a continuous line. This was divided by the second operator into lines of the desired length, and justified by hand. An automatic device enabled the machine to take a whole galley of used type, line by line, and distribute the characters correctly in the various tubes. It was usually operated by two men, as one operator alone could compose only 3,000 to 4,000 ems per hour, but with an assistant to justify, the production could be increased to about 9,000 ems per hour. The first patent was issued to Joseph Thorne, of Hartford, Conn., in 1869. Four different styles were developed later—the Thorne, the Simplex for newspaper single column, the Simplex for bookwork, and the Unitype, for general purposes. When manufacture was discontinued, about 1914, around 2,000 machines had been installed.

McMILLAN COMPOSING MACHINE

John E. McMillan, of Ilion, N. Y., introduced a typesetting machine in 1884, which was used in combination with a separate justifying machine. A later model, brought out in 1890, contained a series of type channels in four rows, and a double machine was provided with two such reservoirs, either of which could be swung into position, permitting the use of different sizes of type. The types were pulled from the channels by striking the keys, and dropped by gravity to the assembling point in front of the keyboard. After a line was completed, it was transferred to a carrier in the justifier where the thin spaces were automatically exchanged for thicker ones. If the line was not then sufficiently filled out, it was carried to other places, where the process was repeated until it was spread to proper size. In 1894 the justifier was combined with the typesetting part in a newspaper machine, three of which were used on the New York Sun for several years, and other offices also installed them. Automatic distribution was accomplished at the rate of 10,000 ems per hour by means of a separate machine on the rotary disk principle. Three operators were required to handle the full equipment.

PAIGE COMPOSING MACHINE

A complete setting, justifying, and distributing machine, the Paige compositor, was started by J. W. Paige, of Rochester, N. Y., in 1872, but not completed until 1887. Manipulation of a keyboard formed the types into words, which were automatically advanced, spaced, and deposited on galleys, with leads if desired. Dead matter was distributed automatically. A machine was installed in the Chicago Herald in 1894. It worked well, but proved too complicated, as it contained about 18,000 separate parts, and the patent, which was granted in 1895, was assigned to Mergenthaler, who in the meantime had perfected assembling of type matrices for casting type in lines.

OTHER COMPOSING MACHINES

In 1896 a 1-man typesetting and justifying machine was invented by Alexander Dow, of New York, which was capable of composing from 5 to 12 point type. The types were released from the channels by touching keys, pushed into a central channel, and from there into the assembler. Touch on a special key removed the line to the justifier, where the temporary spaces were replaced automatically by the proper spaces. A separate rotating disk distributor was used. Another machine, patented in 1902 by Frank B. Converse, jr., of Louisville, Ky., was provided with two vertical type reservoirs, for roman and italic or roman and head letters, which could be shifted into position by a hand lever. Automatic justification was accomplished by pressure of a line key.

Other type-composing machines which were brought out in England were successful for a time, but did not affect the industry materially. Among these were Mackie's Pickpocket, patented in 1867, which was controlled by a paper ribbon, perforated on a keyboard, but which necessitated justification by hand. It was used by the Manchester (England) Guardian. The most popular one was the Kastenbein composer, patented in 1869, which was operated by a treadle. It

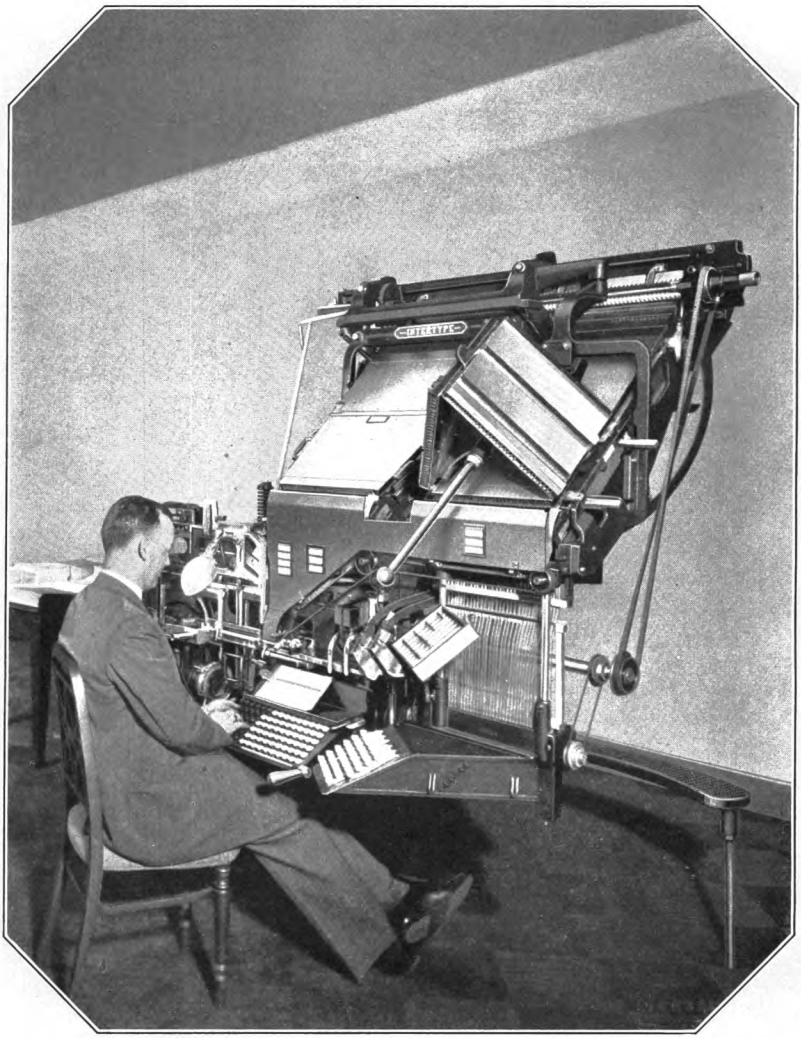
was used by the London Times, together with the Wick's rotary type caster, which provided new type for it and eliminated distribution, and produced 60,000 types per hour, being operated by one man and a boy. Where the Kastenbein composing machine was used with foundry type, as was the case in this country, separate hand distribution of type into hoppers was necessary. Other notable British machines were the Hattersly, which was operated without power, used by the South Wales News, and the Fraser, used in Edinburgh, Scotland. Both of these machines, which were patented in 1872, required justification by hand.

Attempts were also made to produce impression machines, such as the first Mergenthaler machine, the St. John Typobar, and the Rogers Impression Typograph, as well as type-casting and composing machines.

THE LINOTYPE

THE typesetting and distributing machines increased production and would, no doubt, have been developed further, but methods were completely revolutionized by the application of another principle in a machine introduced by Ottmar Mergenthaler, of Baltimore, Md., in 1885. Instead of assembling the types, this machine composed single type matrices, released from their respective reservoirs by the manipulation of finger keys on a keyboard. The brass matrices, with intervening spaces between words, were assembled side by side, the indented characters on the edge of each forming a line. As soon as a complete line was set up, a touch on a handle by the operator started the automatic performance of the succeeding operations. The matrices were justified and transported to a casting mechanism, where they formed one side of a mold, in which was cast a composed and justified line of new type on one bar, or slug. The slug, which was type-high, was delivered on a galley, accurately trimmed and ready to be placed in the form. The matrices which had been used for casting the line were carried to the top of the machine and distributed to their proper reservoirs, to be used over again. The self-adjusting spaces were also returned to their starting point. While these automatic operations were taking place, the operator was assembling another line of matrices. The machine, which was called the "Lin-o-type," because the type was cast in a solid line, required only one operator. As his duties were limited to the operation of the keyboard, except lifting one hand for an instant to send the completed line to be cast, the speed of the machine was limited only by the speed of his fingers. After the line had been used it was remelted for future recasting, distribution of type being made unnecessary. The slugs were also easier to handle than composed single type, and rendered make-up more simple, as 25 lines could easily be picked up at one time without danger of pieing.

A crude machine was finished in 1885, in which the matrices were assisted to the assembling point by gusts of air from an air pump. A second model, improved but also of the blower style, was the first commercially operated linotype. It was installed in the New York Tribune, where the first linotype slug to be used in a newspaper office was produced on July 3, 1886. Further improvements were made, such as substitution of an assembler belt for the air blast, and the



INTERTYPE LINE-CASTING MACHINE EQUIPPED WITH 3 MAIN MAGAZINES AND 3 SIDE MAGAZINES

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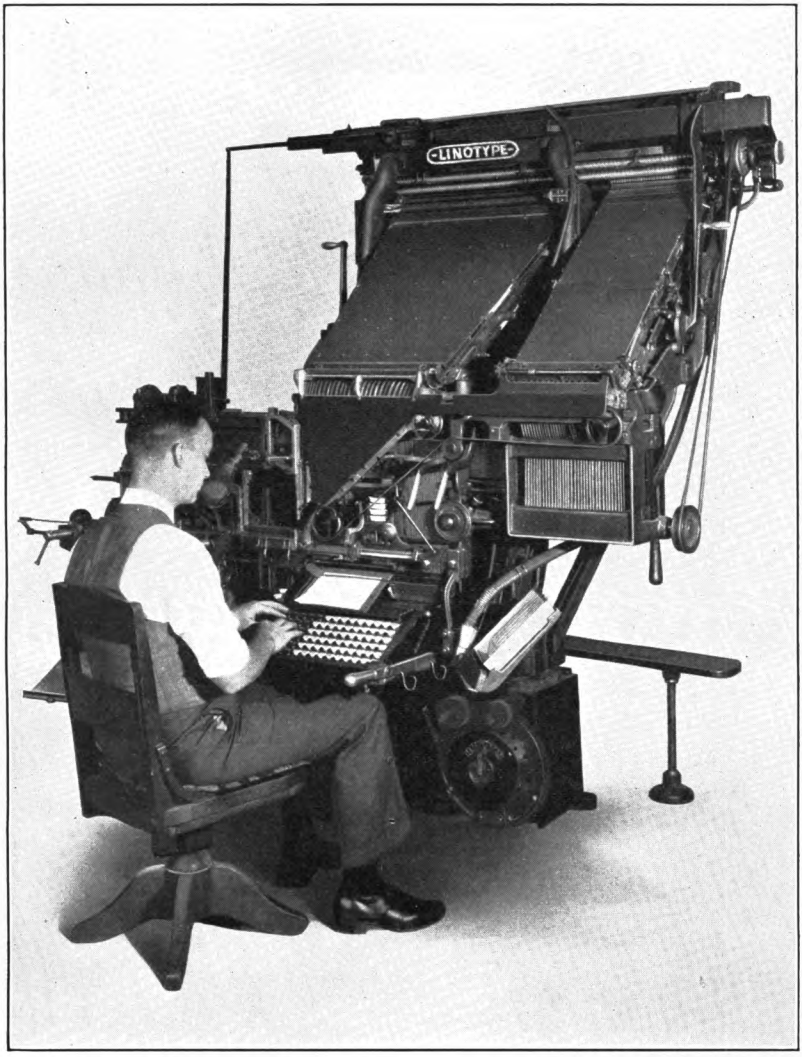

LINOTYPE LINE-CASTING MACHINE EQUIPPED WITH 2 MAIN MAGAZINES AND 2 SIDE MAGAZINES

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fifth model, finished in 1890, was practically the same as the machine of to-day.

With this model the linotype became a commercial success and rapidly eliminated typesetting by hand. For a number of years it was considered the only machine adapted to newspaper composition. Many different models have been constructed by the Mergenthaler Linotype Co., of New York City, though the principal development has been on lines of productive variety or for special features, rather than for increase of speed. There has been very little change in the productive capacity after the standard speed of 6⅓ lines per minute had been definitely established, though some individual establishments operate the machines at a higher rate of speed. Competition by other composing machines during recent years has tended to standardize the linotype, and at present the manufacture is confined to only a few models.

Adaptability has been greatly increased by improvements in connection with the magazine, which contains a number of vertical channels in which the matrices are stored, and occupies the upper part of the machine, together with the distributing device. In the early styles only a single fixed magazine was provided. Later another magazine was added, which was also built in but with a swinging device that permitted either magazine to be placed in position for the delivery of matrices. Model 5, of which a number are still in use throughout the country although not manufactured since 1917, was provided with a single removable magazine that allowed substitution of another magazine with matrices for different faces or sizes of type. Removable magazines were provided in all later models, and split magazines were subsequently introduced, divided so that the upper part remains in the machine and only the lower half is changed, rendering the operation simpler and quicker. In the beginning the linotype was thought to be adapted only to small type, such as that used for text and for classified advertising. Each newspaper usually adopted certain sizes and styles for these and installed machines to produce the same. Other styles and sizes of type, when needed, such as for headings or display advertising, were set by hand or produced on other kinds of machines. Later, special models which would produce larger type were manufactured.

Although only about 15 seconds were required for changing a magazine, other methods were sought for supplying different styles of type. The result was the multiple-magazine machine, in which were added a third and a fourth main magazine, as well as one or two auxiliary magazines, all responsive to a single regular keyboard. The operator on one of these machines can assemble matrices from two magazines in the same line without shifting his hands from the keyboard. As most matrices, up to and including 14-point size, have two letters or characters on their edges, the range at one time would be four different faces or sizes. A touch on a lever swings any of the other magazines into operative position whenever desired, giving a range of up to eight different styles with double-mold matrices. This versatility has extended the use of the linotype to the setting of all kinds of heads and display advertisements, both with the models carrying single regular keyboards and with a special model. The latter is equipped with a regular keyboard for its four main magazines and a separate keyboard, conveniently located, for

its two auxiliary magazines. Consequently, there are 12 different styles, or 850 characters, instantly available direct from the keyboards, and ranging from 5 to 36 point, which can be mixed at will. In some of the other models the range includes 60-point.

By adjusting the mold, slugs can be produced of varying thickness to accommodate the size of the type, and of different lengths to suit the width of the text. For newspaper use the latter varies ordinarily from 12½ to 42 ems of 12-point type, or from 2$^{1}/_{12}$ to 7 inches.

THE INTERTYPE

IN 1893 W. S. Scudder, of Brooklyn, N. Y., introduced the monoline composing machine, which utilized matrix bands, or strips, in place of single matrices. Manufacture in the United States was prevented through infringement on some of the linotype patents, and a factory was established the following year in Canada. About 1,200 machines were sold before the interests were acquired by the manufacturers of the linotype in 1905. The inventor later introduced another machine, the intertype, based on the general design worked out by Ottmar Mergenthaler and resembling the linotype strongly, which is manufactured by the Intertype Corporation, of New York, N. Y. It performs the same functions in practically similar manner, but some differences exist in small mechanical details.

Profiting by the experience of the other manufacturers, a basic unit, consisting of the main part of the machine, without magazines, was adopted for the production of ordinary sizes of slugs. This can be supplied, according to requirements, with standard interchangeable equipment of one, two, or three main magazines, and one, two or three side magazines. The side magazines, which carry matrices up to and including 60-point, are controlled by a separate keyboard, so located that it can be fingered simultaneously with the main keyboard. The maximum equipment gives a possibility of 12 different faces with 2-letter matrices. A different basic unit is used for slugs ranging from 30 to 42 ems, or 5 to 7 inches in length, though constructed to use the same standard equipment as the ordinary unit. A recent feature, the intertype mixer, sorts and distributes mixed type matrices automatically after use. A single distributor box moves back and forth from one magazine distributor bar to the other and places each matrix on the right bar for its respective magazine. The first intertype, a single-magazine model, was installed by the New York Journal of Commerce in 1913. Competition with this newer, similar machine is no doubt responsible for the later developments in the linotype—standardization and reduction of the many different styles previously manufactured.

LINE-CASTING MACHINE OPERATION

OPERATORS

WHILE each manufacturer considers his product superior to that of the other, the linotype and intertype are so nearly alike that they can well be considered as one, especially so far as the influence on labor productivity is concerned. One operator is required for each machine, and his work would be exactly the same regardless of which of the two machines he used, being regulated specifically by the shop practices of the establishment. In a large or medium-sized plant his

copy is either delivered to him or obtained by himself from the copy cutter, who allots the "takes" or sections. A "take" is the part of an article or of an advertisement, given to a compositor to set up. Large jobs are often divided, for the purpose of getting them done more quickly. While setting the take he keeps the metal pot supplied with metal equal to the amount of slugs produced, unless the machine is equipped with an automatic feeding device. A machine used constantly will require two small ingots, or pigs, weighing around 3 pounds each, about every half hour. The ingots are customarily distributed to the machines by machinists' helpers, who in some cases also feed them into the metal pots.

After the take is finished or the receiving galley is full, the slugs are taken to the bank, as the depositing stand is called, either by the operator or by some one assigned to that task. The bankman either turns the galley over to the operator of a proof press, or proves it himself. After the proof readers have compared the proof with the original copy and marked the errors, the proof is usually returned to the same operator so that he can recast the lines to be corrected. Any change, even as small as the addition of a comma, requires resetting and recasting of a whole line. If several words are added or taken out the compositor may have to recast a number of the following lines, sometimes clear to the end of the paragraph. In a few composing rooms all of the corrections are made by special operators.

MACHINISTS

The operator is not concerned with the mechanical functions of the machine. These are taken care of by one or more linotype machinists, the number being determined by the number of machines in a plant. Machinists repair and adjust the machines, see that they are running properly, change matrix magazines, and often supervise the remelting of the metal. Helpers ordinarily clean the machines, tend the remelting furnaces, and assist the machinists generally.

Conditions in small establishments differ somewhat. A composing room containing less than four machines is usually considered a small plant. In such a plant the functions of a machinist are ordinarily performed by one of the operators who has sufficient knowledge of the mechanism to act as a machinist-operator. Overlapping of functions usually increases in the same proportion as the size of the establishment decreases. The duties of an operator in a small plant may vary considerably and embrace several of the functions performed by specialists in a large plant.

PRODUCTION ON LINE-CASTING MACHINES

LINOTYPES were first introduced in newspaper plants. Both linotypes and intertypes are essentially fitted for newspaper composition, which demands speed first of all, especially as the time draws near for publication, even at the sacrifice of workmanship. While they are also used in periodical and in book and job printing plants, the great majority of the machines have been installed in newspaper establishments.

After 1890 hand composition was rapidly supplanted by machine composition. Before that time the average rate of setting type by hand was only about 750 ems per hour, and few compositors averaged

as high as 1,000 ems per hour. Hand compositors were ordinarily paid at piece rates, in fixed amounts per 1,000 ems. With the adoption of the linotype the payment on piece basis was in most places gradually changed to a time basis. The requirement of a minimum number of hours disappeared and the maximum number of hours per working-day became the important factor. This was, in most cases, fixed at eight hours. While a number of labor-saving inventions changed the vocations of the skilled workers to mere machine tenders, the action of the linotype was different, as the amount produced by this machine was directly proportional to the skill of the operator. Some time was naturally required to accustom the former hand compositors to manipulation of the linotype, and production was comparatively slow in the beginning, even though three times faster than hand setting.

MINIMUM STANDARD OF COMPETENCY

Minimum competency requirements for linotype or monotype operators have often been stipulated in agreements between employers and employees. This so-called "dead line" varies somewhat in different localities, and has been changed from time to time in some of them. For New York it was fixed in 1894 at 18,000 ems of 6-point per 8-hour day. This minimum standard was, inside of two years, so far below the actual minimum production that it did not mean anything, as shown in a report by Mr. Ethelbert Stewart on printing and publishing.[9] In 1904 this standard was raised to 24,000 ems per 8-hour day and increased again later. The agreement in effect during July, 1926, specified:

> No man shall be deemed a competent machine operator unless he sets a minimum of 4,500 ems of solid nonpareil (6-point), corrected matter, per hour, from straight narrative copy free from intricacies and impediments, either as to short takes, long waits, or long walks. In offices where the body type of the newspaper is other than nonpareil, 4,200 ems of minion (7-point), or 4,000 ems of brevier (8-point) shall be the test under the same conditions as stipulated above.

Similar stipulations, in varying forms and with different competency requirements, are in effect in many cities, sometimes covering all of the newspapers therein and sometimes only a portion of them. A tabulation prepared from data furnished by the American Newspaper Publishers Association, showing various dead lines, or standards of competency, in 110 specified cities of the United States at the present time, is presented in Table 21.

To facilitate comparison the number of hours constituting a regular day's or night's work in each city is shown in the table. In six of the cities the shift hours for day work and night work differed, creating a variation in production on a shift basis, and so they were listed separately. In the majority of cases dead lines are stipulated as a specified number of ems of a certain size of type per hour, or per shift, though in recent years the line count has been substituted in quite a few places and stipulation made for a specific number of lines per shift and occasionally per hour. In the latter cases the figures were converted to number of lines per shift. In 23 of the cities a specific amount was stipulated for two or more different sizes of type, and these are all shown in the table. Where a specific type size was not

[9] U. S. Commissioner of Labor. Eleventh special report, 1904. Regulation and Restriction of Output in the United States, Washington, 1905.

stipulated, it was assumed to be for 6-point and listed as such. The length of the line was stipulated in less than one-third of the cases, and the column widths for the remainder were obtained from other records. A column is given showing the average number of lines required per hour in each case. In comparing these figures it must be remembered that the number of lines produced per hour increases proportionately as the size of the type is increased, but that the number of ems produced per hour decreases proportionately.

TABLE 21.—*Dead lines for linotype and intertype operators on newspapers in specified cities of the United States*

City	Hours per shift	Stipulated dead line			Size of type (in points)	Column width (in 12-point ems)	Average number of lines per hour
		Ems per hour	Ems per shift	Lines per shift			
Allentown, Pa	8	4,000			7	12½	187
Anaconda, Mont	7½	4,500			6	13	173
Anniston, Ala., night	7			1,600	8	12	228
Anniston, Ala., day	8			1,800	8	12	225
Auburn, N. Y., night	7½			1,300	6	13	173
Auburn, N. Y., day	8			1,300	6	13	162
Augusta, Ga	8		36,000		5½	12	171
Do	8		36,000		7	12	218
Beaver Falls, Pa	8			1,600	6	13	200
Do	8			1,600	8	13	200
Boston, Mass	7⅓	4,500			6	12½	180
Bridgeport, Conn	8	4,000			6	12½	160
Buffalo, N. Y	8		32,500		7	12½	189
Burlington, Vt	8		35,000		6	12½	175
Butte, Mont	7½	4,500			6	13	173
Charleston, S. C	8	5,300			6	12	221
Charleston, W. Va	8	7,000			6	12½	280
Chattanooga, Tenn	7½	4,700			6	12½	188
Do	7½	4,300			7	12½	201
Chicago, Ill	7	4,500			6	12½	180
Cincinnati, Ohio	7½		30,000		6	12½	160
Clarksburg, W. Va	8	4,500			6	12	187
Columbus, Ohio	8		35,000		6	12½	175
Concord, N. H	8	4,500			7	12½	210
Danville, Ill	8			1,600	6	12½	200
Dayton, Ohio	7⅔	4,000			6	12	166
Decatur, Ill	8			1,600	6	12½	200
Denton, Tex	8	5,000			7	12	243
Elmira, N. Y	8		30,000		6	12	156
Evansville, Ind	8	4,400			6	12	183
Do	8	4,300			7	12	209
Do	8	4,200			8	12	233
Do	8	4,000			9	12	250
Do	8	3,800			10	12	264
Do	8	3,500			11	12	267
Do	8	3,200			12	12	266
Fall River, Mass	8		36,000		6	13	173
Do	8		34,500		7	13	193
Do	8		32,500		8	13	208
Fargo, N. Dak	8	5,000			6	13	192
Flint, Mich	8			1,600	7	12	200
Fort Wayne, Ind	8	4,500			6	12½	180
Grand Forks, N. Dak	8	4,000			6	12½	160
Great Falls, Mont	7½	4,500			7	12½	210
Greensboro, N. C	8		32,000		6	13	153
Do	8		32,000		8	13	205
Harrisburg, Pa	7½	5,000			6	12	208
Haverhill, Mass	8			1,600	6	13	200
Hoboken, N. J., night	7½	4,000			7	12½	187
Hoboken, N. J., day	7⅔	4,000			7	12½	187
Hudson, N. Y	8	5,000			7	13	224
Hutchinson, Kans	8		41,000		6	13	197
Do	8		34,000		8	13	218
Jackson, Mich	8			1,540	6	12	192
Jersey City, N. J	7⅔	4,080			7	12½	187
Knoxville, Tenn	7½	5,000			6	12	208
La Crosse, Wis	8			1,700	8	13	212
Lancaster, Pa	8	5,000			5½	12½	171
Do	8	5,000			6½	12½	217
Lawrence, Mass	8			1,500	7	12½	187
Leavenworth, Kans	8	3,500			6	12½	140

TABLE 21.—*Dead lines for linotype and intertype operators on newspapers in specified cities of the United States*—Continued

City	Hours per shift	Stipulated dead line			Size of type (in points)	Column width (in 12-point ems)	Average number of lines per hour
		Ems per hour	Ems per shift	Lines per shift			
Lexington, Ky	8			1,540	7	12½	192
Lima, Ohio	8			1,400	8	13	175
Los Angeles, Calif	7½	5,200			6	12½	208
Do	7½	5,000			6	12	209
Do	7½	5,000			7	12½	233
Do	7½	4,800			7	12	233
Louisville, Ky	8	4,500			6	12	187
Lowell, Mass	8			1,600	6	12½	200
Lynchburg, Va	8	5,000			6¾	12½	225
Madison, Wis	8	4,000			7	13	179
Memphis, Tenn	7½		60,000		6	12½	320
Meridian, Miss	8		28,000		6	12	146
Do	8		32,000		8	12	222
Miami, Fla	8		32,000		6	13	153
Middletown, N. Y	8		30,000		8	13	192
Milwaukee, Wis	8	4,000			7	12	194
Missoula, Mont	7½			1,500	8	13	204
Muncie, Ind	8	4,200			6	12	175
Do	8	3,500			8	12	194
Muscatine, Iowa	8	4,000			8	12	222
Muskogee, Okla	8	4,000			8	13	205
Newark, Ohio	8			1,400	7	13	175
New Bedford, Mass	8			1,600	7	12½	200
Newburgh, N. Y	8		34,000		6	12	177
New Castle, Pa	8			1,800	6	12½	225
New Orleans, La	7	7,500			5½	12	286
Do	7	7,500			6	12	312
New York, N. Y	7½	4,500			6	12½	180
Do	7½	4,200			7	12½	196
Do	7½	4,000			8	12½	213
Norfolk, Nebr	8			1,600	8	12	200
Norristown, Pa	9	4,000			8	12½	213
Oakland, Calif	7½	5,000			6	12	208
Oklahoma City, Okla	8		41,000		5½	12	183
Do	8		38,000		6	12	198
Do	8		35,000		7	12	212
Do	8		32,000		8	12	222
Oneonta, N. Y., night	7⅓	3,300			6	13	127
Oneonta, N. Y., day	8	3,300			6	13	127
Owosso, Mich	8			1,600	8	12	200
Paterson, N. J	7⅔			1,300	8	13	169
Pensacola, Fla	8	5,000			6	12	208
Peoria, Ill	7⅚	4,500			7	12½	210
Do	7⅚	4,000			8	12½	213
Perth Amboy, N. J	7⅔			1,400	7	12½	182
Philadelphia, Pa	8	5,000			5½	12½	171
Do	8	5,000			7	12½	233
Pittsburgh, Pa	7½	4,500			6	12½	180
Port Huron, Mich	8			1,500	7	12	187
Poughkeepsie, N. Y	8		24,000		8	12½	160
Reading, Pa., night	7½		32,000		6	12½	170
Reading, Pa., day	8		32,000		6	12½	160
Reno, Nev	7½		30,000		6	12	166
Rochester, N. Y	8	4,000			6	12	166
Saginaw, Mich	8			1,600	7	12	200
Salem, Oreg	8			1,800	8	12	225
Salt Lake City, Utah	7¼	6,000			6	12	250
San Antonio, Tex	6½	5,500			6	12	229
San Diego, Calif	7½	4,800			7	12	233
San Bernardino, Calif	7½			1,600	7	12	213
San Francisco, Calif	7½	5,000			6	12	208
Savannah, Ga., night	8	5,000			6	12	208
Savannah, Ga., day	7½	5,000			6	12	208
Schenectady, N. Y	8		30,000		6	12½	150
Scranton, Pa	8		32,000		6	12½	160
Seattle, Wash	7	4,600			6	12	191
Do	7	4,100			7	12	198
Do	7	3,520			8	12	195
Spokane, Wash	7½	5,000			6	13	192
Springfield, Ill	8		30,000		6	12½	150
Stockton, Calif	7½	5,000			6	12	208
Syracuse, N. Y	8		35,000		6	12	182
Tacoma, Wash	7			1,300	6	12½	186
Do	7			1,300	7	12½	186
Do	7			1,300	8	12½	186

TABLE 21.—*Dead lines for linotype and intertype operators on newspapers in specified cities of the United States*—Continued

City	Hours per shift	Stipulated dead line			Size of type (in points)	Column width (in 12-point ems)	Average number of lines per hour
		Ems per hour	Ems per shift	Lines per shift			
Tarrytown, N. Y.	8	------	24,000	------	6	12	125
Terre Haute, Ind.	8	4,200	------	------	5½	13	138
Do	8	4,200	------	------	6	13	161
Do	8	3,600	------	------	7	13	161
Do	8	3,200	------	------	8	13	164
Toledo, Ohio	8	4,000	------	------	6	13	154
Do	8	3,600	------	------	7	13	161
Do	8	3,200	------	------	8	13	164
Trenton, N. J.	8	4,000	------	------	6	12½	160
Union City, N. J.	8	4,000	------	------	7	12½	187
Waco, Tex.	8	6,000	------	------	6	12	250
Do	8	5,500	------	------	7	12	266
Do	8	5,000	------	------	8	12	277
Washington, Pa.	8	3,500	------	------	7	12	170
Do	8	3,500	------	------	8	12	194
Wheeling, W. Va.	8	4,000	------	------	6	12½	160
Do	8	4,000	------	------	7	12½	187
Do	8	4,000	------	------	8	12½	213
Wilkes-Barre, Pa.	8	------	------	1,440	7	12½	180
Worcester, Mass.	8	5,500	------	------	6	12½	250
Zanesville, Ohio	8	------	30,000	------	8	12	208

A great variation exists in the dead lines for the different cities, as shown in a tabulation of the highest and lowest amounts stipulated for each of the different sizes of type and column widths, expressed both in lines and in ems, given in Table 22:

TABLE 22.—*Lowest and highest average number of lines and ems per hour required in deadlines for linotype and intertype operators in 110 cities of the United States*

Column width in 12-point	Size of type (in points)	Lines per hour		Ems per hour	
		Lowest	Highest	Lowest	Highest
12 ems	5½	171	286	4,500	7,500
Do	6	125	312	3,000	7,500
Do	7	170	266	3,500	5,500
Do	8	194	277	3,500	5,000
Do	9	250	250	4,000	4,000
Do	10	264	264	3,800	3,800
Do	11	267	267	3,500	3,500
Do	12	266	266	3,200	3,200
12.5 ems	5½	171	171	5,000	5,000
Do	6	140	320	3,500	8,000
Do	6½	217	217	5,000	5,000
Do	6¾	225	225	5,000	5,000
Do	7	180	233	3,850	5,000
Do	8	160	233	3,000	5,000
13 ems	5½	138	138	4,200	4,200
Do	6	127	200	3,300	5,200
Do	7	161	224	3,600	5,000
Do	8	164	218	3,200	4,250

In some of the cities additional provisions covered other sizes of type. In Augusta, Ga., all type above 7-point is measured as 7-point. In Cincinnati, Ohio, a reduction of 2,400 ems per day is allowed for each increase of one point in size. In Dayton, Ohio, where the regular dead line was fixed at 4,000 ems per hour, an average of 3,000 ems is considered a fair hour's work in all offices where the size of type and the width of measure fluctuate, or where intricate work is performed. In Meridian, Miss., a reduction of 2,000 ems

per day is allowed for each increase of one point in size above the customary 8-point. In Miami, Fla., a reduction of 2,000 ems per day is allowed for each increase of one point in size above the customary 6-point, and all type matter set less than 13 ems in width is measured as 13 ems. All intricate and tabulated matter is measured as double. It was often stipulated that due allowance be made for time lost through no fault of the operator. Shop conditions in the various localities influence production materially. In nearly all of the cities tabulated each operator goes to the desk of the copy cutter for his alloted takes and, after the type is set, carries the slugs to the bank. Consequently the distance from the machine to the copy cutter or the bank is an important factor. It is ordinarily as short as possible for the layout of the plant, but varies from 2 or 3 steps up to as much as 40 feet. In some places the copy is delivered to the operators, and in a few composing rooms the slugs are removed from the machines by other labor. In practically all of the places named each operator, after receiving the first proof, also resets and recasts all lines containing errors, and in many offices he also inserts the corrected lines in the galleys and takes out those with the errors. The condition of the copy is likewise important, and the dead-line provisions for several cities, such as Bridgeport, Conn., Elmira, N. Y.; Fort Wayne, Ind., Peoria, Ill., Rochester, N. Y., and Wilkes-Barre, Pa., prescribe that it must be legible. In Savannah, Ga., however, it is required that an operator must handle in a workmanlike manner any and all copy placed on the hook.

AVERAGE PRODUCTION RECORDS

The actual production was often considerably more than that stipulated. A committee from Indianapolis, which investigated the conditions in New York during February, 1891, reported the average production per linotype operator at 3,000 ems per hour, and that it believed a speed of 4,000 ems was possible.

In a report from the New York Typographical Union to the Bureau of Statistics of Labor of the State of New York in 1895, the average production of linotypes was given for several establishments, as shown in Table 23.

TABLE 23.—*Machine composition in New York in 1895*

Establishment	Number of linotypes in use	Average production per machine		Establishment	Number of linotypes in use	Average production per machine	
		Ems per 8-hour day	Ems per hour			Ems per 8-hour day	Ems per hour
No. 1	50	28,000	3,500	No. 10	12	22,000	2,750
No. 2	48	28,000	3,500	No. 11	12	32,000	4,000
No. 3	28	25,000	3,125	No. 12	12	24,000	3,000
No. 6	20	35,000	4,375	No. 13	10	24,000	3,000
No. 7	18	28,000	3,500				
No. 9	12	24,000	3,000	Average, all machines		27,532	3,441

The report does not state whether the establishments were all newspaper plants or whether some magazine or book publishing houses were included. The year and the number of machines would, however, indicate that all of them belonged in the former class. Neither

is there any information regarding what sizes of type were set on the machines. The size of the type makes considerable difference, as it takes approximately two minutes longer per 1,000 ems for each increase of one point. Consequently, if it takes 15 minutes to produce 1,000 ems of 7-point type it will take about 30 minutes to turn out 1,000 ems of 14-point type.

In a previous investigation by the Department of Labor, covering production on linotypes in 27 newspaper composing rooms,[10] the average output of all compositors in each establishment for a 1-week period ranged from 3,267 to 6,200 ems per man-hour. Records of individual operators, in five selected representative establishments among the 27, varied from 2,847 to 8,219 ems per man-hour. In 4 of these establishments, containing 148 operators, only 19 of them produced less than 4,500 ems per man-hour. In the fifth establishment the output per man-hour for individual operators ranged from 2,847 to 5,326 ems, with only 4 out of the 23 operators passing the 4,500 mark.

Tables 32 to 49, inclusive (pp. 69 to 89), contain additional figures on linotype and intertype production, gathered by the Department of Labor in a previous investigation of hand and machine methods, as well as figures secured by the Bureau of Labor Statistics in various establishments during the survey for this study.

Additional information on actual production of linotype operators in 1926, furnished by six newspaper establishments, show a wide range of output. This may be partly due to different methods of computing the production, though presumably the same general systems are in vogue all over the country. A tabulation of the data is presented in Table 24.

The original data contained the number of hours per shift, the hourly production, the size of the type, and the width of the column. The production was furnished in ems per hour but expressed in various ways by the different establishments. For establishments Nos. 1, 2, and 3 it was stated that the general average was, respectively, 4,000 ems 7-point, 4,500 ems 6-point, and 4,880 ems 7-point type per hour, but no statement was made of the number of operators employed or of individual records. For establishment No. 4 the production figures evidently covered only the output of the most competent operators, as the amounts were all considerably above customary averages and the list included only 18 operators—just a part of those employed there. The individual production for 4 of these was given at 7,500 ems 6½-point, for 6 at 8,000 ems 6½ point, for 3 at 8,500 to 9,000 ems 6½-point, for 2 at 9,000 ems 5-point, and for 3 at 9,500 ems 5-point type per hour up to 10,500 ems. Details of shop conditions or methods of measurements were not included. For establishment No. 5 the average individual production of seven operators was furnished, three of whom produced 3,763 ems 7-point type per hour each, while the others produced varying amounts. For establishment No. 6 the average individual production was furnished for 11 operators, 3 of whom produced only 7-point type, while the other 8 turned out both 5½ and 7 point type and were listed for each size. The number of ems per shift was computed on the basis of shift hours and the number of ems per hour. The production was also expressed in number of lines per shift, as well as lines per hour, in similar manner as for the dead-line tabulation.

[10] U. S. Commissioner of Labor. Eleventh special report, 1904. Regulation and restriction of output, Washington, 1905.

TABLE 24.—*Production of linotype operators in six newspaper establishments*

Establishment	Hours per shift	Production			Size of type in points	Column width (in 12-point ems)	Average number of lines per hour
		Ems per hour [1]	Ems per shift	Lines per shift			
No. 1	7⅓	4,000	29,333	1,251	7	13½	172
No. 2	8	4,500	36,000	1,440	6	12½	180
No. 3	8	4,880	39,045	1,900	7	12	237
No. 4	7	7,500	52,500	2,373	6½	12	339
Do	7	8,000	56,000	2,534	6½	12	362
Do	7	8,500	59,500	2,695	6½	12	385
Do	7	9,000	63,000	2,849	6½	12	407
Do	7	9,000	63,000	2,625	5	10	375
Do	7	9,500	66,500	2,737	5	10	391
Do	7	10,500	73,500	3,059	5	10	437
No. 5	8	4,434	35,472	1,656	7	12½	207
Do	8	3,494	27,952	1,304	7	12½	163
Do	8	4,098	32,784	1,528	7	12½	191
Do	8	3,344	26,752	920	5½	12½	115
Do	8	3,763	30,104	1,408	7	12½	176
No. 6	8	6,382	51,056	1,816	5½	12	227
Do	8	6,044	48,352	1,728	5½	12	216
Do	8	7,508	60,064	2,144	5½	12	268
Do	8	8,397	67,176	2,392	5½	12	299
Do	8	6,230	49,840	1,776	5½	12	222
Do	8	6,636	53,088	1,896	5½	12	237
Do	8	5,567	44,536	1,584	5½	12	198
Do	8	7,400	59,200	2,112	5½	12	264
Do	8	6,480	51,840	2,520	7	12	315
Do	8	5,837	46,696	2,272	7	12	284
Do	8	5,530	44,240	2,152	7	12	269
Do	8	6,382	51,056	2,520	7	12	315
Do	8	6,044	48,352	2,352	7	12	294
Do	8	7,508	60,064	2,920	7	12	365
Do	8	8,397	67,176	3,264	7	12	408
Do	8	6,230	49,847	2,424	7	12	303
Do	8	6,636	53,088	2,584	7	12	323
Do	8	5,567	44,536	2,160	7	12	270
Do	8	7,400	59,200	2,880	7	12	360

[1] See text following.

A tabulation was also made of the lowest and highest hourly average production for each of the different sizes of type and column widths, expressed both in lines and in ems, which is presented in Table 25.

TABLE 25.—*Lowest and highest averages of hourly production for linotype operators in six newspaper establishments*

Column width in 12-point	Size of type (in points)	Lines per hour		Ems per hour	
		Lowest	Highest	Lowest	Highest
10 ems	5	375	437	9,000	10,500
12 ems	5½	198	299	5,567	8,397
Do	6½	339	407	7,500	9,000
Do	7	237	408	4,880	8,397
12.5 ems	5½	115	115	3,344	3,344
Do	6	180	180	4,500	4,500
Do	7	163	207	3,494	4,434
13.5 ems	7	172	172	4,000	4,000

EFFECT OF IMPROVEMENTS IN MACHINES AND IN SHOP CONDITIONS

Average actual hourly production has increased since the survey in 1895, partly through improvements in the machines, such as multiple magazines, partly through labor-saving accessories, such as automatic metal feeders, and partly through application of efficiency methods to shop management. Multiple magazines permit the oper-

ator to use different faces or sizes by touching keys or levers, instead of getting up from his seat to remove the magazine and insert another, or of waiting while the machinist is making the change. Automatic metal feeders eliminate the periodical feeding of ingots into the metal pot, and insure more continuous production. Among the methods of efficiency introduced is that of providing typewritten copy, which prevents waste of time in deciphering illegible handwriting and results in greater speed by the operator. In most plants the operators go to the copy cutter's desk for their "takes," and also deliver the finished galley of slugs to the bank. While this breaks the monotony of manipulating the keyboard, considerable productive time might be lost if the distance from the machine to either place is long and the takes are short. In some plants both of these functions are performed by other help, insuring practically continuous machine production.

Though linotype machines are ordinarily adjusted in the factory for a maximum production of 6⅓ lines per minute and intertype machines for a maximum production of 6 lines per minute, quite a number of plants have found it expedient to change the drive pinions so as to secure higher speed. The manufacturers of the linotype advise that the speed should not exceed 8 lines per minute and that it is preferable to increase only to 7 or 7½ lines per minute. The manufacturers of the intertype claim that the speed of that machine can be increased without damage to 9 lines per minute. A machine operating continuously at the rate of 6 lines per minute on 6-point type, 12½ ems pica column width, would produce 9,000 ems per hour. At the rate of 6⅓ lines per minute, the production would be 9,500 ems per hour, at 7 lines per minute 10,500 ems per hour, at 7½ lines per minute 11,250 ems per hour, at 8 lines per minute 12,000 ems per hour, and at 9 lines per minute 13,500 ems per hour.

Continuous production is, of course, out of the question and the actual production is in all cases reduced in proportion to the percentage of idle machine time. This might fluctuate from 25 to 50 per cent of the total working time for an operator, according to shop conditions, such as length of takes and distance to the desk of the copy cutter or to the bank. During the last few hours of a shift, the takes are often very small, an article being divided among a number of operators, to insure quick clock-time production, which naturally retards production for the individual operators.

Occasionally some productive time is lost through machine trouble. Whenever this occurs in a large shop, the operator stops the machine and signals the machinist, who makes the necessary adjustments. In a small plant, equipped with more than one machine and using a machinist-operator, it might result in stopping not only the machine where the trouble developed, but also that used by the machinist-operator. No data covering this subject could be discovered or secured, and consequently all figures for production have been treated as if the work of the operators was continuous. There is another feature in connection with stops for the operators, the significance of which is often lost sight of. The work requires a great deal of concentration, especially when setting difficult copy such as tabulations. For that reason it often takes quite a while for the operator, after a stoppage or even after just an interruption through temporary distraction, to get back into the same productive state as before the disturbance. If many interruptions occur, the average production is decreased in proportion.

SPEED PRODUCTION RECORDS

Records of possible production furnished by the manufacturers of the machines show figures which greatly exceed the averages obtained in the newspaper plants. They were, of course, results obtained under very favorable conditions and by a few expert operators, working under pressure and sometimes on machines speeded higher than ordinarily. In most cases the tests were for approximately one day's duration. For such a period a maximum speed might be reached, which could not be maintained during a protracted length of time, even under similar working conditions. A number of the tests, some of them covering extended periods, resulted in records of considerably over 10,000 ems per hour, as shown in Table 26:

TABLE 26.—*Linotype and intertype speed records, furnished by machine manufacturers*

Operator	Length of test period	Average number of ems per hour	Remarks
No. 1	7.50 hours	14,560	
Do	6 months	11,000	Corrected 6-point, 26 ems per line. Worked in regular manner, unaware of being measured.
No. 2	7 hours	10,760	
No. 3	6 hours	13,167	
No. 4	6.75 hours	12,700	
No. 5	6.58 hours	12,540	
No. 6	8 hours	13,287.5	Corrected 6-point.
No. 7	5 hours	[1] 12,000	
No. 8	6 hours	11,548	
No. 9	10 hours	[1] 10,000	
No. 10	12 hours	13,066.7	5½-point, 28 ems per line.
No. 11	7 hours	[1] 11,000	
No. 12	1 hour	14,000	
No. 13	8 hours	12,131	
No. 14	7.25 hours	14,620.7	5½-point, 28 ems per line.
No. 15	7 hours	12,858	
No. 16	1 week	10,000	
No. 17	do	[1] 9,000	
No. 18	38 hours	12,797.4	Corrected 5 and 5½ point.
		Per half hour	*Two operators alternating, by periods.*
No. 19	30 minutes	4,752	10-point, 22 ems per line.
Do	do	4,664	Do.
Do	do	6,030	6-point, 30 ems per line.
Do	do	6,720	Do.
No. 20	do	5,616	8-point, 24 ems per line.
Do	do	5,500	Do.
Do	do	6,720	5-point, 32 ems per line.
Do	do	7,488	Do.

[1] Over.

NONDISTRIBUTION

THE change from hand composition to machine composition affected another important item, the distribution of used material. After using foundry type it was necessary to pick out the rules and leads and distribute them in their proper racks, sorted according to thickness and length. Cuts, either electrotypes or photo-engravings, and borders also had to be separated and stored. The type remaining was distributed into the respective compartments of the type cases. Linotypes and intertypes partially eliminated distribution, as all slugs produced on them could be thrown together for remelting. Only type which was larger than the capacity of the machines required distribution. In the beginning this capacity was limited, but it was increased from time to time. In 1916 any letters larger than 36-point, or half an inch high, were either foundry type or cast on other

HAND DISTRIBUTION OF USED TYPE, ONE LETTER AT A TIME, WHICH FORMERLY REQUIRED ONE-FOURTH TO ONE-THIRD OF THE COMPOSITOR'S TIME

NONDISTRIBUTION OF USED PRINTING MATERIAL, ELIMINATING SORTING AND HANDLING BY DUMPING THE ENTIRE PAGE INTO THE HELLBOX FOR REMELTING

styles of machines, but during recent years the capacity has been increased to 60-point, or five-sixth of an inch in height.

Installation of other styles of machines, which make rules, leads, borders, or display letters, has expanded the nondistribution feature so that in a modern plant it is necessary only to pick out the electrotypes and photo-engravings from the forms. All that remains can be dumped together and sent to the remelting furnace.

THE MONOTYPE

AT THE time the linotype was being introduced, Tolbert Lanston, of Washington, D. C., was experimenting with a device for producing types or spaces individually and assembling them in successive lines of desired width. A patent for his invention, the monotype, was applied for in 1885 and granted in 1887. It consisted of two independent mechanisms, a keyboard machine and a type-casting machine. The keyboard was used for perforating a paper ribbon with holes representing characters.

The ribbon was transferred by the operator, when desired, to the casting machine, which functioned automatically, but was controlled by the positions of the perforations in the paper. The separate types and the spaces were automatically cast, trimmed, and ejected upon a galley in proper position, forming lines and columns, in reverse order to that in which the strip was punched. In one respect the product was identical with that of the linotype—no distribution was required for either and all of it could be remelted to make new material.

In the beginning the machine was not of much value to newspaper publishers and seemed especially adaptable to magazine or book printing plants. The first keyboard was controlled mechanically, by electricity. In the next model a change was made to pneumatic control—the method still used. The first casting machine, which made type by compression, was a failure. Pneumatic action was adopted for the second model, but other changes were required, and the fourth model, brought out in 1894, was the first machine put to practical use. It was installed in a commercial printing plant in Washington, D. C. Although it produced 3,600 ems per hour, it was considered too expensive for general use. After additional improvements, the sixth model was turned out in 1897. This was intended especially for newspaper work and formed the basis of the present-day machines. It was of reduced size, containing only 132 characters, which were increased two years later, in the seventh model, to 225 characters, the present standard.

The ordinary monotype keyboard is provided with the universal typewriter arrangement of keys, but with a greater number of alphabets, and is operated similarly to the keyboard of a typewriter. Each depression of a key produces a perforation in a paper ribbon on the top of the machine, the ribbon being advanced automatically and rewound on a spool. When the end of a line of the desired size is reached, a pointer on the justifying scale indicates the proper keys to strike for automatic spacing between words for correct length. A duplex keyboard, which carries two ribbons, is also used. On this the same copy can be set in two different type sizes or measures at one operation, or each of the two sections of the keyboard can be used independently.

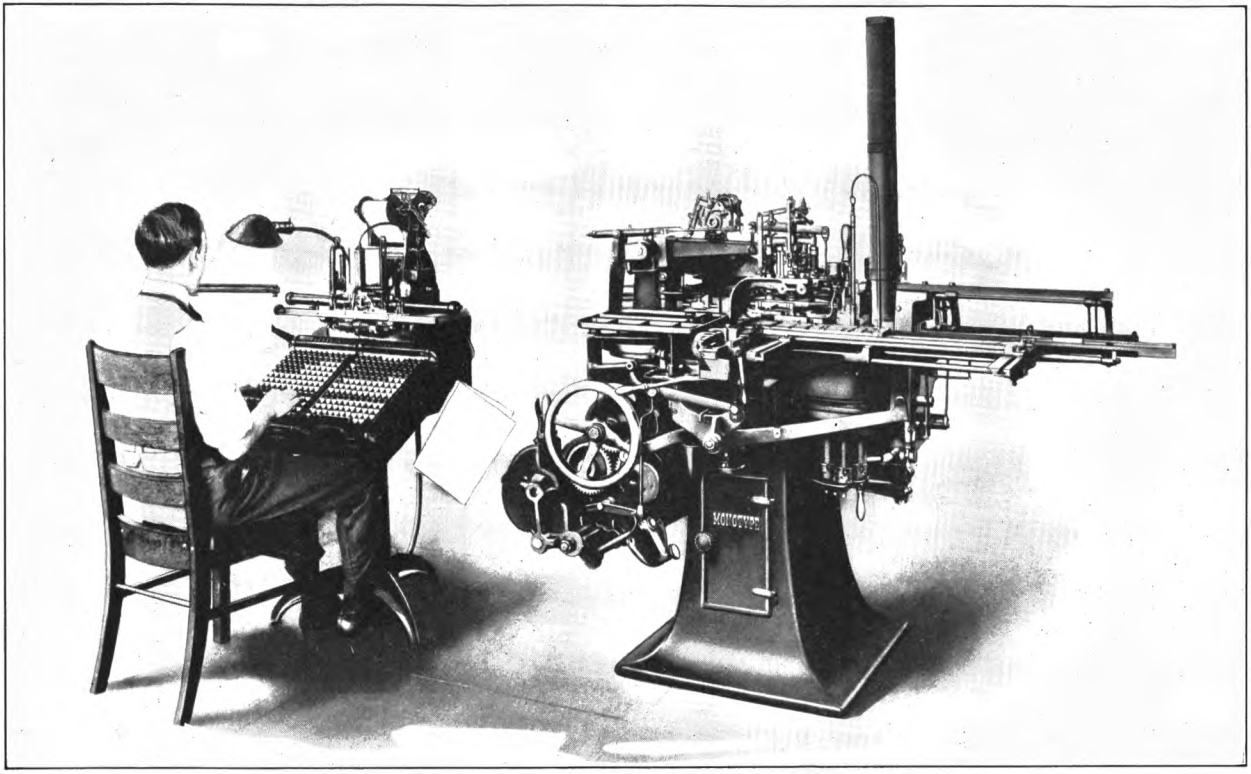
The casting machine is controlled by the perforations in the paper ribbon prepared on the keyboard, all the functions being performed automatically after the ribbon has been transferred to it and the machine started. As the paper feeds through, the matrix case moves so as to place the matrix for each selected character in its proper position over the mold, the mold is adjusted to the correct width for the body of the character or space, and molten metal is forced into the mold. The cast is cooled, trimmed, and ejected. When the last letter of a line has been cast, the finished line is automatically placed on a galley, and when the last line has been delivered the machine stops. By substituting different matrices and molds, various sizes or faces of type can be produced, within certain limitations.

According to the manufacturers, the Lanston Monotype Co., of Philadelphia, Pa., more than 500 daily newspapers are equipped with monotypes for part of the work. The ordinary composing machine, as manufactured at present, casts and sets 5-point to 12-point type in justified lines. It can also be used to produce type for hand setting. By adding special attachments, type as large as 36-point, can be cast, or leads, slugs, and rules can be produced in continuous strips or cut to measure. The introduction of this machine enabled newspaper plants to eliminate hand composition in headings up to one-fourth inch in height, and in complicated matter to which the line-casting machines were not then adapted, as well as to cast larger display type and strip material. The matrix case contains 225 different matrices of 12-point size, or smaller, but only 135 of 14 or 18 point sizes.

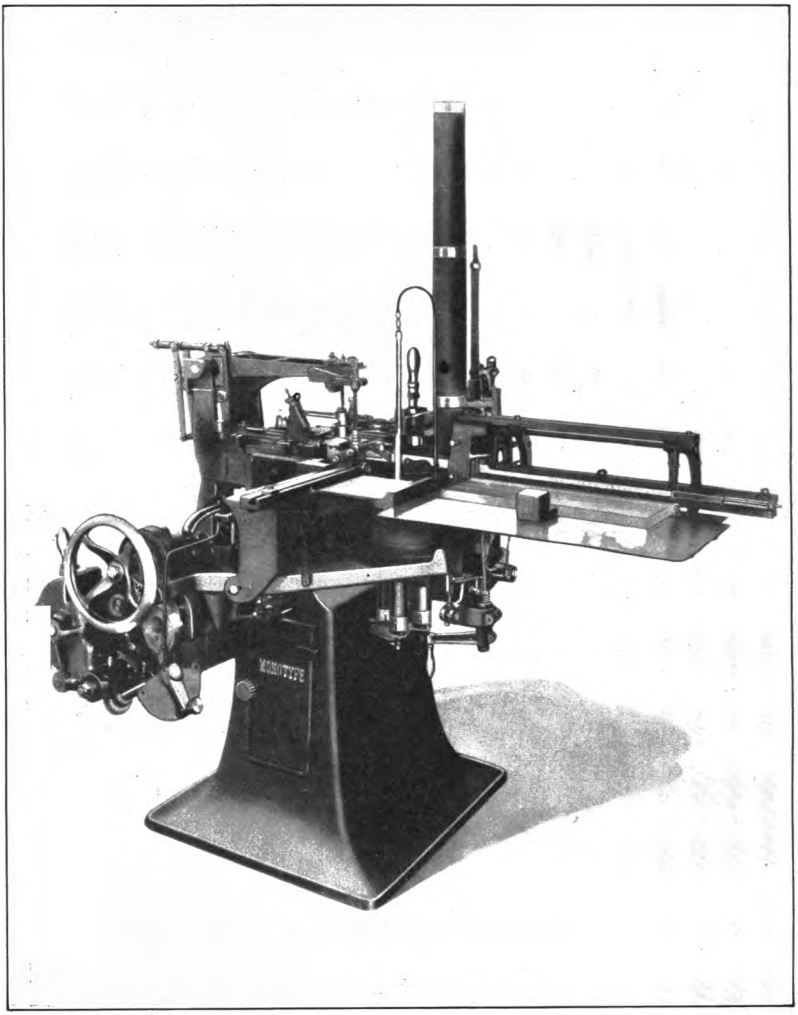
A different model, the type-&-rule caster, produces type for hand setting, from 5 to 36 point, or with proper attachments, manufactures leads, slugs, and rules. The operation of a third style, the lead-slug-&-rule caster, is confined to casting of leads, slugs, and rules only, either in continuous strips up to 25 inches or cut to measure. A fourth model, the material-making machine, produces not only the ordinary strip material—leads, slugs, and rules—but also design borders in long or short pieces, as well as one-column cast strips. A new model, the giant caster, was brought out in 1926. It produces large type (42 to 72 point), borders, decorative material, and spacing material of same sizes from 4-point, or one-eighteenth inch, to 30 inches in length. Some newspapers use composition equipment, consisting of keyboards and composing machines, as well as strip or material-making machines. Others use the latter only.

MONOTYPE OPERATION

THE handling of monotype composition equipment differs considerably from the handling of line-casting machines, as the former consists of two separate machines. The keyboards function only when manipulated by the operators; hence, they require constant attendance of one person for each keyboard, ordinarily one who is capable also of taking care of it and attending to minor repairs. While the casting machines operate automatically, they are complicated and their mechanism is delicate, making it necessary to have someone watch them. In a plant where the equipment consists of only one keyboard and one composing machine, both are customarily handled by one man, who operates the keyboard while the casting machine is running. Whenever any trouble develops on the



MONOTYPE KEYBOARD AND MONOTYPE COMPOSING MACHINE



MONOTYPE TYPE AND RULE CASTING MACHINE

latter machine, it stops automatically. In such case the operator, after finishing the line on which he is working, adjusts the difficulty, starts the caster again, and then returns to his work on the keyboard. He also changes the ribbons, matrices, and molds, when required, and supervises the mechanical operation of the machine. It is estimated that he works two-thirds of the time on the keyboard, during which time he will also be running the caster, and that he will be busy on the latter exclusively during the other third, really dividing his time equally between the two mechanisms. On a large newspaper using several machines, each keyboard is handled by one operator and there is ordinarily one attendant to every two casting machines, with a monotype machinist supervising the operations, making the adjustments, and tending to repairs. Where the type is not composed but merely cast on the machines and stored in the type cases, a hand compositor is, of course, required for assembling, just as with foundry type.

Practically the same methods are followed for the finished product as for that from line-casting machines. As the product consists of single types, it is not necessary to recast entire lines in case of minor corrections, as is the case with slug composition, such corrections being made by the substitution of the needed characters from a type case.

PRODUCTION ON MONOTYPE MACHINES

MOST of the general explanation for production on line-casting machines applies also to production on monotype keyboards, taking into consideration the later introduction of the latter machines. In most of the larger cities operators on both are classed as machine operators, with similar rates of wages.

While type is produced in assembled form, ready for printing, from both line-casting machines and monotype equipment, figures for production for the two groups are not comparable. Each machine occupied until recently a special field of its own. The line-casting machine was intended for rapid production, especially of straight matter for newspapers, where editions must be prepared promptly and typographical accuracy is often sacrificed for speed. The monotype was primarily better adapted to book and job composition, or for production of larger type than could be turned out on slugs. The subsequent developments of lead, rule, and material-casting machines increased the scope of monotype equipment. In recent years there has been considerable overlapping of products from the two sources.

THE KEYBOARD

The production of the monotype keyboard depends entirely on the ability of the operator. According to the manufacturers a record of 18,000 ems an hour has been made, but the generally accepted high record is 14,300 ems per hour, produced by a demonstrator on the machine. Monotype characters have fixed relations in width to the em for each size, based on the proportion of 53 average roman characters equaling 25 ems. For purposes of computation an em is divided into 18 units. The characters vary greatly in width, according to whether the alphabet is extended or condensed. Some types are very thin, the same letter may vary from 3 to 18 units in width, making a radical difference in the number of keys to be struck in the

production of a specified number of ems. The high record naturally differs considerably from the practical working average, which holds closely around the dead lines in Table 21. (See p. 47.) A school conducted by the manufacturers requires a minimum of 4,000 ems per hour for finished operators. A keyboard operator can easily keep ahead of one composing machine. In a plant where several of the latter are used, there are ordinarily two keyboards for every three composing machines.

THE CASTING MACHINE

The capacity of the composing machine varies according to the type sizes and the individual operating speed. For 4 to 12 point it is usually adjusted at 140 revolutions per minute, which will give a maximum production of 3,962 ems per hour. For 14-point it is ordinarily fixed at 128 revolutions per minute, and for 18-point at 110 revolutions per minute, giving maximum output of 3,622 and 3,113 ems per hour, respectively. For small sizes it is sometimes regulated at 150 revolutions per minute or more. The manufacturers claim that one firm (in Pittsburgh, Pa.) operates successfully at 160 revolutions per minute, and that one newspaper (in New York, N. Y.) produces 5½-point type at 180 revolutions per minute.

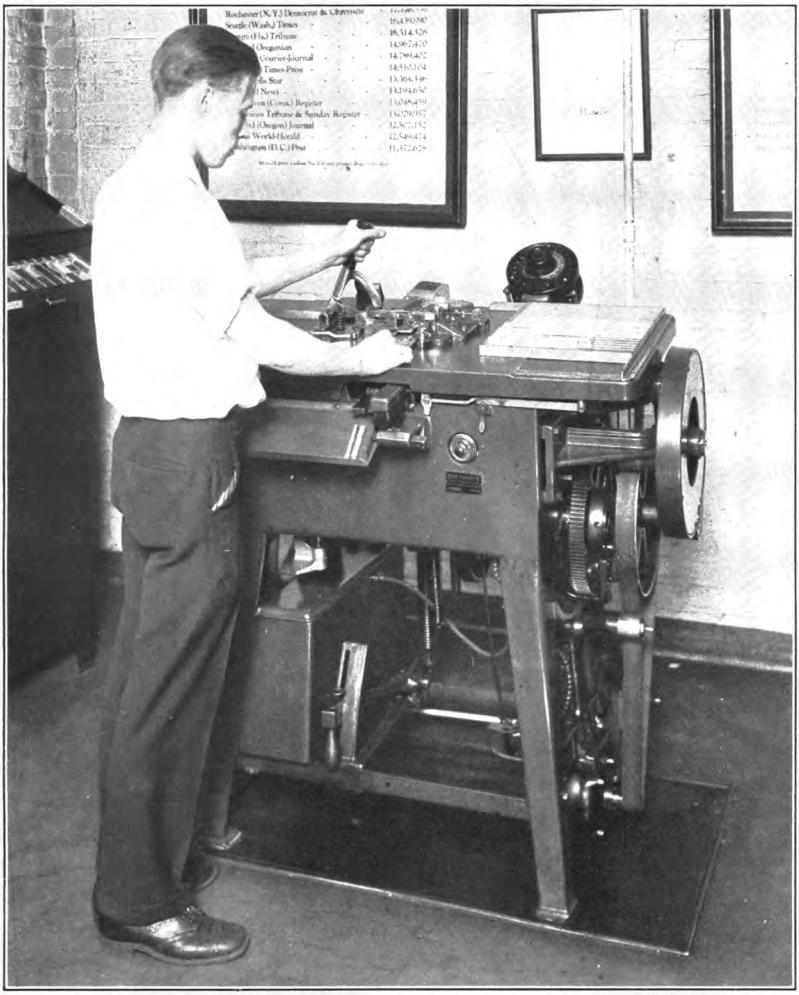
The material-making machine has a capacity of 4,848 single-column leads, or 2,820 single-column 6-point slugs, or 1,920 12-point borders per hour. When operated on continuous strips its capacity is 780 linear feet of 2-point leads, or 672 feet of 6-point slugs, or 276 feet of 12-point borders per hour. The new giant caster will produce approximately 650 square inches of metal spacing and cut-mounting furniture per hour.

Casting of type, strips, or furniture is, of course, a mechanical process and depends greatly on the running condition of the machines, as well as the number of stops necessary for changes or adjustments. The manufacturers claim that the average production on newspapers reaches 70 per cent of capacity. Additional figures on monotype production are included in data on pages 77 to 89.

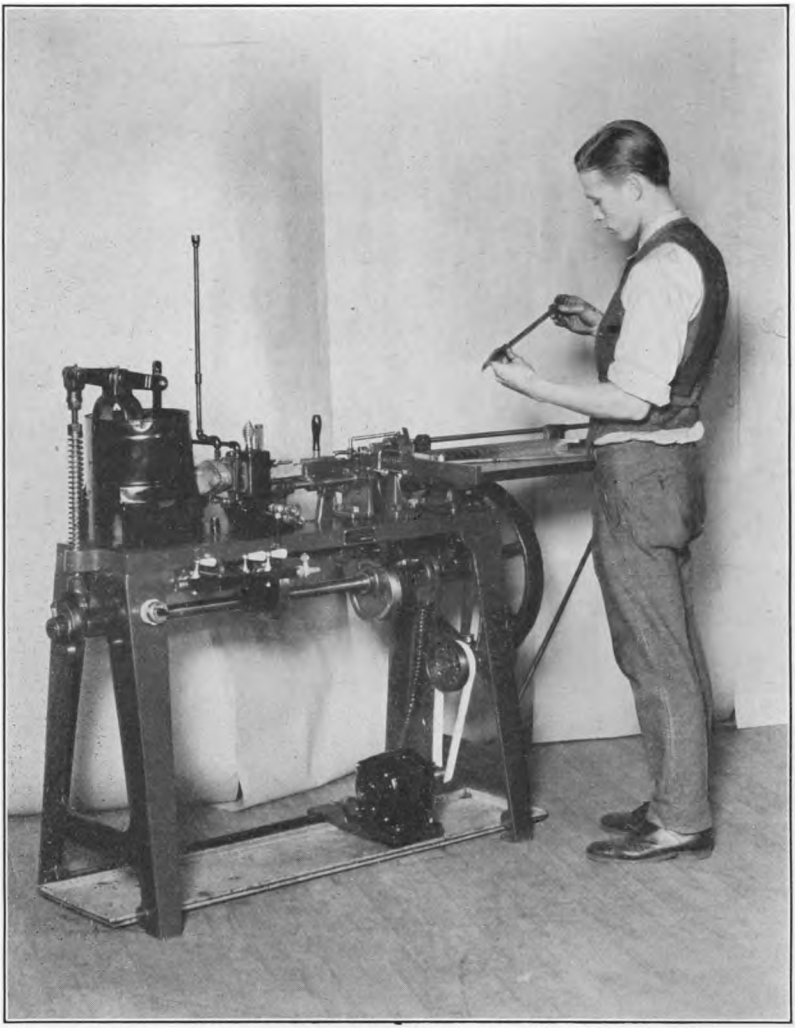
An important time saving has been effected through the resulting expansion of nondistribution by the use of monotype equipment. Approximately one-half of the total contents of a form is strip material. When this is produced on the monotype, there is no need to pull the form apart and spend time in distributing the strip material. The whole page can be dumped into a receptacle and taken to the remelting furnace, saving practically the entire time of distribution.

THE LUDLOW TYPOGRAPH

A different style of machine, the Ludlow typograph, is used in some newspaper composing rooms for producing large display type, cast in single lines. It was invented by Washington I. Ludlow, of Cleveland, Ohio, in 1905, and is manufactured by the Ludlow Typograph Co., of Chicago, Ill. It is usually operated by hand compositors several sometimes working intermittently on one machine. Brass matrices, which are kept in cases, are assembled by hand in a special composing stick, in a similar manner to the hand setting of type. The line is justified with brass spaces and locked in the stick by tightening a thumb screw. The stick is clamped into casting position in the machine and hot metal forced into the mold, forming the type-



LUDLOW TYPOGRAPH



ELROD LEAD, RULE, AND SLUG CASTER

face line on a slug having either a 6-point or a 12-point body. Types over 12 points high are cast with an equal overhang on each side of the slug. When used in a form the overhangs are supported by low blank slugs, cast automatically in the same machine. Types smaller than 12-point are cast on 6-point bodies, if required to print solid, and the overhangs treated similarly in the form. After casting, the matrices are distributed by hand into the cases, where they are kept for future use. The machine is seldom utilized for small sizes of type; but it will cast letters from 6 to 60 points in height in a line any length up to 26½ ems, or 4⅝ inches. It will also cast slug spacing material and borders.

OTHER MACHINES

WHILE the linotype, intertype, monotype, and typograph are the representative machines in present-day newspaper composing rooms for production of printing material, other successful machines are also found.

THE LINOGRAPH

A slug-casting machine, the linograph, which is used in some plants, was invented in 1912 by Hans Pedersen, of Davenport, Iowa, and is manufactured by the Linograph Co. of that city, resembles the linotype or the intertype, and embodies the same principles but with slight variations in details, such as vertical matrix magazines. It will cast lines of any length from 4 up to 30 ems pica, or three-fourths of an inch to 5 inches. With special matrices it will produce borders or ornaments up to 24-point, and with special block and slides will cast rule borders up to 30 ems pica, or 5 inches in length. A late model, brought out in 1923, is equipped with 12 magazines in one frame, and provided with a power lift to bring the proper one into position. As in the other two styles, one operator is required for each machine.

THOMPSON TYPE, LEAD, AND RULE CASTER

Individual type is produced in several composing rooms on the Thompson type, lead, and rule caster. The type-casting machine was invented by John S. Thompson, of Pittsburgh, Pa., in 1905, and was later adapted to include leads and rules. It casts single types, 5 to 48 point, spacing material, borders, and slugs, leads, or rules, cut automatically to desired lengths. Different sizes of type are obtained by changing the mold body pieces to the size required, placing matrices of desired character in the matrix holder, and attaching holder to machine. Hot metal, which is forced into the mold by each revolution of the machine, is hardened instantly by a water cooling device. The type is pushed out automatically, being trimmed on the way. The manufacturers, the Thompson Type Machine Co., of Chicago, Ill., claim a type production of 8 to 150 casts per minute, the smaller sizes being turned out more rapidly than the larger ones. Leads, slugs, and rules also can be cast, though these are not made in the mold itself but in a body piece inserted in the mold.

ELROD LEAD, RULE, AND SLUG CASTER

Up to a few years ago the most productive strip-casting machine in use was the Elrod lead, rule, and slug caster, manufactured by the Ludlow Typograph Co., of Chicago, Ill. It casts strip material from 2 to 12 points in thickness, according to the mold used. The metal is forced into the mold by a plunger in the metal pot and the

continuous strip is pulled from the mold by a special mechanism, in strokes of from ½ inch to 1¼ inches according to the thickness of the strip. A special cutting arrangement severs the strip into the desired lengths. Approximately 15 pounds of 1-point strips in 40-em lengths are produced per hour. Many of these machines are used throughout the country, though they have been gradually replaced in the larger plants by the monotype material-making machines, which have a wider range of products, the Elrod caster being confined to plain strip material.

ROGERS TYPOGRAPH

Another matrix-composing and slug-casting machine, the Rogers Typograph, was invented in 1888 by John Raphael Rogers, of Lorain, Ohio. Because it infringed on Mergenthaler patents the factory was moved from Cleveland, Ohio, to Canada, where it remained until the expiration of the patents, when the American Typograph Co. was established in Detroit, Mich., in 1907. The firm later went out of existence. The matrices were suspended by eyes on wires, placed at an angle of 45°, spread in fan shape at the rear and converging into a common vertical plane in front. The matrices, which were released by touching keys on a regular keyboard, slid down the wires through gravity and were assembled at the front of the machine. The line was spaced between the words automatically with disks. The mold was brought against the matrices, and closed by the spout of the metal pot. A force pump ejected the molten metal from the metal pot into the mold to form a slug, which was pushed into a galley by a mechanical finger. The wire frame was tilted back, returning the matrices by gravity to their original positions. The machine, which required only one operator, cast any size of book type and produced about 3,000 ems per hour.

In 1891, before the linotype was fully perfected, a contest of devices for machine composition was held in Chicago, Ill. The judges reported that, while the linotype showed bursts of superior speed, the Rogers typograph produced the best and most economical result, as it was set up ready for running in 90 minutes, required no attention except from the operator, and ran smoothly. The McMillan machine was judged to give the highest typographical excellence, but it was too expensive, as it required three operators.

MACHINE ACCESSORIES

AUTOMATIC METAL FEEDERS

Modern attachments to the various composing and casting machines have also affected production. Automatic feeding of ingots to the metal pots was first attempted by supplying either slugs or the ordinary small ingots at fixed intervals, as proposed in a patent issued to Joseph N. Chamberlain, of Springfield, Mass., in 1899. Other styles of automatic metal feeders were subsequently developed, in which larger ingots were used, saving time for the operators by keeping the metal pots filled automatically. In the Margach feeder, invented in 1914 by Andrew L. Margach, of Utica, N. Y., the ingot is suspended from a hook on a chain, in direct contact with the molten metal, and is lowered automatically as required to keep the metal at uniform level. The ingot weighs about 25 to 30 pounds, or the equivalent of 8 to 10 ordinary small ingots. The Simplex feeder

consists of a clasp frame, holding a long, trapeziform ingot, weighing about 24 pounds, also in direct contact with the molten metal and lowered gradually as adjusted. The Knoop feeder, invented in 1919 by J. H. W. Knoop, of Highland Park, Pa., is somewhat similar, using a long cylindrical bar of approximately the same weight. The Newton feeder and the Reliable feeder also consist of holders, through which the long ingots are kept in contact with the metal, but the Lee feeder, invented in 1913 by George E. Lee, of Cleveland, Ohio, is based on a different principle. The cylindrical ingot, which is about 3 inches in diameter, rests in a melting cup suspended above the metal pot. The cup, which in the earlier model is heated by gas and in the later one by electricity, melts the metal, which drips down into the pot. The Monomelt system, which was invented by George L. Curee, of Minneapolis, Minn., in 1921, was based on the early idea of direct melting of slugs or other dead material, eliminating ingot casting. It consists of an additional metal pot, placed on top of the regular metal pot on the machine. It is provided with agitation to force dirt and ink to the surface for skimming off, and with thermostat control to maintain a uniform height of metal in the regular pot, so that every time a slug is cast the same amount of metal is fed into the main pot from the auxiliary pot. Where the filling of the metal pots is performed by the machinists instead of by the operators, the time saving naturally affects the machinists' helpers directly. The manufacturers of automatic metal feeders, however, claim an additional time saving for the machinists in either case, as automatic feeding keeps the metal at a constant level in the pot, eliminating connected machine trouble.

ELECTRIC METAL POTS

The method of heating the metal pots also has some bearing on hourly production. The fuel can be either gas, electricity, gasoline, or kerosene. In a hygienic survey conducted by the bureau during 1923 and 1924, 3,575 type-casting machines were noted, of which 64.7 per cent were equipped with gas-fuel metal pots.[11] Analysis of the data disclosed that this ratio could not be accepted for newspaper production, as only 2,066 machines were located in the 64 newspaper printing plants then surveyed. Gas was used for fuel on 1,073 of these, or approximately 52 per cent, and electricity on the remainder. Since the period of that survey there have been a number of changes from gas to electricity, due to better electrical heating, especially for linotypes and intertypes. Electric metal pots are also used on the other machines, except the Elrod slug caster. The automatic control of heating in electric pots requires no attention from the operator and, as the temperature is easily regulated, machine troubles are reduced. The electric heaters can, in addition, be started automatically, through a time-clock attachment, so that the metal will be ready for casting when the operator arrives. With gas-heated pots it is necessary to have someone come in early to light the burners, so that the 38 pounds of metal in the pot will be melted before the metal is needed by the operator. Gasoline and kerosene are seldom used for fuel except in small communities where gas is not available, and are hardly important enough for consideration in connection with production.

[11] U. S. Bureau of Labor Statistics Bull. No. 392: Survey of Hygienic conditions in the Printing Trades. Washington, 1925.

TRIMMING ATTACHMENTS

In some newspaper plants part of the line-casting machines have been provided with attachments for automatically sawing off portions of the slugs, this being sometimes required to make them of correct length to fit around cuts or in special spaces. For several years the Mohr lino-saw, patented in 1912, was the only device for that purpose but recently the Miller slugotype saw has also been introduced. The simple adjustment on these attachments to various desired odd lengths often saves the time of the operator by making changes of molds unnecessary, but it especially saves time later for the hand compositors, who usually trim the slugs to required lengths.

REMELTING OF USED METAL

ANOTHER operation has been added to the composing room through the use of casting machines—the remelting of slugs or type. This is ordinarily under the supervision of the chief machinist on a large newspaper, or of the foreman of the composing room on small newspapers, but is occasionally apportioned to the stereotyping department. The material to be melted is either dumped on the floor and shoveled into the kettle of the metal furnace, or dropped into the kettle from a trap above. The molten metal is stirred occasionally, the dross is skimmed off, and the metal is poured into ingot molds.

In some places ordinary stereotype metal furnaces have been adapted by attaching an ingot casting device, by which the metal is pumped into the ingot molds by means of a long lever, and the ingots are discharged by pulling another lever. In other plants small furnaces of various manufacture are used, which also require stirring of the metal by hand. Some of them are provided with outlet valves and spouts, while others require the use of a ladle to dip out the metal and pour it into the molds. One style frequently seen is the Double-Quick automatic metal furnace, in which the metal is stirred by rocking a handle that operates a mixer. It is provided with a circle of molds, which revolve around the outside of the furnace under the outlet valve. The manufactures claim that a full kettle of metal, or 1,000 pounds, can be poured and cast in about 20 minutes. The majority of furnaces are equipped for gas fuel, though some are still found which are heated by coal, involving additional work in supplying fuel.

A newer style consists of the Supreme metal furnace and the Monarch Monometer. These are provided with automatic mixers, automatic temperature control, and movable spouts for pouring the molten and refined metal into water-cooled molds. They render the work easier and more pleasant, but apparently retard man-hour production of actual ingot casting when large molds are used, as shown by a comparison with hand pouring in a large establishment. It required 3½ hours of actual pouring by 2 men to produce 400 ingots, emptying 10,000 pounds of metal from one of the special furnaces through the spout into 12 water-cooled Margach molds, one man pouring and the other emptying the molds. The same result was accomplished in three hours by the two men dipping from an ordinary metal furnace by hand, each man using a 25-pound ladle and 6 water-cooled Margach molds.

In a few plants the usable metal is also extracted from the dross, which is collected by skimming the metal, involving the tending of

special furnaces for that purpose, but the majority find it more convenient to ship the dross to the metal supply houses for that operation. In the early days of machine composition a number of the plants mixed their own metal, but this sometimes resulted in a poor grade which did not work well in the machines and retarded production. At present practically all plants obtain the metal already mixed from the supply houses, many of which have conducted extensive research in suitable mixtures for the various machines and in the developing of a combination to fuse at the lowest temperature possible.

In some of the large plants one or even two special workers, commonly helpers, are occupied in ingot casting and connected work during the entire day shift. This is especially the case where a large number of machines are operated on both day and night shifts. On small newspapers the work is often performed by one of the apprentices during part of the shift.

DIVISION OF COMPOSING-ROOM WORKERS

WHEN newspapers were first established in the United States there was only one class of craftsmen, who performed any and all of the necessary operations. With the increase in production divisions occurred, such as the separation of the composing room from the pressroom. The compositors later began to specialize, separating into straight-matter compositors, ad compositors, proof readers, and make-up men. Adoption of machines changed the divisions somewhat, practically eliminating the straight-matter hand men and substituting linotype or monotype operators for them and adding machinists. The introduction of nondistribution reduced the number of hand men still further, especially among the less skilled, who had been kept mostly at simple tasks. In the small plants of the early days the foreman was an active worker, but as the composing rooms grew larger his duties became gradually more executive, and supervisory assistants were placed in charge of the various divisions. These changes did not take place at the same time in all of the plants, and consequently all sorts of divisions of work might exist at any given time even among composing rooms in the same city. At the present time each special operation in a large modern composing room is almost a trade in itself, while in the small ones there may be unlimited overlapping.

HAND COMPOSITION IN MODERN PLANTS

Straight-matter, or news, compositors have been supplanted by operators on the various machines, mostly specialists on a certain style. During recent years the ad compositors have also felt the influence of the machines, which have been developed to assemble type that formerly could be set only by hand. As a rule these newer machines have been installed in the larger composing rooms alone, and there is proportionately more hand setting of ads and of headings for news material in the smaller plants. The product of the machines must, however, be put together, rules and leads inserted, and corrections made. Slugs, leads, and rules require cutting to certain lengths, an operation usually performed by hand compositors, unless produced in correct sizes on the machines.

The old-fashioned hand cutters are still used in some places, but since 1910 power machines have gradually supplanted the hand implements on most newspapers. The Miller saw trimmer, either stationary or portable, is commonly found in composing rooms. Some use other styles of trimming machines, such as the Trimosaw, the C. & G. Trimmiter, the Superior, or the Laclede saw trimmer, also the Rouse rotary mitering machine. A quantity of slugs, leads, or rules can be cut in a single operation on one of these machines, while on a hand cutter it is necessary to cut them one at a time. Several of the power machines are, like the Miller saw trimmer, equipped with miterers, jig saws, drills, and routers, increasing the scope of the machines. These attachments are often used for the trimming of oversize cuts, or for making corrections on the cuts. On some large newspapers the cuts are placed in charge of a compositor, who proves them, stores them, and attends to trimming them when required. In other places they may be stored in the counting room or advertising office, so that only occasional trimming is required of compositors, and in still other places the trimming is performed by the stereotypers.

Aside from the time actually consumed in cutting slugs, leads, and rules, considerable time was wasted by the compositors in walking to and from the central rack where the material to be cut was usually stored and from which it had to be obtained, the cutting being done by the compositor as each piece was required. Adoption of improved type cases, equipped with worktable tops and individual slug and lead racks, also disposed of many waste steps and helped to increase production. An individual test was made by one compositor on a New York morning newspaper in 1916 after some of the improved cases had been installed. Under the old system each compositor cut his own material, secured from a central rack, though using a power saw. This was timed for one night and a comparison made with the following night, when quantity-cut leads and slugs were used from the individual rack on the worktable. The result was a saving of 30 minutes for the night by the latter method, or 6.7 per cent.

PROOFS AND PROOF READING

Proofs are taken of all material to be printed. In some plants special helpers are employed to operate the proof presses, while in others the operation is performed by compositors. The type is inked and covered with a sheet of paper, large enough to leave sufficient space for corrections, and pressure is applied to deposit the ink on the paper. The proofs are turned over to the proof readers, who compare them with the original copy and mark the mistakes. Proof readers are commonly former compositors and are often considerably older than the average worker. They are usually assisted by copy holders, who read the original text to the proof readers. The speed of this work is entirely dependent on the individual and is not subject to any general change.

After the proofs have been read the errors are corrected by substituting new material. This is customarily done by the hand compositors. The corrected printing material is made up in pages by the make-up men, and locked up in the chases with grooved wedges, for stereotyping. Make-up men, who are either hand men or operators but specialized, constitute another group in which results depend on personal ability.

The early method of taking proof was by aid of a planer, a solid block of hardwood with a felt-covered surface, which was placed on the paper and tapped lightly with a mallet. Moving the planer over a large surface took considerable time, and quicker work was obtained after the proof press had been introduced. The galley with the type was placed on the bed of the press. The type was inked by hand and after it had been covered with the paper, a metal roller covered with felt was rolled over it, giving the proof. In another style the pressure was supplied by a curved segment, covered with felt or with paper, which turned while the bed with the galley was moved under it by the turning of a crank. The crank movement and the traveling bed were also combined with a cylinder, on which the proof paper was held by grippers. There are still a number of the older styles in use throughout the country, but faster methods were found necessary because of the demands of the large department stores and other heavy advertisers, who often required from 50 to 200 proofs of their advertisements in advance of publication. Coupled with this was the constantly increasing number of pages issued, especially the huge Sunday editions. These were produced during practically the same number of working hours and consequently in a large composing room, required several proof presses and operators. The development of the Wesel electric proof press solved the problem. Different styles of these are used. In one style the inking rollers and the rubber-covered impression cylinder are carried over the form by endless chains, returning under the bed, where the rollers are supplied with ink. The operator places the paper on the type after the inking rollers have passed over it, and removes it after the passage of the impression cylinder. The balance of the operation is performed automatically. One model, for heavy work, is claimed by the manufacturers to be capable of producing 40 proofs per minute from the same galley. Another style is provided with an inking mechanism, a rubber-covered impression cylinder, and a roll of proving paper, all mounted on a carriage which travels over the top of the bed. Going in one direction the rollers ink the form. On the return the impression is secured, while sufficient paper is drawn from the roll and cut to suitable length. Proof presses are made in various sizes, some large enough for proving full pages.

CHAPTER 5.—DETAILED STUDY OF PRODUCTIVITY AND LABOR COST FOR COMPOSITION IN 1896

IN 1894 an investigation was started by this bureau (then called the United States Department of Labor) to determine the relations of hand and machine methods in a number of industries. The report thereof [1] contained several tables showing production of composition on newspapers. Other tables, prepared from these, are presented in this chapter for comparison with similar tables containing data from the survey for the present productivity study. For convenience of comparison at that time, the data presented in each table in the early report was for 10,000 ems of tpye, and these figures have been converted to show productivity per man-hour for the productive labor and for all employees, time cost for each of the various labor groups engaged in the man-hour output for all employees, and the corresponding labor costs for such portions of the man-hour. Additional information, taken from the previous report, is also presented.

HAND METHOD OF PRODUCTION

COMPOSING ROOM NO. 1

TABLE 27 contains data for setting type by hand on a newspaper in 1895.

TABLE 27.—*Man-hour production and labor cost in hand setting of type in newspaper composing room No. 1, 1895*

Occupation	Man-minutes worked in producing 10,000 ems	Average production per man-hour	Labor cost per man-hour	Cost of man-hour production	
				Time cost	Labor cost
		Ems		*Minutes*	
Productive labor: Compositors	943.2	636.1	$0.140	45.0	$0.105
Nonproductive labor:					
Provers	10.5		.167	.5	.001
Proof readers	104.8		.167	5.0	.014
Copyholders	104.8		.100	5.0	.008
Supervisory employees	94.3		.167	4.5	.012
Total nonproductive labor	314.4		.144	15.0	.036
All employees	1,257.6	477.1	.141	60.0	.141

The working-day consisted of 10 hours, and the total time consumed by 8 workers in setting 171,750 ems of leaded type had apparently been considered. Compositors, who set the type and inserted the leads, were paid on a piece basis—22 cents per 1,000 ems. No information was given regarding the size of the type, nor if the work included making up into pages. It is presumed that the duties consisted only of actual setting, correcting, and leading out the type, together with proof reading. All of the nonproductive help were paid on time basis. The prover operated a small hand-power proof press.

[1] U. S. Commissioner of Labor. Thirteenth Annual Report, 1898. Hand and Machine Labor. 2 vols. Washington, 1899.

COMPOSING ROOM NO. 2

Table 28 contains data for setting of agate (5½-point) and nonpareil (6 point) type by hand on a newspaper in 1896. The working-day consisted of 9 hours, and the total time consumed by the 43 workers in producing 369,000 ems of type had seemingly been considered. All were paid on a time basis. As no other explanations were given, the work presumably consisted of just setting and correcting the type.

TABLE 28.—*Man-hour production and labor cost in hand setting of agate and nonpareil type in newspaper composing room No. 2, 1896*

Occupation	Man-minutes worked in producing 10,000 ems	Average production per man-hour	Labor cost per man-hour	Cost of man-hour production	
				Time cost	Labor cost
		Ems		*Minutes*	
Productive labor: Compositors	600.0	1,000.0	$0.444	57.2	$0.424
Nonproductive labor: Supervisory employees	29.2	----------	.694	2.8	.032
All employees	629.2	953.6	.456	60.0	.456

COMPOSING ROOM NO. 3

Table 29 contains data for the setting of brevier (8-point) type by hand on a newspaper in 1896.

TABLE 29.—*Man-hour production and labor cost in hand setting brevier type in newspaper composing room No. 3, 1896*

Occupation	Man-minutes worked in producing 10,000 ems	Average production per man-hour	Labor cost per man-hour	Cost of man-hour production	
				Time cost	Labor cost
		Ems		*Minutes*	
Productive labor: Compositors	916.7	654.5	$0.166	60.0	$0.166

The working-day consisted of 10 hours, but only a single worker and presumably just the work of setting and correcting 36,000 ems of type had been considered. He was paid on a time basis.

COMPOSING ROOM NO. 4

Table 30 contains data for the setting of brevier (8-point) type by hand on a newspaper in 1896. The working-day consisted of 10 hours, and the total time consumed by the five workers in producing 18,000 ems of type had apparently been considered. All were paid on a time basis. The tabulation evidently covers just the setting and correcting of type.

TABLE 30.—*Man-hour production and labor cost in hand setting of brevier type in newspaper composing room No. 4, 1896*

Occupation	Man-minutes worked in producing 10,000 ems	Average production per man-hour	Labor cost per man-hour	Cost of man-hour production	
				Time cost	Labor cost
		Ems		*Minutes*	
Productive labor: Compositors	1,066.7	562.5	$0.200	58.2	$0.194
Nonproductive labor: Supervisory employees	33.3	----------	.250	1.8	.008
All employees	1,100.0	545.5	.202	60.0	.202

COMPOSING ROOM NO. 5

Table 31 contains data for the setting of minion (7-point) type by hand on a newspaper in 1895.

TABLE 31.—*Man-hour production and labor cost in hand setting of minion type in newspaper composing room No. 5, 1895*

Occupation	Man-minutes worked in producing 10,000 ems	Average production per man-hour	Labor cost per man-hour	Cost of man-hour production	
				Time cost	Labor cost
		Ems		*Minutes*	
Productive labor: Compositors	900.0	666.7	$0.167	59.3	$0.165
Nonproductive labor: Supervisory employees	10.0	----------	.250	.7	.003
All employees	910.0	659.3	.168	60.0	.168

The working-day consisted of 10 hours, and the total time consumed by the 4 workers in producing 60,000 ems of type had seemingly been considered. Compositors were paid on a piece basis—25 cents per 1,000 ems. The supervisor was paid on a time basis. The work presumably was just the setting and correcting of the type.

These tables for hand composition show considerable variation in man-hour production for compositors, ranging from 562.5 to 1,000 ems. This variation may be due to differences in the type sizes, in the shop practices, or in the ability of the workmen. Table 26, which shows an exceptionally high production, was for a large newspaper in a large city, while the others were for comparatively small establishments. The work was probably more specialized in the former. Table 27 is for leaded type, which means the additional work of inserting the leads. This table also includes proving and proof reading for the process, while the others include supervisory help only. The latter does not appear in Table 29, probably because the solitary worker acted also in that capacity. The difference in man-hour labor costs is due mostly to locality, which ordinarily accounts for variations in wages. In the previous report the information was not presented for a comparison of these various tables with each other, but for the comparison of each table with another that covered a plant where similar work was performed by the machine method. (See Tables 32 to 36.)

MACHINE METHOD OF PRODUCTION

COMPOSING ROOM NO. 6

TABLE 32 contains data for the setting of type with linotypes on a newspaper in 1895. The working day for linotype operators consisted of eight hours and for those of the other employees of nine hours. The total time consumed by the seven workers of each division in producing 246,400 ems of type had apparently been considered. All were paid on a time basis. No information was given regarding the size of the type. Linotype operators were substituted for hand compositors, except one man, the bankman, who leaded out the matter on the galleys. The tabulation included proving, proof reading, and supervisory help, similar to items for hand setting in Table 27, with which it is comparable. It also contained the vocation of machinist-engineer, for keeping the machines in running order and furnishing operating power. This was not necessary under hand setting, but was required for machine production. The provers operated small hand-power proof presses.

TABLE 32.—*Man-hour production and labor cost in machine setting of type in newspaper composing room No. 6, 1895*

Occupation	Man-minutes worked in producing 10,000 ems	Average production per man-hour	Labor cost per man-hour	Cost of man-hour production	
				Time cost	Labor cost
		Ems		*Minutes*	
Machine operators	136.4	4,398.8	$0.438	30.0	$0.219
Bankmen	21.9		.358	4.8	.025
Total, productive labor	158.3	3,790.3	.420	34.8	.244
Provers	26.8		.111	5.9	.011
Proof readers	43.8		.222	9.6	.036
Supervisory employees	21.9		.370	4.8	.045
Machinist-engineers	21.9		.556	4.8	.030
Total, nonproductive labor	114.4		.290	25.2	.122
All employees	272.7	2,200.2	.366	60.0	.366

COMPOSING ROOM NO. 7

Table 33 contains data for the setting of agate (5½-point), nonpareil (6-point), and minion (7-point) type on a newspaper in 1896, with linotypes.

TABLE 33.—*Man-hour production and labor cost in machine setting of agate, nonpareil, and minion type in newspaper composing room No. 7, 1896*

Occupation	Man-minutes worked in producing 10,000 ems	Average production per man-hour	Labor cost per man-hour	Cost of man-hour production	
				Time cost	Labor cost
		Ems		*Minutes*	
Productive labor: Operators	138.9	4,319.6	$0.615	49.7	$0.509
Nonproductive labor:					
Machinists	8.2		.677	2.9	.033
Machinists' helpers	8.3		.313	3.0	.015
Supervisory employees	12.3		.951	4.4	.070
Total, nonproductive labor	28.8		.689	10.3	.118
All employees	167.7	3,577.8	.627	60.0	.627

The working-day consisted of 8 hours, and the total time consumed by the 42 linotype operators and the 7 other workers who were employed at nonproductive labor in producing 6,260,750 ems of type had evidently been considered. All were paid on a time basis, but the operators received different rates, varying from $27 to $33 per week. Amounts paid them have been adjusted according to the time worked at each rate, and the man-hour labor cost shown for operators is average rate on such basis. The same procedure has been followed with others, where varying rates existed in any group. An additional item of 5 cents appeared in the original table for rented steam power, the actual cost for production of the 10,000 ems. This item has not been included in Table 33, as it does not involve workers in the establishment. Table 33 is comparable with Table 28.

COMPOSING ROOM NO. 8

Table 34 contains data for setting agate (5½-point), nonpareil (6-point), and minion (7-point) type on a newspaper, in 1896, with linotypes. The working-day consisted of 8 hours, and the total time consumed by the 26 linotype operators and the 6 other workers in producing 5,016,816 ems of type had seemingly been considered. All were paid on a time basis. The actual cost of 0.75 cent for rented power has not been included in the table, which is comparable with Table 29.

TABLE 34.—*Man-hour production and labor cost in machine setting of agate, nonpareil, and minion type in newspaper composing room No. 8, 1896*

Occupation	Man-minutes worked in producing 10,000 ems	Average production per man-hour	Labor cost per man-hour	Cost of man-hour production	
				Time cost	Labor cost
Productive labor: Operators	167.4	*Ems* 3,584.2	$0.667	*Minutes* 49.8	$0.553
Nonproductive labor:					
Machinists	11.4		.677	3.4	.038
Machinists' helpers	11.5		.313	3.4	.018
Supervisory employees	11.4		.938	3.4	.053
Total, nonproductive labor	34.3		.642	10.2	.109
All employees	201.7	2,974.7	.662	60.0	.662

COMPOSING ROOM NO. 9

Table 35 contains data for setting of agate (5½-point), nonpareil (6-point), and minion (7-point) type on a newspaper in 1896, with linotypes.

TABLE 35.—*Man-hour production and labor cost in machine setting of agate, nonpareil, and minion type in newspaper composing room No. 9, 1896*

Occupation	Man-minutes worked in producing 10,000 ems	Average production per man-hour	Labor cost per man-hour	Cost of man-hour production	
				Time cost	Labor cost
		Ems		*Minutes*	
Productive labor: Operators	136.9	4,382.8	$0.625	46.6	$0.485
Nonproductive labor:					
Machinists	15.8		.729	5.4	.065
Machinists' helpers	7.9		.313	2.7	.014
Supervisory employees	15.8		.990	5.4	.089
Total, nonproductive labor	39.5		.750	13.4	.168
All employees	176.4	3,401.4	.653	60.0	.653

The working-day consisted of eight hours, and the total time consumed by the 17 linotype operators and the 5 nonproductive laborers in producing 3,651,300 ems of type had evidently been considered. All were paid on a time basis. Actual cost of 10 cents for rented power has not been included in Table 35. The table is comparable with Table 30.

COMPOSING ROOM NO. 10

Table 36 contains data for setting of agate (5½-point), nonpareil (6-point), and minion (7-point) type on a newspaper, in 1895, with linotypes. The working-day consisted of eight hours, and the total time consumed by the 11 linotype operators and the 2 other employees in producing 548,200 ems of type had apparently been considered. Operators were paid on a piece basis—14 cents per 1,000 ems. The others were paid on a time basis. In the table in the previous report from which Table 36 was compiled there was included in the time worked in the setting of 10,000 ems 4.4 hours each for 1 engineer, at $3 per 10-hour day, and 1 fireman, at $2 per 10-hour day, but these items have not been included in Table 36, in order to keep the tables uniform. The table is especially comparable with Table 31, but as the type sizes are similar and the personnel proportionally the same as those in Tables 33, 34, and 35, it is also comparable with them and their analogous tables for hand composition.

TABLE 36.—*Man-hour production and labor cost in machine setting of agate, nonpareil, and minion type in neswpaper composing room No. 10, 1895*

Occupation	Man-minutes worked in producing 10,000 ems	Average production per man-hour	Labor cost per man-hour	Cost of man-hour production	
				Time cost	Labor cost
		Ems		*Minutes*	
Productive labor: Operators	132.4	4,531.7	$0.634	53.0	$0.560
Nonproductive labor:					
Machinists	8.8		.515	3.5	.030
Supervisory employees	8.8		.770	3.5	.045
Total, nonproductive labor	17.6		.642	7.0	.075
All employees	150.0	4,000.0	.635	60.0	.635

The man-hour production by the machine method also shows a variation for the productive workers—the operators—though proportionally less than was apparent for the hand compositors, ranging from 3,584.2 to 4,531.7 ems. The variations are probably due more to differences in shop practices or conditions than to differences in the skill of the operators.

AVERAGE MAN-HOUR PRODUCTION AND LABOR COST BY HAND AND BY MACHINE METHODS IN 1896

A DECIDED increase in production is, however, noticeable for the machine method when the five tables for it are compared with the five tables for the hand method, as shown in Table 37. Allowance must be made in such comparison for the difference in size of type (which is shown in Tables 28 to 36). Man-hour production, in each establishment, is shown for the productive labor alone, and also for all employees, which includes time for the nonproductive labor that was necessary in the process. Labor cost per man-hour both for productive labor and for all employees, is also shown. The averages are based on total man-hours, total production, and total labor cost for the five establishments in each group.

TABLE 37.—*Comparison of man-hour production and labor cost for 10 newspaper composing rooms, 1895 and 1896*

Method of production and establishment	Man-hour production for—		Man-hour labor cost for—	
	Productive labor	All employees	Productive labor	All employees
Hand method:	*Ems*	*Ems*		
No. 1	636.1	477.1	$0.140	$0.141
No. 2	1,000.0	953.6	.444	.456
No. 3	654.5		.166	
No. 4	562.5	545.5	.200	.202
No. 5	666.7	659.3	.167	.168
Average	677.8	615.9	.207	.215
Machine method:				
No. 6	3,790.3	2,200.2	.420	.366
No. 7	4,319.6	3,577.8	.615	.627
No. 8	3,584.2	2,974.7	.667	.662
No. 9	4,382.8	3,401.4	.625	.653
No. 10	4,531.7	4,000.0	.634	.635
Average	4,161.9	3,097.9	.590	.567
Increase for machine method over hand method	*Per cent* 511.1	*Per cent* 403.0	*Per cent* 185.2	*Per cent* 163.7

The weighted averages reveal that over six times as much type was turned out per man-hour by the productive labor in the five establishments using the machine method as in the five establishments using the hand method. It must, however, be considered that a certain amount of supervision was required in both methods and that the machine method necessitated additional help, so that a comparison between the man-hour production for all employees would be more indicative than that for the productive labor only. The averages for all employees reduces the increase, but still shows more than five times the amount of type per man-hour produced by the machine method than by the hand method.

The labor cost per man-hour varies considerably for the two methods, although the periods involved were all within two years, 1895 and 1896. This is partly due to the data for the machine method covering establishments in larger cities, where higher wages and shorter working shifts prevailed. The averages show that where the machine method was employed, the labor cost per man-hour for productive labor was 185 per cent more than the cost in establishments using the hand method, and for all employees was nearly 164 per cent more. These data for hand composition and early machine composition assume new importance for comparison with present day composition, as revealed by the survey just finished, data for which are presented in chapter 6.

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CHAPTER 6.—DETAILED STUDY OF PRODUCTIVITY AND LABOR COST FOR COMPOSITION IN 1916 AND 1926

DURING the latter part of 1926 an investigation was commenced by the Bureau of Labor Statistics to ascertain if any changes had taken place in labor productivity of newspaper composing rooms, as well as of other departments. Establishments were visited and data were secured from production records and pay rolls of the firms. Personal inspections were made of the different operations and the conditions under which they were performed. In addition, explanations were obtained from supervisory forces of special conditions, peculiar to each establishment, which might affect production. Many of these conditions which would prove very interesting, unfortunately can not be described without disclosing the identity of the establishment.

The survey was directed toward securing data on actual accomplishments in regular daily work, not on what could be done under the most favorable circumstances. Figures were obtained for periods of one month's duration in each establishment, day by day, to insure a fair and impartial average. As each place used a special system of its own for records, much detail work was necessary in securing the information, so that the facts could be presented in a uniform manner for all of the establishments. Considerable tabulation and compilation were required later to reduce the data to a man-hour basis. The resulting data for the composing rooms are presented in Tables 38 to 48. The composing rooms investigated in this survey have been given numbers following those given the composing rooms included in the previous survey, with the exception of two which were also investigated in the early survey and so are given the same numbers, thus facilitating comparisons for the same establishments during different periods. Information relating to other departments is shown in the chapters relating to such departments.

HAND METHOD OF PRODUCTION

COMPOSING ROOM NO. 11

Hand composition, with the use of foundry type, is almost a thing of the past on newspapers in cities of any size; but one establishment was found where it was still used. Table 38 contains data for this establishment, which issues a weekly publication:

TABLE 38.—*Man-hour production and labor cost in hand setting of 10-point type (with make-up and subsequent distribution) in newspaper composing room No. 11, 1926*

Occupation	Man-hours worked in producing 292,260 ems	Average production per man-hour	Labor cost per man-hour	Cost of man-hour production	
				Time cost	Labor cost
		Ems		*Minutes*	
Productive labor: Compositors	1,129.5	258.8	$0.270	50.4	$0.227
Nonproductive labor: Supervisory employees	216.0	----------	.602	9.6	.096
All employees	1,345.5	217.2	.323	60.0	.323

Table 38 covers the entire typographical work on the publication. The workers have been divided into productive labor—the hand compositors, who set the type and corrected the errors, and also distributed the used material after the printing was finished—and nonproductive labor, those who read the proofs, made up the pages, and supervised the other work. Accurate figures could not be obtained for the setting of type alone, for no record was kept of the time devoted to any single operation. As the publication was issued weekly, it consisted of one edition only. Consequently, the number of pages made up corresponded with the number of pages in the issues, requiring less work on make-up than is customary on ordinary daily newspapers.

Both production and labor costs have been computed on the same basis as in the previous chapter, to show productivity per man-hour for productive labor alone and for all employees, and the time cost and labor cost for each of the different groups engaged in the man-hour output for all employees. The few employees, who all worked 9 hours per day, daywork, were paid on a time basis, and did not have any overtime. Wages for compositors ranged from $14 to $17 per week, an unusually low rate compared with the ordinary wages of the period for the trade—$30 to $65 per week.

MACHINE METHOD OF PRODUCTION

The tabulations for the next four composing rooms also cover the entire typographical work on each publication, but differ from the preceding one, as part of the type was set by machine and part of it by hand. Machine operators have, therefore, been grouped with hand compositors as productive labor and, while man-hour production is shown for the operators alone where possible, and also for total productive labor, the computations have been made on the basis of man-hours for all employees.

COMPOSING ROOM NO. 12

Table 39 contains data for setting 25,116,360 ems of type with line-casting machines and 2,925,676 ems by hand, on a newspaper in 1926, including proof reading and make-up.

TABLE 39.—*Man-hour production and labor cost in machine setting of 5½, 6, and 8 point type, and hand setting of larger type reduced to 6-point measure, in newspaper composing room No. 12, 1926*

Occupation	Man-hours worked in producing 28,042,036 ems	Average production per man-hour	Labor cost per man-hour	Cost of man-hour production	
				Time cost	Labor cost
		Ems		*Minutes*	
Machine operators	6,586.8	3,813.2	$1.448	23.2	$0.559
Hand compositors	5,846.0	500.5	1.255	20.5	.430
Total productive labor	12,432.8	2,255.5	1.358	43.7	.989
Machinists	1,304.8		1.298	4.6	.099
Proof readers	2,193.0		1.454	7.7	.187
Laborers	415.0		.449	1.5	.011
Supervisory employees	721.0		1.846	2.5	.078
Total, nonproductive labor	4,633.8		1.381	16.3	.375
All employees	17,066.5	1,143.1	1.364	60.0	1.364

The newspaper was published mornings, Sundays included, but while most of the work in the composing room was performed at night, part of it was handled by a day shift, whose aggregate hours were approximately one-fifth of the whole. Seven hours constituted a net working shift, day or night, except for one day laborer in the machine department who tended the remelting of the metal and worked an 8-hour shift.

The group classed as machine operators consisted of linotype and intertype operators. The type produced on the machines was principally of three sizes, 8-point for the majority of the news text, 5½-point for some news and for the classified advertising, and 6-point for stock and market quotations. Other sizes, required for display advertisements or for headings, were also produced within the limitations of the machines. To simplify compilation the em quantities of the various kinds have been added, as if all were of the same size. Each operator secured his copy from the copy cutter's desk and carried his completed takes to the bank, and also set his own corrections. There was no record of actual operating time on the machines, nor of delays due to machine trouble, so the production figures are based on full working time for the operators.

The group classed as hand compositors included make-up men and apprentices, as well as the regular hand compositors who set type and operated the Ludlow typographs, since intermingling of duties did not permit separation. The production listed for this group is not the actual number of ems set of the different sizes, but has been computed by a method commonly used. The space occupied by the varied-size, large type in display ads and in heads of articles is measured and computation made of the number of ems of 6-point type required to fill it. The result is used to indicate the number of ems set. Practically all daily newspapers of the present period publish several editions of each daily issue, to supply important news as early as possible and to meet competition, or to furnish the surrounding sections or communities with the latest news possible according to train service or other transportation facilities. The number of these editions naturally affects the work of the compositors, especially the make-up men, in proportion to the number of pages changed. In this case three separate editions were turned out daily, and the total number of pages made up during the period was double the number of pages contained in the final editions of the daily issues.

The group classed as machinists consisted of linotype machinists, who also supervised the operation of the monotypes as well as slug or rule casters in the establishment. The group classed as laborers included the linotype laborers, mentioned previously, and provers, who used both automatic and hand proof presses. The other two groups covered only the vocations listed in their titles, proof readers and supervisors.

The total man-hours for nonproductive labor were considerably less than those for productive labor, being only 27.2 per cent as against 72.8 per cent of the total for all employees. In this table, as well as in other tables for this survey, the labor cost per man-hour and the actual labor cost for producing a specified number of ems naturally show a decided increase when compared with figures in the previous survey, due to the constant increase in daily or weekly rates of wages and the shortening of daily or weekly working hours during the

interim. This is a general feature affecting practically all places, though the changes have not been uniform in all localities, and differences consequently exist according to location of the plant. There are, however, also special circumstances which influence conditions in individual plants, such as the proportionate amount of overtime and the proportionate amount of day work or night work. The overtime rate is usually time and one-half, while the rate for night work is ordinarily 50 cents to $1 more per shift than for day work. In this composing room 2.8 per cent of the total man-hours worked were overtime, all belonging to the night shift, 75.7 per cent were night work inside of regular hours, and 21.5 per cent were day work.

Daily wages for ordinary machine operators, hand compositors, machinists, and proof readers were the same, but the actual labor cost per man-hour differed for the groups. It was comparatively low for hand compositors, due to a proportionately large number of day workers and the inclusion of several apprentices, who received lower rates of pay. Machinists also show a low average on account of a large percentage of day workers, while the comparatively high rate for proof readers was caused by relatively fewer day workers. The total number of employees in each group, the actual daily rates of wages for the different positions, and a list of the equipment, can not be published without practically revealing the indentity of the establishment.

COMPOSING ROOM NO. 8 IN 1916

Tables 40 and 41 contain data for setting partly on linotypes, intertypes, and monotypes, and partly by hand 46,702,017 ems of 5½, 6, and 7 point type on a newspaper in 1916. The establishment is the one previously listed as No. 8, data for which are given in Table 34. For that reason two tables have been compiled for this establishment, one conforming to the classification in Table 34, and including only part of the personnel, while the other relates to full production and all employees in the composing room.

TABLE 40.—*Man-hour production and labor cost in machine setting of 5½, 6, and 7 point type for news composition, in newspaper composing room No. 8, 1916*

Occupation	Man-hours worked in producing 29,016,017 ems	Average production per man-hour	Labor cost per man-hour	Cost of man-hour production	
				Time cost	Labor cost
		Ems		*Minutes*	
Productive labor: Operators	8,712.3	3,330.5	$0.698	47.9	$0.557
Nonproductive labor:					
Machinists	869.6		.818	4.8	.065
Machinists' helpers	730.0		.297	4.0	.020
Supervisory employees	612.5		.950	3.4	.053
Total, nonproductive labor	2,212.0		.682	12.1	.138
All employees	10,924.3	2,656.1	.695	60.0	.695

The newspaper was published mornings, Sundays included. Most of the composing-room work was performed at night but approximately 4.5 per cent of the total time worked was outside night-shift hours, not including the overtime of night-shift workers. Seven and one-half hours, exclusive of the lunch period, constituted a regular shift for night work.

Only news operators have been considered for productive labor in Table 40, which reveals a considerably smaller output per man-hour than Table 34 shows for the same establishment during the earlier period, both for these and for all employees. As the only information available for the 1896 period consisted of the figures given in the tables, the reason for the decrease can not be determined absolutely. It was claimed that in 1916 the bulk of the copy for the operators was furnished during the last few hours before publication, necessitating a proportionately large number of machines to set it up, while during the early part of each shift a smaller number of machines could have handled the copy supplied then. The average production was consequently smaller than if the supply of copy had been distributed evenly. For the different groups of nonproductive labor the proportionate amounts of the time and labor cost of man-hour production for each have been computed in the same manner as in Table 34. The group of machinists shows an increase in time cost of over 41 per cent in 1916, indicating that a proportionately larger force of these were employed, which is also reflected in an 18 per cent increase for their helpers. The man-hour labor cost for the machinists also advanced more than that for the other groups, showing an increase of 21 per cent, while the increase for all groups was only 5 per cent.

TABLE 41.—*Man-hour production and labor cost in machine setting on linotypes, intertypes, and monotypes of 5½, 6, and 7 point type, and hand setting of larger type reduced to 6-point basis, in newspaper composing room No. 8, 1916*

Occupation	Man-hours worked in producing 46,702,017 ems	Average production per man-hour	Labor cost per man-hour	Cost of man-hour production	
				Time cost	Labor cost
		Ems		*Minutes*	
Linotype operators	9,959.3	[1] 3,330.5	$0.707	14.8	$0.175
Monotype keyboard operators	583.0		.766	.9	.011
Hand compositors	7,434.5		.774	11.1	.143
Total productive labor	17,976.8	2,597.9	.737	26.8	.329
Linotype machinists	993.8		.818	1.5	.020
Monotype machinists	431.0		.715	.6	.008
Machinists' helpers	834.0		.297	1.2	.005
Proof readers	4,650.8		.676	6.9	.078
Make-ups	4,091.3		.747	6.1	.076
Laborers	8,981.5		.218	13.4	.049
Supervisory employees	2,341.8		.950	3.5	.055
Total, nonproductive labor	22,324.0		.526	33.2	.291
All employees	40,300.8	1,158.8	.620	60.0	.620

[1] News composition only.

In Table 41 the entire production of type and all of the employees in the composing room have been considered. The figures are of especial interest for comparison with those in Table 42, which covers the same establishment 10 years later.

The group classed as linotype operators consisted of linotype and intertype operators. The line-casting machines were what are now considered early models, mostly with single fixed magazines (though some of the news machines were provided with three and some of the ad machines with four magazines each), and did not present a wide range of type varieties. Twelve per cent of the machines were

equipped with Mohr lino-saws. The metal pots were heated by gas and the ingots were fed into them by hand. Eight or 10 point type was measured on a 6-point basis, while smaller type was measured on its own basis. Tabular matter was calculated. Each operator secured his copy from the copy cutter and delivered his galleys to the bank, and also set his own corrections. Claims had been made that the average production on line-casting machines during this earlier period had been 4,000 to 4,300 ems per man-hour, ranging from 3,400 to 5,600 ems according to the individual skill of the operator. This was probably based on productive time alone, as measured by clocks on machines, which gave line production and eliminated time lost through machine difficulties. Figures furnished for this tabulation reveal, however, that the average output per man-hour for news composition was only 3,330.5 ems, based on the total hours for all of the operators, as there was no record of lost time or other delays.

Hours and wages were obtained for the monotype keyboard operators, but the actual production for them could not be separated from the amount of type set by the hand compositors, so the total output of the two groups was treated as a whole. The group of hand compositors consisted only of the regular ad compositors, who set type for advertisements, headings, etc. The material used had been produced on the monotype casting machines. The combined hours for the three groups mentioned reduced the average output per man-hour to 2,597.9 ems.

The groups listed under nonproductive labor were practically similar to those mentioned for previous establishments. Linotype machinists repaired the machines and kept them running properly, each man taking care of 12 or more machines. Monotype machinists supervised the mechanical operation of the keyboards and the running of the casting machines, one man handling 3 keyboards, 4 composition casters, and 2 lead and rule casters on each shift. Most of the display type and headings were cast on these, which were tended directly by laborers, one for each composition caster and one for two lead and rule casters. Machinists' helpers and proof readers pursued the usual duties of their vocations. Three or four editions were ordinarily published daily, requiring considerable extra work by the make-up men, as the number of pages published in the final daily issues constituted only 52.8 per cent of the total number of pages made up during the period. The group of laborers, also included provers, who operated automatic proof presses, and one man who worked six days a week, daywork, tending the metal furnace and casting the ingots.

The total man-hours for nonproductive labor exceeded the total for productive labor, being 55.4 per cent as against 44.6 per cent of the total for all employees. As the publication was a morning paper, the majority of the work was performed in the regular night shift, and practically all of the overtime was for workers on the night shift. A little over 7 per cent of the total hours was overtime, 71 per cent was night work inside of regular hours, and almost 22 per cent was in other regular shifts.

Regular wages were paid to linotype operators, monotype operators, hand compositors, proof readers, and make-up men, but the actual labor costs per man-hour for these groups varied according to the

relative amount of nightwork, daywork, and overtime for each group. Linotype and monotype machinists received a slightly higher rate, but the actual man-hour costs for these were also affected by the relative amounts of night shifts, day shifts, and overtime worked. Machinists' helpers and laborers received comparatively low wages, which were naturally reflected in the man-hour labor costs, though the latter worked relatively more overtime than any other group.

COMPOSING ROOM NO. 8 IN 1926

Table 42 contains data for setting 57,615,783 ems of news composition and 56,408,967 ems of advertising composition, on machines or by hand, on a newspaper in 1926, including proof reading and make-up. The establishment is the one for which data are given for earlier periods in Tables 34, 40, and 41.

TABLE 42.—*Man-hour production and labor cost in machine setting on linotypes, intertypes, and monotypes of 5½, 6, and 7 point type, and hand setting of larger type reduced to 6-point basis, in newspaper composing room No. 8, 1926*

Occupation	Man-hours worked in producing 114,024,750 ems	Average production per man-hour	Labor cost per man-hour	Cost of man-hour production	
				Time cost	Labor cost
		Ems		*Minutes*	
Machine operators	21,039.5	[1] 3,684.8	$1.440	18.1	$0.433
Hand compositors	13,831.8		1.433	11.9	.285
Total productive labor	34,871.3	3,269.9	1.437	29.9	.717
Machinists	1,906.0		1.447	1.6	.039
Machinists' helpers	1,267.5		1.491	1.1	.009
Proof readers	9,529.0		1.445	8.2	.197
Make-ups	6,921.0		1.421	5.9	.141
Laborers	11,082.5		.543	9.5	.086
Porters	2,010.0		.263	1.7	.008
Supervisory employees	2,327.0		1.867	2.0	.062
Total, nonproductive labor	35,043.0		1.081	30.1	.542
All employees	69,914.3	1,630.9	1.258	60.0	1.258

[1] News composition only.

In 1926 conditions in this establishment were changed somewhat from those existing during the 1916 period, mainly due to the greater number of pages published in the daily issue, which had increased nearly 115 per cent. This had necessitated the installation of more equipment and the employment of additional labor. The group division of the workers differed slightly from that of the earlier period, so that in this table separation could not be made of linotype operators and monotype operators, who were classed together as machine operators, nor of linotype machinists and monotype machinists, who were classed together as machinists. A new group, porters, had been added, as these constituted a direct part of the composing-room force during 1926, while in 1916 cleaning of the floors and around the machines was performed by the regular building porters.

The battery of line-casting machines—linotypes and intertypes—had been enlarged 50 per cent. The majority of the machines in use during the earlier period had been replaced by more modern styles, which permitted a wider range of type sizes without loss of

time through changing of magazines. While gas fuel was still used for heating the metal pots, automatic metal feeders had been installed, eliminating the frequent dropping of small ingots into the metal pots. The proportion of machines equipped with Mohr lino-saws had been increased to 18 per cent. There had also been a 33 per cent increase in the number of monotype keyboards. Ludlow typographs had been installed for the production of complete lines of larger type. These were operated by hand compositors, three operators for two machines on the regular night shift, and one operator for each machine, as required, during the remainder of the shift. Type was measured in the same manner during both periods and the shop practices were similar.

Based on the total man-hours for machine operators, the machine production of news composition was 3,684.8 ems per man-hour, an increase of 10.6 per cent over the man-hour production in 1916. The fact that in the 1926 period monotype keyboard operators could not be separated from line-casting machine operators may have had a slight effect on this increase, as the former may have had a somewhat higher production. Separation could not be made in either period of advertising composition set on machines from that set by hand. Improvements in machines permitted a much larger proportion of advertising matter to be set on machines during the 1926 period, resulting in an increas of 52.9 per cent in the man-hour production of total advertising composition. While the output of news composition had advanced only 10.6 per cent, this larger increase for advertising composition brought the total man-hour production for the combined productive labor down to 3,269.9 ems, or an increase of 25.9 per cent over the 1916 man-hour production for the group.

Proportionally fewer hours appear for the nonproductive labor, raising the average man-hour production for all employees to 1,630.9 ems as against 1,158.8 ems in the 1916 period, or an increase of 40.7 per cent. While the productive labor showed an increase of 94 per cent in man-hours in the same length of time, the percentage increase was only 33.8 for machinists, 52 for machinists' helpers, 69.2 for make-ups, and 23.4 for laborers, though inclusion of the porters in the latter group would raise the percentage to 45.8. The proof readers alone showed as high an increase in man-hours as that for the group—105 per cent—while the supervisory force remained practically the same as during 1916. Consequently, the number of man-hours for nonproductive labor was only slightly larger than that for productive labor.

Installation of additional monotype casting machines had increased the number of these 83.3 per cent, but without enlargement of personnel, as the handling of the extra equipment was added to the previous duties of the regular machinists and laborers in that division. Application of automatic metal feeders to some of the machines had reduced the individual work somewhat. A new, improved style of ingot metal furnace also permitted the casting of sufficient large ingots to supply the additional line-casting and monotype casting machines by one man working 6 days a week, the same length of time having formerly been required to supply the machines of that period. Improved automatic proof presses had been provided, increasing the number of proofs taken in a given time, and additional trimming machines facilitated the work of the hand compositors.

The number of editions had been increased to four or five, sometimes ranging as high as seven. The proportion of additional pages made up had increased to 51.8 per cent of the total, while the pages published in the final editions of the daily issues represented only 48.2 per cent. The proportion of overtime had been lowered to 4.2 per cent of the total hours, and night work inside of regular hours to 64.2 per cent, but hours in other regular shifts had increased to 31.8 per cent of the total.

Like the 1916 period, variations existed in the actual labor cost per man-hour for the groups receiving similar daily wages for regular work, according to the proportion of night work or daywork and the relative amount of overtime for each group. The man-hour labor costs shown for the different groups were practically double the amounts for the 1916 period, due to the general rise in daily wages for the district in which the establishment was located, though the reductions in proportionate night work and in overtime had lowered the average rates slightly.

TREND OF MACHINE OUTPUT IN COMPOSING ROOM NO. 8, FROM 1896 TO 1926

The man-hour output of news operators, as stated previously, was based on their total working time. This included more or less waiting time and time lost through machine trouble. As machine operators on news composition constitute the most important group of workers in the newspaper plant, Table 43 has been prepared to facilitate comparison of the average man-hour production (on basis of total working time) and average actual labor cost per man-hour for machine operators on news composition in this establishment during selected periods in 1896, 1916, and 1926.

TABLE 43.—*Man-hour production and labor costs for machine operators* [1] *on news composition in newspaper composing room No. 8, 1896, 1916, and 1926*

Year	Average man-hour production			Man-hour labor cost		
	Number of ems	Per cent of increase, compared with—		Amount	Per cent of increase, compared with—	
		1896	1916		1896	1916
1896	3,584.2			$0.667		
1916	3,330.5	[2] 7.1		.698	4.8	
1926	3,684.8	2.8	10.6	1.440	115.9	106.1

[1] Included linotype operators in 1896, linotype and intertype operators in 1916, and linotype, intertype, and monotype keyboard operators in 1926.
[2] Decrease.

The man-hour output for news operators in 1916 was 7.1 per cent smaller than in 1896, due mostly to the necessity of having a large force on hand to be ready for emergencies and to handle late, important news promptly, permitting the forms to be held open later than would otherwise be possible. By 1926 improved machines had been installed, and the man-hour production had passed the 1896 output and was 10.6 per cent over the 1916 amount.

The man-hour labor cost for 1916 shown in this table varies slightly from that in Table 41, as that table included ad operators, whose

hourly earnings were somewhat higher. The labor cost per man-hour for news operators increased only 4.8 per cent between 1896 and 1916, but advanced 106 per cent during the following 10 years, making a total increase between 1896 and 1926 of 116 per cent.

AVERAGE PRODUCTION ON LINE-CASTING MACHINES IN COMPOSING ROOM NO. 8, IN 1926

Quite a difference existed in 1926 in the man-hour output for the total time worked, or the hours for which the operators were paid, and the actual man-hour production registered on the machines by clocks, based on the operating, or productive, time for the operators. Figures were obtained of individual average production during a 5-week period in 1926, from special weekly records of machine production, and weekly averages for the different groups of news operators based on these records are presented in Table 44:

TABLE 44.—*Average man-hour production for news operators on line-casting machines in newspaper composing room No. 8 during five weeks in 1926*

Period	Average production per man-hour		
	Day force	Night force	
		Regulars	Substitutes
	Ems	*Ems*	*Ems*
First week	4,850	4,852	4,792
Second week	5,012	4,905	4,706
Third week	4,998	4,877	4,878
Fourth week	4,713	5,077	4,944
Fifth week	5,054	4,874	4,963
Total 5 weeks	4,925	4,917	4,856

The comparison is between day workers and night workers, the latter being composed of "regulars," who held steady positions, and "substitutes," who worked when the regular hands laid off or as extra help when more hands were needed. No attempt has been made to compute the total average for each week nor a grand average for the entire period, as all figures for the different groups could not be weighted, and consequently the result would not be accurate. Each operator set his own corrections, which were not included in the averages, so the figures shown represent the corrected composition only. On one Saturday night during the period 25 out of 61 operators averaged over 5,000 ems per hour, 30 averaged over 4,500 ems, and the others less than 4,500 but more than 4,000 ems per hour. The highest average production of straight news matter for an individual operator during one week was 6,956 ems per hour.

COMPOSING ROOM NO. 13

Table 45 contains data for setting 61,449,945 ems of 5½, 6, 7, and 8 point type, partly on linotypes, intertypes, and monotypes and partly by hand (including proof reading and make-up), on a newspaper in 1926.

TABLE 45.—*Man-hour production and labor cost in machine setting on linotypes, intertypes, and monotypes of 5½, 6, 7, and 8 point type, and hand setting of larger type reduced to 6-point basis, in newspaper composing room No. 13, 1926*

Occupation	Man-hours worked in producing 61,449,945 ems	Average production per man-hour	Labor cost per man-hour	Cost of man-hour production	
				Time cost	Labor cost
		Ems		*Minutes*	
Linotype operators	15,844.7		$1.438	23.5	$0.562
Monotype keyboard operators	1,089.0		1.377	1.6	.037
Hand compositors	9,129.2		1.417	13.5	.319
Total, productive labor	26,062.8	2,357.7	1.428	38.6	.919
Linotype machinists	1,107.5		1.483	1.6	.041
Linotype machinists' helpers	210.0		.444	.3	.002
Monotype machinists	210.5		1.446	.3	.008
Monotype machinists' helpers	699.5		.604	1.0	.010
Proof readers	4,953.5		1.437	7.3	.176
Make-ups	2,106.3		1.520	3.1	.079
Laborers	3,190.0		.503	4.7	.040
Supervisory employees	1,978.3		1.590	2.9	.078
Total, nonproductive labor	14,455.7		1.213	21.4	.433
All employees	40,518.5	1,516.6	1.351	60.0	1.351

This publication differed from the preceding ones in that, while it also was published mornings, including Sundays, the work was performed in an establishment where an evening newspaper was also prepared. For that reason practically all composing-room work connected with it was done during the regular night-shift hours, only an insignificant number of men being employed for it during the day. The regular working shift consisted of seven and one-half hours net.

The body of the publication was 7-point type set on 8-point slugs, while 5½-point type was used for the classified advertising and, together with 6-point type, scattered through the text. Eight-point type was also used. Market quotations and most of the advertising were produced on monotypes. Some of the larger type used for headings or display advertising was set on display styles of line-casting machines, but type larger than the capacity of these was produced by hand compositors on Ludlow typographs. All of the casting machines were equipped with electrically heated metal pots. All of the line-casting machines and part of the monotype casting machines were provided with automatic metal feeders. Nineteen per cent of the line-casting machines were equipped with Mohr lino-saws, eliminating considerable slug trimming by hand compositors on the individual power trimmers. Type production was measured in the same way as that heretofore described for other newspapers. Each operator secured his copy from the desk of the copy cutter, dumped his completed takes at the bank, and set his own corrections.

The group classed as linotype operators worked on both linotypes and intertypes. Hours and earnings were secured separately for this group, for monotype keyboard operators, and for hand compositors, but the production could not be divided correctly for the three groups, making it necessary to consider it as a whole for the combined productive labor. Each linotype machinist, with the assistance of helpers, tended 12 or more machines. One monotype machinist, assisted by 4 helpers, tended 6 keyboards and 11 casters. Hours and earnings were obtained separately for these helpers, who

in computations for previous composing rooms were included among laborers. The group classed as proof readers performed the ordinary functions of that vocation. While there were ordinarily five separate editions published daily, there were proportionally fewer actual changes of pages than on the other morning papers covered. The number of pages carried in the final daily editions was 55.6 per cent of the total number of pages made up during the period, leaving only 44.4 per cent additional make-ups. The group classed as laborers included one of the two men, working day shifts, tending the metal remelting furnace and casting ingots for the casting machines. These were producing the ingots for both morning and evening publications, and their time and earnings have been apportioned on an even basis, though more metal was consumed during the night shifts than during the day shifts, as one man would be required for each publication if they were conducted separately. Provers, using automatic and hand-power proof presses, were also included. The supervisory group contained comparatively fewer hours than would have been necessary for a single publication, as some of the members also supervised the work on the evening paper, which was prepared in the same composing room. Both working hours and earnings for these individuals have been apportioned between the two publications on the basis of total man-hours for each.

The total man-hours for nonproductive labor was considerably less than for productive labor—only 35.7 per cent as against 64.3 per cent of the man-hours for all employees. Only 3.78 per cent of the total man-hours for the period were overtime. A slight difference in labor costs per man-hour was again shown, due in this case to small variations within each group of the rates for regular hours, coupled with some overtime.

COMPOSING ROOM NO. 14

Table 46 contains data for setting 45,365,075 ems of 5½, 6, 7, and 8 point type, partly on linotypes, intertypes, and monotypes, and partly by hand (including proof reading and make-up), on a newspaper in 1926.

TABLE 46.—*Man-hour production and labor cost in machine setting of 5½, 6, 7, and 8 point type, and hand setting of larger type reduced to 6-point basis, in newspaper composing room No. 14, 1926*

Occupation	Man-hours worked in producing 45,365,075 ems	Average production per man-hour	Labor cost per man-hour	Cost of man-hour production	
				Time cost	Labor cost
		Ems		*Minutes*	
Linotype operators	13,698.6		$1.407	20.9	$0.490
Monotype keyboard operators	1,777.8		1.413	2.7	.064
Hand compositors	8,908.4		1.471	13.6	.333
Total productive labor	24,384.8	1,860.4	1.431	37.2	.887
Linotype machinists	1,210.5		1.434	1.8	.044
Linotype machinists' helpers	864.0		.495	1.3	.011
Monotype machinists	348.0		1.443	.5	.013
Monotype machinists' helpers	1,474.5		.511	2.3	.021
Proof readers	3,340.3		1.482	5.1	.126
Make-ups	2,234.6		1.494	3.4	.085
Laborers	3,167.2		.535	4.8	.043
Supervisory employees	2,306.2		1.534	3.5	.090
Total, nonproductive labor	14,945.3		1.394	22.8	.433
All employees	39,330.0	1,153.5	1.320	60.0	1.320

While the composing room covered in this table was the same as that in the preceding survey, and the identical equipment was employed, it has been designated in this instance as composing room No. 14, because the product was for an evening paper, published six days a week, and the work was performed by different individuals, partly in the regular 7½-hour day shifts and partly in 7-hour night shifts. As only six issues were prepared weekly, there being no Sunday issue, which ordinarily contains a proportionately larger number of pages, the amount of type required for a given period was far less.

The grouping of the workers and the shop conditions were practically the same as those described for composing room No. 13, but the number of daily editions was nine instead of five, involving more changes of pages. The number of pages in the final editions for the period was only 30.9 per cent of the total number of pages made up. The production per man-hour was considerably lower than that shown for the morning issue in Table 45, both for productive labor alone and for all employees, partly on account of the many changes of pages involved. The total amount of type produced during the period for the morning paper was 35.5 per cent more than that for the evening paper, and with equal conditions the man-hours should presumably show similar relativity. Comparison of the total man-hours in the two tables, however, reveals that those for the productive labor on the morning paper exceeded those on the evening paper by 6.9 per cent, and that the total number of man-hours for all employees was only 3 per cent more on the morning paper than on the evening paper. The man-hours for linotype operators, hand compositors, proof readers, and laborers were from 0.7 to 48.3 per cent more for the morning paper than for the evening paper, but the opposite condition existed for the other groups, with a decrease ranging from 5.7 to 75.7 per cent, and for the total nonproductive labor, for which the decrease came to 3.3 per cent. Contributory causes, aside from the numerous changes in pages, can not be published without disclosing the identity of the establishment.

On the evening paper the proportion that the man-hours for productive labor and for nonproductive labor formed of the total man-hours for all employees did not vary greatly from that on the morning paper, being 62 per cent for productive labor and 38 per cent for nonproductive labor. Only 1.5 per cent of the total man-hours were overtime, 62.8 per cent were regular day-shift hours, and 35.7 per cent were regular night-shift hours. The labor costs were, like previous ones, subject to small fluctuations in the rates for similar occupations.

COMPOSING ROOM NO. 10 IN 1926

Table 47 contains data for setting 20,024,600 ems of 5, 5½, 6, 7, and 8 point type by news operators on linotypes on a newspaper in 1926. The composing room was the same as that in Table 36.

TABLE 47.—*Man-hour production and labor cost in machine setting of 5, 5½, 6, 7, and 8 point type by news operators in newspaper composing room No. 10, 1926*

Item	Amount
Total man-hours worked in producing 20,024,600 ems	3,713.2
Average production per man-hour (ems)	5,392.9
Labor cost per man-hour	$1.071

The newspaper was published mornings, Sundays included, making the work of practically all the news operators fall inside of the regular night shifts, which consisted of 7 hours and 40 minutes each, actual working time. No account was kept of idle time on the machines, so it was necessary to make computations on full time for all operators.

As the information permitted further analysis, Table 48 is presented giving additional details for the operators:

TABLE 48.—*Average production and labor cost per man-hour for news operators on linotypes in newspaper composing room No. 10 during two weeks in 1926*

Period	Total man-hours	Number of ems produced					Labor cost	
		5-point [1]	7-point	8-point [2]	Total, all sizes	Average per man-hour	Total	Average per man-hour
First week	1,878.7	4,667,600	4,557,900	688,500	9,914,000	5,227.1	$1,960.47	$1.044
Second week	1,834.5	5,079,400	4,553,600	477,600	10,110,600	5,511.4	2,017.16	1.100
Total	3,713.2	9,747,000	9,111,500	1,166,100	20,024,600	5,392.9	3,977.63	1.071

[1] Includes 5½ and 6 point. [2] Includes 10-point.

The overtime hours aggregated 7.4 per cent of the total man-hours, and the regular day shift hours 3.1 per cent, the remaining 89.5 per cent being for the regular night-shift hours. Record was kept of the different sizes set by each operator, because the rates of pay per thousand ems varied according to size of type—from 17 cents for 5-point (including 5½ and 6 point), to 22 cents for 8-point and 24 cents for 10-point, the latter being included under 8-point in the table. These rates were for straight news matter alone, and in measuring production the line-age was increased to cover extra rates, such as figures, tabulated matter, mixed faces, etc., so that all production listed was on the basis of straight news composition. For example, the operators who set stock quotations were allowed double the number of actual ems contained therein. Additional pay was given to operators who worked more than 48 hours per week (including the time allowance of 20 minutes for lunch each shift), to compensate them for idle time during working hours. The hourly rates for such time adjustment varied according to individual production. A special assistant was employed to measure the strings for the night operators. He pasted the galley proofs together, measured each size of type, and marked the measure, with earnings for same, on the strings. Proportionate deductions were made from the earnings of the operators for the pay of this assistant. The time adjustments have been added to the computed earnings for output of the operators and deductions made for the compensation of the assistant, so that the figures listed under labor cost represent actual net earnings of the operators for the specified amounts of production.

Each operator obtained his copy from the desk of the copy cutter, carried his product to the bank, set and made his own corrections, and inserted all title lines in his "takes" regardless of whether the titles were set on his own machine or that of another operator. He also trimmed the slugs when required, so that the material was completed and ready for insertion in the form without further labor. The body

of the news text was 7-point type. Stock quotations were set in 5½-point type on 6-point slugs. Editorials were set in 8-point type on 9-point slugs for the daily issues and on 10-point slugs for the Sunday issues. Five-point type was set on 5½-point slugs. The machines were of comparatively modern styles, with multiple magazines, and were equipped with electrically heated metal pots and automatic metal feeders. They were operated at a slightly higher speed than customary in composing room No. 14, with an average of 6.5 to 7 lines and a maximum of 7.5 lines per minute.

The individual records for the 52 operators showed considerable difference in man-hour production during the period. One of them attained an average of 13,189 ems on straight news matter, and 3 others were credited with over 11,500 ems per hour each, but the latter set stock quotations which, as previously mentioned, were allowed double the actual line-age. Two averaged more than 8,000 ems per man-hour, 1 more than 7,000 ems, 5 more than 6,000 ems, 11 more than 5,000 ems, 10 more than 4,500 ems, and 6 more than 4,000 ems each. Six operators averaged between 3,000 and 4,000 ems each, and 4 others between 2,000 and 3,000 ems each. The last 3, who were learners, fell below the 2,000-em mark.

Comparison of the figures in Table 46 with the figures presented in Table 36 shows an increase of 19 per cent in man-hour production from 1895 to 1926. The 1895 survey took place about one year after the publication had moved into a new building, which was considered a model for that period. The equipment was presumably new, though accurate data are lacking, but in any event would consist of the earlier styles. The survey in 1926 was made about one year after the plant had again moved into a new, up-to-date building and installed modern, improved equipment. Information as to shop conditions during the earlier survey is not available, but they were presumably about the same as during the later period. The increase in production may be partly due to individual ability of the operators, but is undoubtedly also due to the improved housing facilities and equipment. The labor cost per man-hour for linotype operators advanced 68.8 per cent during the same time, attributable to the general increase in wages for the country and especially for that particular locality.

AVERAGE MAN-HOUR PRODUCTION AND LABOR COST BY HAND AND BY MACHINE METHODS IN 1916 AND 1926

The man-hour production and labor cost for all of the establishments included in the 1926 survey are presented in Table 49 in a similar manner as those for the earlier survey are presented in Table 37. As a period in 1916 for one establishment was included, the results for this are also presented. The individual tables for the various establishments should be studied in connection with the table, as the conditions were not similar in any two establishments and even the grouping might vary sufficiently to prevent accurate comparison. Averages for both production and labor costs have been computed from the total man-hours, total production, and total labor costs for all establishments where the data permitted segregation of the figures.

TABLE 49.—*Man-hour production and labor cost for one newspaper composing room in 1916 and six newspaper composing rooms in 1926*

Establishment, and method of production	Man-hour production for—		Man-hour labor cost for—	
	Productive labor	All employees	Productive labor	All employees
1916				
No. 8:	*Ems*	*Ems*		
Hand			$0.774	
Machine	[1] 3,330.5		.707	
			.766	
Hand and machine combined	2,597.9	1,158.8	.737	$0.620
1926				
No. 11: Hand	258.8	217.2	.270	.323
No. 12:				
Hand	500.5		1.255	
Machine	3,813.2		1.448	
Hand and machine combined	2,255.5	1,643.1	1.358	1.364
No. 8:				
Hand			1.433	
Machine	[1] 3,684.8		1.440	
Hand and machine combined	3,269.9	1,630.9	1.437	1.258
No. 13:				
Hand			1.417	
Machine			1.438	
			1.377	
Hand and machine combined	2,357.8	1,516.6	1.428	1.351
No. 14:				
Hand			1.471	
Machine			1.407	
			1.413	
Hand and machine combined	1,860.4	1,153.5	1.431	1.320
No. 10: Machine	[1] 5,392.9		1.071	
Average, all establishments in 1926:				
Hand	461.3		1.480	
Machine	3,961.9		1.404	
Hand and machine combined	2,623.9	1,566.1	1.398	1.294

[1] News composition only.

The weighted averages for the productive labor in 1926 show an output of 461.3 ems per man-hour by the hand compositors, but 3,961.9 ems per man-hour by the machine operators, nearly 760 per cent more. The average man-hour production for all employees was 1,566.1 ems, or a little over 35 per cent more than the 1916 production.

The average man-hour labor cost for the hand compositors exceeded that for the machine operators in 1926 mostly on account of relatively more overtime work. The average labor cost per man-hour for all employees was $1.294, or more than twice the amount for 1916.

CHAPTER 7.—DEVELOPMENT OF STEREOTYPING

CASTING of metal plates in molds made from pages of type, or stereotyping, was invented in England in 1727, but was afterwards abandoned until the beginning of the nineteenth century, when it was revived there. About 1812 it was introduced into the United States, where it was gradually adopted for bookwork. It did not prove practical for newspaper use until after the invention in France in 1829 of the papier-mâché mold, which provided a flexible mold that permitted casting of curved printing plates. The new method was introduced in this country in 1850, and the first curved plate for newspaper use was produced in 1854. After further experiments papier-mâché molding was adopted in 1861 by several large newspapers, revolutionizing their mechanical production. The solid, semicylindrical plates cast in the flexible molds, when clamped on the presses instead of type forms, permitted printing at higher speed, and the production of several casts from a single mold made possible the operation of several presses simultaneosly on the same publication.

The use of stereotype plates grew rapidly, resulting in the addition of stereotyping departments to the newspaper plants. For the limited number of pages per issue published at the time only a few hands were required for the work, but as the size of the publication grew, there developed two distinct divisions of such workers on the larger newspapers—the molding division, which prepared the flong and molded the matrices, and the foundry division, which cast the plates. Flong preparation was later dispensed with in a number of modern establishments, but as it is still carried on in many stereotyping rooms its development is here described, as well as the development of matrix molding and of plate casting.

FLONG PREPARATION

WET FLONG

FOR many years each stereotyping department prepared its own matrix material, ordinarily called flong. It was necessary first to manufacture the special paste required, principally from starch, flour, and dextrin, but with varying proportions and additions according to the individual secret formula of each head stereotyper, who ordinarily mixed and cooked it himself. A sheet of heavy, unsized paper, similar to blotting paper, about 20 by 24 inches in size, was covered with a thin layer of the paste. A sheet of rice tissue paper was placed over it and smoothed down with a roller, this operation being repeated with two or three more sheets of tissue paper. Sometimes one or two sheets of thin blotting paper were added before the tissue paper was applied. Ordinarily two men worked together in preparing the flong. A sufficient quantity was made for the next day's requirements at least, and it was left to season in a moist place. It could not be prepared too far in advance, because of a tendency to sour and spoil. About five hours were required to make 100 flong, though this time was not always taken into consideration, as the work was ordinarily performed during waiting hours before the daily rush period commenced. Tissue-holding stands were later devised, which allowed one man to perform the operation with the ready cut sheets.

AUTOMATIC MACHINES

About 1910 an automatic flong-making machine was invented, which carried each kind of paper in roll form, distributed paste on the papers as they were drawn through the machine, pressed them together between rollers, and cut the flong to proper lengths. Several makes of flong machines, such as the Autoflong, the Handley, and the Norton, were placed on the market and installed in many of the larger newspaper plants, resulting in considerable time saving. These machines were seemingly of about equal capacity, as all of them were advertised as being capable of producing about 2,000 flong per day. One newspaper, which had used one of them for three years, declared that previous thereto it had required three men working eight hours per day to manufacture the flong for the plant, but with the aid of the machine only two hours work per day was required to get the paste ready and to make 400 flong. A more elaborate invention, the Rivett flong machine, was designed by J. G. Rivett, of Chicago, about 1915. It consisted of a combination of units, one for each sheet assembled in the flong, fed from a similar number of rolls. Flongs in any desired width or length and composed of any number of sheets were produced automatically at the rate of between 300 and 400 an hour. This machine was especially adapted to auxiliary newspaper or syndicate service, as well as to the commercial manufacture of flong.

DRY FLONG

A so-called dry flong, which could be molded without heating the type form, was invented in 1893 in England by George Eastwood, of Kingston, who had introduced some of its features in a previous patent in 1887. It consisted of a single sheet of thick, soft paper, coated with a special composition, which by a slight moistening would be rendered sufficiently plastic to receive an impression. The following year, 1894, a similar article was patented in Germany by Herman Schimansky, of Berlin. While the English invention seems to have remained dormant, the German flong was improved upon and adopted by some of the newspapers of that country. Manufacture of dry flong was started in several of the paper mills, and for many years Germany was the sole source of supply for this commodity.

Samples of various kinds of dry flong were tested during 1899 in several foundries in the United States—among others the New York Tribune—but they were not found satisfactory. Friedrich Schreiner, manufacturer, of Plainfield, N. J., introduced his cold method flong in 1900. It consisted of two pieces, a coated face sheet and a gummed back sheet, necessitating pasting together and giving a second impression. In 1901 a German dry mat, which had been used successfully in England, was imported into the United States by F. Wesel Manufacturing Co., of New York, and a few years later several other firms began to import other varieties. In 1910 Alfred Birdsall, a stereotyper of Pittsburgh, Pa., invented another coating for dry flong and started the Dry Mat Service Co. (Ltd.), in Pittsburgh, which claimed to supply a number of the smaller newspapers that wanted to avoid using heated matrix-drying tables. This product was soon displaced by the imported German flongs, but even these were not generally adopted. Many of the larger newspapers used them in a limited way—for stereotyping the last forms on the several editions—on account of the saving in time for molding.

The World War stopped importation from Germany, and manufacturing was taken up in this country, resulting in the introduction of the Wood dry mat in 1916 by Benjamin Wood, of New York. Other American manufacturers experimented, resulting in several flongs being produced, notable among which were Certified dry mats, introduced in 1924 by George A. Kubler, of Akron, Ohio. Until a couple of years ago, the wet-flong method prevailed in the larger newspaper stereotyping rooms of the United States, but since then the use of dry flong has made rapid strides. Dry flong is not, as the name implies, used absolutely dry. It is a specially prepared thick and plastic single sheet, which requires a certain amount of moisture, necessitating proper conditioning in a humidifier and subsequent seasoning, for good results. The dry-flong method did away with the preparation of paste and the assembling of the wet flong, a considerable item as to man-hours on a large newspaper, especially if it is not provided with a flong-making machine.

MATRIX MOLDING

BRUSH METHOD

THE early method of molding stereotype matrices was essentially manual. When a form was received from the composing room it was transferred to an elevating table. A wet flong was placed, face down, upon the type and beaten in with a flat brush, about 3½ inches wide and nearly 1 foot long, provided with a handle of similar length. After the flong had been driven down around the type, the depressions were filled with backing powder, usually a mixture of flour and lime, to prevent the mat from giving way under the pressure of the metal in casting and causing smudges in the subsequent printing. A thin sheet of paper was placed on top. The beating table was rolled up to a steam-heated iron table, and the form pushed off on this. It was covered with several layers of dry, soft blanketing, and placed under an iron plate or platen, which was screwed down upon it. The heat from the table, applied to the form, drove the moisture from the matrix into the blankets in from four to seven minutes. The platen was raised and the matrix lifted. It was taken to the casting division, while the form was transferred to a form truck and returned to the composing room. Two men usually worked together in molding a matrix.

Heavier flong was later brought into use, and the backing powder eliminated. It was necessary, however, to back up these matrices in some of the larger open spaces with strips of thick felt paper, for similar effect. This provided an additional operation connected with molding, known as packing, and also necessitated preparation of the strips by coating one side of the felt paper with dextrin paste, afterwards cutting the sheets into strips. The preparation was usually done in so-called idle time during the shift. Mechanically operated beating brushes, such as a machine patented in 1889 by C. S. Partridge, of Chicago, were installed on some of the larger newspapers, but all brush molding was eventually abandoned for the speedier mangle method.

ROLLING-MACHINE METHOD

A matrix-rolling machine was invented in 1861 by James Dellagana, a Swiss printer who had established a sterotype foundry in London, England, and introduced the papier-mâché method in that country.

The molding was performed by a heavy iron cylinder. The early machines were provided with impression cylinders at a fixed distance above the bed, but about 1890 improved machines were introduced, which were arranged with adjustable impression cylinders. The form was transferred from the form truck to the table of the rolling machine. A moist flong was laid upon it and covered with a heavy felt blanket. Pulling a lever caused the table to move automatically under a heavy iron cylinder, which turned in unison with the bed movement and squeezed the flong down over the type, molding the impression. The table returned automatically to its former position, giving the matrix a second squeeze. The travel of the table, or bed, in one direction under the roller consumed approximately five to seven and one-half seconds. The form, with the matrix still clinging to it, was transferred to the heated drying table, where it was covered with drying blankets and dried in the manner previously described. Machine molding rapidly supplanted brush molding in newspaper plants of any size, as it reduced the time for molding a form. While with each machine two men were required to handle the work efficiently, just as with each unit in brush molding, these men could produce more matrices in a given time, an important consideration with the constant increase in the number of pages per issue.

Other manufacturers of stereotype machinery also introduced matrix-rolling machines, resulting in varying styles, though all are constructed on the mangle principle and differ only in details. During the survey machines were found made by the Duplex Printing Press Co., the Goss Printing Press Co., R. Hoe & Co., Walter Scott & Co., F. Wesel Manufacturing Co., and Wood Newspaper Machinery Corporation. Adoption of the dry-flong method necessitated slower speed for matrix rolling to obtain the proper result. The dry flong could be rolled one way only, as a reverse rolling caused a double impression; and the ideal speed was found to be with a bed travel of 20 to 22½ seconds. This condition was responsible for the construction of two-speed rolling machines, adapted for both wet and dry flong, as well as machines with slow bed travel for dry flong alone.

DIRECT-PRESSURE METHOD

In 1926 another method—direct pressure molding—was introduced in the United States. In this method the impression is obtained by means of a flat, horizontal platen instead of a cylinder.

Two styles of machines were found in operation during the survey, the American Birotadruck hydraulic press and the Hoe direct-pressure hydraulic matrix molding press. The former machine, which was first installed on the New York Tribune, was based on German patent rights for this country on a machine originally invented to produce better molding of half tones with dry flong. Direct pressure had been used for a number of years in Europe, especially in Germany, where it was obtained first by the use of toggle presses, but since 1911 by employment of hydraulic presses. The machine had been redesigned to meet the American requirements of higher speed and more pressure.

One of the machines observed in operation was provided with two stanchions, one at each side, a table with a molding area 24 by 30 inches and projecting aprons at the front and the back, and a platen, directly above the molding part of the table, at the bottom of the head. The form was transferred from the form truck to the front

apron, covered with a flong and a molding blanket, and pushed onto the molding area. Pressure on a push button started a motor, which was located at the top of the press and directly connected with a hydraulic pump mounted on the side of the frame and using oil as a medium. Raising of the ram forced the table with the form against the platen until the desired pressure was reached, when it stopped automatically, holding the pressure or releasing it as manipulated. The machine was adjusted to a maximum pressure of 5,000 pounds, which was attained in 13 seconds. Solid forms, such as those containing classified advertisements, required about 15 seconds contact pressure, while open forms, those with approximately 40 per cent of white space, were released as soon as the maximum pressure was reached. Another form was placed on the front apron, and as it slid into place for molding it pushed the molded form out on the back apron for removal to a form truck. Two men were employed on the unit during the time, one operating the machine, while the other brought the forms to the machine, took them away, and assisted generally. With a constant supply of forms, the average time consumed in molding was about 30 seconds per matrix. The general description of this machine and its manipulation also practically covers the Hoe hydraulic matrix molding press, which was first installed on the World, in New York, and was adapted from the hydraulic wax or lead molding presses used in electrotyping manufactured by the firm for over 65 years. It differed in some of the details, especially in having four stanchions, one at each corner, in location of the motor and the pump on the base under the aprons, and in construction of the pump. Successful demonstrations of the direct-pressure method has prompted other manufacturers to experiment and will, no doubt, bring out other different makes.

DRYING TABLES

The real time saving through the dry-flong method occurred, however, not in the actual molding of the matrix, but through the elimination of the slow-drying process, necessary for wet flong, on the matrix-drying table or press. The original drying table, commonly called a "steam table," used in 1861 was a comparatively crude appliance, capable of drying only one matrix at a time. Improvements were continually being brought out. Several units were combined, so that eventually it was not unusual on large newspapers to find six platens placed side by side over one unbroken table surface. In the beginning only steam was used for heating the table, and it was ordinarily produced by a large boiler, using coal or gas fuel. Independent gas-heated generators, single unit or double unit or larger, were gradually applied in the majority of the plants. In several places electrical heating, based on the electric matrix drier invented by W. S. Hadaway, of New York, in 1905, was substituted for steam. The platens on the early drying tables were screwed down over the forms by means of a handwheel and tightened with the aid of a bar. Pneumatic operation was applied to lower and raise the platen, thus reducing the manual labor. A motor drive was also devised for that purpose, and compression springs utilized with it to increase the pressure. Operation of drying tables made it necessary for the stereotypers to wash the drying blankets at intervals, so as to preserve their elasticity, and some of the larger newspapers installed special equipment for such work.

DRYING OVENS

A matrix roaster, or scorcher, was invented in England in 1885, which permitted removal of the matrix from the form as soon as the impression had been set, but before being entirely dry, and the placing of it in the scorcher for final baking by dry heat. Since less time was consumed, that procedure was gradually adopted for the last form, called the "starter," or during rush periods. In the dry-flong method the matrix was separated from the form as soon as the impression had been given, whether by roller or by direct pressure. It was backed in like manner to that of the wet matrix. The dry flong contained a certain amount of moisture to render it plastic for molding; but this would create steam during casting and cause imperfect printing plates, therefore, the matrix was placed in the scorcher until thoroughly dry, usually for 30 to 60 seconds, after which it was ready for the casting. No steam table was required, and elimination of this not only reduced the time necessary for producing a finished matrix, commonly called a "mat," but also created better working conditions in the molding operation by doing away with the excessive heat radiating from the table. It also permitted immediate handling in the composing room of the forms returned there after molding, instead of waiting for them to cool. The importance of the scorcher had grown continually, but with the use of the dry flong it became a necessity. Different styles were brought out, mostly consisting of small gas-heated ovens provided with a curved metal shelf on which the matrix was rested, face down, during scorching.

The casting operations were not affected by the introduction of dry flong, but it was found that the amount of shrinkage during drying could be controlled and kept uniform with dry flong by proper humidity, a condition which had not been possible with wet flong. The normal shrinkage for dry flong proved to be about one-fourth inch in width for an ordinary 8-column page and about two lines of 5½-point type in length. While this did not make any difference in stereotyping, it affected the pressroom work somewhat, as it permitted the use of narrower paper.

TRANSMISSION OF MATRICES

In most of the larger newspapers molding was performed close to, or in a section of, the composing room, to facilitate transportation of forms, while the foundry section, where the casting was done, was placed close to the pressroom, to permit speedy delivery of plates. As the composing room was often located on the top floor of a tall building, while the pressroom was situated at or near the bottom of the structure, considerable distance existed in such cases between the two sections. This was overcome by the installation of chutes or air lifts for delivering the matrices from the molding section to the casting section, and both packing and scorching operations were usually performed in or adjoining the casting section.

CASTING OF PLATES

WHEN the flexible paper matrix was introduced in France, a crude flat casting box was formed by pasting a cardboard frame on the molded and dried matrix, and placing this between two iron

plates. Through a large opening the molten metal was poured with a ladle on to the face of the matrix. This appliance was developed into regular casting boxes, with the plates hinged together at one side or end, and separated on three sides by steel strips, called gauges, which regulated the thickness of the cast. After the matrix had been inserted and its edges covered with the gauges, the box was clamped together and molten metal poured through the open end with a ladle.

Until about 1855 all plates were cast about one-sixth of an inch in thickness. At that time James Dellagana, of London, England, obtained a patent for casting plates type-high. This had, however, been accomplished shortly before by Charles Craske, in New York, while experimenting with curved plates for rotary presses. Semicylindrical boxes were devised for the curved plates, with a concave lower plate and a convex grooved cover, supported in an iron frame near the center of greatest weight. Considerable physical exertion was required to operate these boxes, as the appliances were heavy and a finished plate of ordinary size contained nearly 50 pounds of metal, though improvements were continually reducing the manual work.

HAND CASTING

In the earlier styles of casting boxes, some of which are still in use, the matrix was placed, face up, on the lower plate while this was in a horizontal position. Detachable side gauges were inserted to hold the matrix in place, and an end gauge with a beveled recess was adjusted at the bottom. The cover, which was hinged at the end, was pulled down and clamped to the lower plate, after which the box was tipped to a perpendicular position. A counterbalance weight on a chain, attached to the cover and operating in a grooved wheel at the top of the frame, assisted the workers in raising the cover or swinging the box. The molding space was considerably longer than the plate, to provide room for impurities and air bubbles which rose to the top as the metal was poured. With a double-handled ladle, capable of holding from 65 to 120 pounds according to size, the metal was dipped from a furnace close by and poured quickly into the open top of the box. The cover was provided with a water-cooling arrangement—a substitute for the earlier method of pouring water by hand into fixed recesses of the top. After the plate had cooled sufficiently, the mold was swung back into a horizontal position and opened. The cast was turned face up and the matrix was removed, to be again placed in the casting box for another plate.

Two men were required to insert the matrix, put the mold together, pour the metal, take the mold apart, and remove the cast, but as speed was essential two casting boxes were often installed in places where a large number of plates were required, so that one plate could be poured while the other solidified. Boxes were also constructed with the two halves opening sideways. In a later style of casting box the cover was stationary in the upright position, while the bottom plate was supported on rollers, permitting it to be moved from the top plate and tipped to a horizontal position for insertion of the matrix or removal of the plate, and back again, for locking the box, with comparatively slight effort. Side gauges were placed on hinges.

METAL FURNACES

Stereotype metal consisted in the beginning mostly of lead, but, like type metal, contained various alloys. Iron, steel, brass, copper, tin, and antimony had been used from time to time. By 1870 the commonly accepted alloys were tin and antimony, in varying proportions according to the hardness desired. The early stereotypers mixed their own metal and kept it in proper working condition. The plates returned from the pressroom were remelted for use in casting new plates, and the consistency of the metal was changed through the constant remelting. Establishment of metal supply houses gradually relieved the stereotypers from metal mixing, and also from much of the refining. The metal was melted in large furnaces, with pots ordinarily having a capacity of 700 to 14,000 pounds of metal. Pouring molten metal with a ladle into the casting box was practically supplanted by the use of force-pump equipment for the metal furnaces, requiring only a downward pull on a lever to send a sufficient quantity of metal through a spout ending just above the opening in the casting box. Pump furnaces were manufactured with either 1, 2, or 3 pumps, and provided with a casting box for each pump. At first furnaces were heated by coal, which required a certain amount of attention to maintain the correct temperature. This was reduced later by the substitution of gas, commonly used at present, or oil. Electric heating has recently been adopted in a few places, and is claimed to assure easy temperature control of the metal. The minimum of two men required for the casting operation was not reduced by these improvements, but they could produce more plates in a given time than formerly, and with less manual effort.

FINISHING MACHINES

The cast, as turned out in the casting boxes, contained considerable surplus metal, especially the part above the height of the matrix, commonly called the "tail," where the extra amount was poured in. After the matrix had been stripped from the cast, the latter was laid on the cylinder of a trimming machine, usually called a "tail cutter." The cast was secured by one or two broad straps to the cylinder. This was revolved slowly by means of a crank, passing the cast against a rotating cutter, which severed the tail and left the curved edge of the plate beveled, to insure satisfactory clamping surface on the press. The plate was turned by hand, and its other end was trimmed in similar manner. Power was later applied to the machine, automatic clamping provided, and a second cutter added so that both ends of the plate could be trimmed at the same time—all reducing both exertion and the time involved.

After trimming, the plate was taken to another machine, commonly termed a "shaver," where it was slipped, face down, into a semicircular trough, and the inner surface was planed down by a rotating straight-edged knife to insure proper thickness, or height, of the plate. As the top part, or core, of the casting box was provided with narrow grooves about 1 inch apart, the inner surface of the plate was provided with ribs, reducing the surface to be shaved. Old-style shaving machines were, like tail cutters, operated by cranks, requiring the efforts of two men. With the application of power drives one man was dispensed with. Combination shaving and trimming machines also were devised. After shaving, the plate was laid face up on a

finishing cylinder, where two men removed all superfluous metal from the edges and deepened recesses where necessary, to prevent them from smudging the sheet in printing. Hand planes and chisels were used. The plate was next carried to a water trough and cooled, and then delivered to the pressroom.

AUTOMATIC CASTING AND FINISHING

A complete change in stereotype casting was created by the invention of the Autoplate machine by Henry A. Wise Wood, of New York. This machine, which was first installed on the New York Herald in 1900, required only the placing of the matrix and the moving of a lever, which started the automatic operation and produced finished plates, ready for the press, at the rate of four per minute. Change of matrices could be effected with the loss of only one cast. The casting mechanism consisted of a horizontal, water-cooled cylinder, around the lower half of which the plate was cast, and which turned halfway intermittently, and a concave back below, with a corresponding up and down movement, provided with a sliding matrix clamp. The upward rise of the back, with the matrix, formed the mold, into which the metal was forced by a pump in an attached furnace. After the cast had cooled for 10 seconds, the dropping of the back stripped the matrix from the plate, which was brought to the top by the revolving core and pushed to the finishing mechanism while the back closed against the other bottom half of the cylinder for another cast. The plate passed between two saws, which trimmed the straight edges close to the type, into a shaving chamber, where it was shaved and the beveled edges smoothed, then over a wetting appliance for cooling, and was ejected.

Several of the larger newspapers installed the machine. In 1908, according to a lecture delivered in that year by the inventor, the New York Herald had three of the machines, the World four, the New York Times two, the Chicago Daily News four, and the Chicago Tribune three, while others were in use on the Boston Post, the Boston Globe, the Brooklyn Daily Eagle, the Kansas City Star, and on other papers in America and in Europe. The World, of New York, after the first Autoplate machine had been installed, stated that the equipment for 10 sextuple presses, 4 starters to the press, had been prepared in about 15 minutes, all delays considered, while previously it used to take 50 minutes and often an hour. By the old-fashioned hand method a large plant required 2 men at the casting box, 1 at the tail cutter, 1 at the shaver, 2 at the finishing block, and 1 to dip the plate for cooling. Such a crew would ordinarily produce plates at the rate of two in three minutes. The Autoplate machine was operated by four men, who adjusted the matrices, manipulated the control lever, supplied metal to the furnace and removed the ejected plates, producing about seven plates in two minutes.

JUNIOR AUTOPLATE

The Wood Newspaper Machinery Corporation subsequently built another machine on similar principles, which was called the "Junior Autoplate" to distinguish it from the former one, designated as the Senior, or Standard. The new machine was installed in a number of plants where the old method was still used, and also gradually replaced the older machines, the last of which was discarded in 1926. In the

operation of the new machine several of the entirely automatic functions of the older one were performed by the workers. The casting mechanism resembled in some respects the individual casting boxes. The mold was vertical instead of horizontal, and of extra length to insure the necessary pressure of the metal for perfect casting of the plate. The molten metal was supplied, as in the old model, by means of a hand-worked force pump through an overhanging spout. The matrix was inserted by the operator in the back, which was moved to and from the core by a hand-worked lever. A downward pull on the pump lever filled the mold. After the cast had cooled, in about 14 to 20 seconds, and the back drawn away, stripping the matrix from the cast, power was applied by operating another hand lever starting the automatic function of the machine. The core was given a half turn, carrying the cast with it and passing it against two rotating saws to sever the tail from the plate and trim the lower beveled edge. The straight sides of the plate had been so cast that no trimming was needed.

The back with the matrix was again moved into casting position by the operator and a new plate poured, which was left to cool while the cylinder tender removed the tail piece, still hanging to the cylinder by a couple of pins, and the plate which had been projected from the core by the closing of the back on the other half. The plate was laid on an inclined runway of an auxiliary finishing machine, called the "Autoshaver," where it was automatically passed successively through gates into a shaving chamber, over a water saddle, and over a brush to a delivery stand, from which it was sent to the press-room by the shaver tender. In some of the larger newspaper plants automatic devices were provided for transportation of the plates. A fourth worker, the metal tender, kept the metal pot in the furnace filled with metal, usually consisting of plates returned from the press-room for remelting. Plates were produced at the rate of three per minute.

The need for several casting units resulted in the construction of the double Junior Autoplate, consisting of an elliptical metal furnace, with about 16,000 pounds capacity, to which were attached two casting mechanisms, each of which was operated independently by two men and would produce three plates per minute. An Autoshaver, which was capable of finishing six plates per minute, completed the unit. Only one metal tender was required for the replenishing of the metal, so the complete unit could be operated efficiently by six men and produce six finished plates per minute. This arrangement is commonly found on modern newspapers, some of which are provided with four or five units.

PONY AUTOPLATE

Another variety of the Autoplate was originated by Henry A. Wise Wood, in combination with patents of Charles E. Hopkins of New York, and called the "Semi-Autoplate." This consisted of a vertical casting box, with a stationary concave back next to the metal furnace and a swinging convex core, combined with the features of a tail cutter and the Autoshaver. It could be operated by one man, and had a capacity of three plates in two minutes. It was eventually developed into the Pony Autoplate, which recently has become very popular for smaller city newspapers. Among the records received by the manufacturers from users, one newspaper gave the average

production as 58 plates in 45 minutes, all work done by one man. Another newspaper stated that on the day the machine was first operated, the last 18 plates were made from 9 matrices in 18 minutes, or 1 plate per minute, while the same crew with the individual machines previously used would have consumed 45 minutes, or 2½ minutes per plate. In 1926 a combination machine was introduced, the Twin Pony Autoplate, consisting of two of the casting boxes, served by a single finishing and cooling mechanism, which swings automatically into position in front of either box to receive the plates.

RELATED OPERATIONS

A plate finishing, cooling, and drying machine, was introduced by R. Hoe & Co. In some places this was utilized for the Autoshaver, and in others it was substituted for the individual finishing machines, for use with the regular casting boxes. At the present time some of the small plants use only the individual machines, old styles or new styles, which naturally has a bearing on productivity.

Some of the larger modern newspapers also use auxiliary sets or individual machines in the production of plates for color printing, and several are equipped with auxiliary double length sets for the production of double pages in a single plate. Plates for color printing on rotary newspaper presses, which were first introduced on the Chicago Inter-Ocean in 1892, required considerable routing, as a rule, to remove part of the design. The plate was fastened on a cylinder, where its surface was brought in contact with a rapidly revolving cutter. Both cylinder and cutter were so manipulated by the operator as to remove all undesirable parts.

About 1900 some attempts were made to produce printing plates to cover the width of two pages. When two plates were used this was a very laborious and slow process, as most of the work had to be done by hand. The common failure to secure accurate adjustment of the lines, induced some of the manufacturers to turn out double length machinery for such purpose, and this was installed on some of the large newspapers.

For several years after the introduction of half tones attempts to stereotype them did not meet with success, and preparation of stereotype plates containing half tones involved considerable extra work. The half tones were first curved to the same degree as the plate. By one method they were tacked or soldered in depressions prepared for them on the surface of the plate. By another method strips of metal were soldered to the backs of the curved half tones, and after the matrix had been placed in the casting box, the half tones were fitted into their respective positions on the matrix, where the strips held them in place after the box was closed. In pouring the cast the metal surrounded the anchors, imbedding the half tones in the plate. Stereotyping of half tones was successfully accomplished in 1897 on the New York Tribune, and is now a daily occurrence on practically all modern newspapers.

JOB WORK

On daily newspapers stereotyping also involves casting and finishing of small work in plate form, commonly termed "job work," such as headings, advertisements, and illustrations, from matrices furnished by advertisers or by syndicates for supplying special features, as well

as metal bases for use with photo-engravings or electrotypes in the page forms. On large newspapers special men are employed continuously on such work, while on small ones the regular workers perform it when time can be spared from other duties. Molding, when necessary, is carried out in the same way as for curved plates. Flat casting boxes of various sizes and styles, some of them large enough to produce full-page casts, are employed. They are usually provided with adjustable gauges to permit casting a plate of any required size within the limits of the box. The metal is ordinarily poured with a ladle, though some boxes are adapted for use with force pumps. The tail is removed by pushing the cast against a circular saw, protruding through a slot above a small metal table, and superfluous metal is removed from the other edges in similar manner. As the saw cut is more or less ragged, the sides are squared and smoothed on a trimming machine, where the plate rests on a small sliding table, which, being pushed forward, carries the edge against rapidly revolving cutters, a development of the old-fashioned hand-operated shoot board and plane. Combination saws and trimmers, mounted on single pedestals, are commonly found in modern plants.

The plate is next laid, face down, on the bed of a flat shaving machine, in which a straight knife planes the back to the correct thickness. The early shaving machines, in which the knife head was propelled forward and backward by means of a hand-operated spoke wheel, has been displaced on most newspapers by power-operated shavers. In some of these the knife head is driven over the bed, and in others the bed travels while the knife head remains stationary. Adjustment for desired thickness is made by raising or lowering either the knife or the bed, according to style. Rotary type-high planers, fitted with revolving disks containing cutters, are used in some places.

When illustrations, or other open matter, is stereotyped, it is often necessary to remove considerable metal from the surface of the cast in order to prevent smudging in printing. A routing machine is usually employed for that purpose, eliminating the slow hand chiseling. It consists of a flat table, supported by a pedestal, on which the plate is clamped, and a router bit, revolved at high speed, situated above the plate. In one style the tool can be moved freely by two radial arms in any direction over the surface of the plate, while in another it is moved by means of a handwheel straight across the table, and the latter is moved to or from the operator by means of another handwheel. The cutter is brought into contact with the plate by means of a foot lever until the superfluous metal has been removed. Mortices are sometimes required in advertising plates, for which purpose a combination jig saw and drill is commonly used in large modern plants.

All of these machines have been developed to a high degree of efficiency by the various manufacturers heretofore named, as well as by Ostrander-Seymour, John Royle & Sons, and others. Finishing machines, however, are merely tools, and each one requires constant manipulation by an operator during execution of the work on it.

A special branch of stereotyping, which consists of job work on a larger scale, is commonly termed "syndicate or auxiliary newspaper service." In 1858 Isaac Heyes, of Sheffield, England, originated the

plan of supplying small newspapers with ready-set matter for publication, in single column, type-high stereotype plates. Thin surface plates and special bases for them were introduced by B. B. Blackwell. of New York, in 1871. These soon supplanted the single piece, type-high strips, but were in turn superseded, on newspapers equipped for stereotyping, by matrices containing the syndicate matter. Several of the large newspapers maintain or are connected with syndicates for furnishing such service.

CHAPTER 8.—DETAILED STUDY OF PRODUCTIVITY AND LABOR COST FOR STEREOTYPING IN 1916 AND 1926

STEREOTYPING was not included among the industrial occupations considered in the 1894 investigation by this bureau, then called the Department of Labor, so the only figures for production available are those obtained during the survey for this study. The tabulations of hours and wages in the publications by the bureau [1] give some interesting sidelights on those items from the early days up to the present time. Wages were stated to have been 89 cents per day for stereotypers in Scotland during 1840, with a 60-hour working week, and in 1850 wages had risen to 97 cents per day. The earliest record for the United States was for New York in 1857, when wages ranged from $1.67 to $2 per day, also with a 60-hour working week, which prevailed up to 1870, wages during that time ranging from $1 to $2.33 per day. In 1872 wages in New York had increased to $3 per day, and the weekly hours had been reduced to 59. Increases in wages and reductions in hours continued periodically from then on. The information for this study was secured in a manner similar to that for composition and, as with the data for that occupation, was reduced to a man-hour basis. The resulting data for stereotyping rooms are presented in the detailed tables. Such data cover only recent periods and modern methods, except for one establishment, in which production, hours, and wages were also obtained for a period 10 years earlier. While those figures can not be considered illustrative of old-style stereotyping, as they are for a large establishment and the equipment would still be considered thoroughly up to date for wet-flong stereotyping, they present an interesting comparison for the same plant during two periods and of the dry-flong method with the wet-flong method.

[1] U. S. Commissioner of Labor, Fifteenth Annual Report, 1900, Wages in Commercial Countries; Nineteenth Annual Report, 1904, Wages and Hours of Labor; bulletins of the U. S. Bureau of Labor Statistics on union scales of wages and hours of labor.

STEREOTYPING ROOM NO. 1 IN 1916

PRODUCTIVITY AND LABOR COST FOR PROCESS

TABLE 50 contains data for production of stereotype plates in 1916, based on total man-hours for all employees:

TABLE 50.—*Man-hour production and labor cost in newspaper stereotyping room No. 1 in 1916 (based on total man-hours)*

Occupation	Man-hours worked in producing 21,149 plates	Average production per man-hour	Labor cost per man-hour	Cost of man-hour production	
				Time cost	Labor cost
		Plates		*Minutes*	
Molding division:					
Molders	643		$0.893	10.4	$0.154
Packers	492		.841	7.9	.107
Foundry division:					
Autoplate operators	683		.799	11.0	.146
Cylinder tenders	669		.797	10.8	.143
Metal-pot tenders	415		.806	6.7	.090
Shaver tenders	415		.806	6.7	.090
Total, productive labor	3,317	6.38	.821	53.4	.730
Job men	240		.818	3.9	.053
Supervisory employees	170		2.030	2.7	.093
Total, nonproductive labor	410		1.325	6.6	.145
All employees	3,727	5.67	.876	60.0	.876

The table covers the total man-hours for all operations in the stereotyping room of the newspaper, which was published mornings, Sundays included. The total man-hours represent all hours the workers were on duty in the establishment, regular as well as overtime, and for which they were paid, including both actual productive time and waiting time. Time devoted to lunch periods has not been considered, even though paid for by the employers. All work was performed at night, six hours constituting a regular working shift, except on Saturday night when it included one and one-half additional working hours.

The workers consisted of productive labor and nonproductive labor. The former included both the molding division, which prepared, molded, and backed up the matrices, and the foundry division, which cast the plates, and the latter contained the job men, who made and finished flat casts for use in the type form, and supervisory employees, who directed the work. Only the finished product of the room, stereotype printing plates, has been considered, and their production, on the basis of total man-hours, is shown for the total productive labor, and for all employees. The actual time and labor cost for each group of labor involved in the man-hour production of plates for all employees is also presented.

PRODUCTIVITY AND LABOR COST FOR MOLDING OF MATRICES

As the operations performed in the molding division and the foundry division were distinctly different and resulted in finished products of varying nature, separate tables have been prepared for each of the two divisions, covering the individual product and omitting the nonproductive labor. Table 51 contains data for molding and backing up 1,666 matrices by the stereotype molding division in 1916.

TABLE 51.—*Man-hour production and labor cost for productive labor in molding of matrices in newspaper stereotyping room No. 1 in 1916 (based on total man-hours)*

Occupation	Man-hours worked in molding 1,666 forms	Average number of forms molded per man-hour	Labor cost per man-hour	Cost of man-hour production	
				Time cost	Labor cost
				Minutes	
Molders	643	2.59	$0.893	34.0	$0.506
Packers	492		.841	26.0	.353
Total	1,135	1.47	.859	60.0	.859

The wet-flong method was used, and the flong was prepared with the aid of tissue-holding stands, the work being done mostly before molding commenced for the day but partly on overtime. The molding on two matrix-rolling machines and pneumatic steam tables was done by three men. A flat gas-heated matrix scorcher was used occasionally for the final drying. The working hours for the molders amounted to 56.7 per cent of the total hours for the division, while those for the packers constituted only 43.3 per cent. The average number of forms molded was 2.59 per man-hour, based on total man-hours for molders, and 1.47, based on total man-hours for the division. No record was kept of imperfect matrices molded, necessitating remolding, but these were claimed not to have exceeded 20 for the period studied. The daily wage rate was the same for all, except that one of the molders received a higher rate, which, together with a slightly larger proportion of overtime, accounts for the additional labor cost per man-hour in this group. The overtime for the two groups aggregated 9.6 per cent of the total time involved.

PRODUCTIVITY AND LABOR COST FOR CASTING OF PLATES

Table 52 contains data for casting 31,149 plates by the stereotype casting division of the same newspaper in 1916.

TABLE 52.—*Man-hour production and labor cost by productive labor in casting of plates in newspaper stereotyping room No. 1 in 1916 (based on total man-hours)*

Occupation	Man-hours worked in casting 21,149 plates	Average number of plates cast per man-hour	Labor cost per man-hour	Cost of man-hour production	
				Time cost	Labor cost
				Minutes	
Autoplate operators	683	30.96	$0.799	18.8	$0.250
Cylinder tenders	669		.797	18.4	.244
Metal-pot tenders	415		.806	11.4	.153
Shaver tenders	415		.806	11.4	.153
Total	2,182	9.69	.801	60.0	.801

The plates were cast by two double Junior Autoplate-Autoshaver equipments, providing four casting mechanisms, each of which was handled by one operator, assisted by one cylinder tender, but on five nights of the week only three of the mechanisms were operated. One metal-pot tender and one shaver tender were required for each

double equipment, whether one or both of its casting mechanisms were utilized. As one operator handled one mechanism, the production per man-hour for operators—31 plates—represents the number of plates cast per clock hour on one casting mechanism. This does not, however, indicate the capacity of the machine, as it was not operated continuously and the basic hours include all of its idle time. The output per man-hour for the combined groups is also based on total time worked, and determines only the hourly production by the labor deemed necessary for such an establishment under the special shop arrangements prevailing at that time. The number of plates produced in this establishment, as well as in the other plants, consisted only of perfect plates delivered to the press-room, as no record was kept of casts spoiled during the process. Some variation existed in the man-hour labor cost for the different groups, due to the different amounts of overtime worked by them, as the regular rate of daily pay was the same. The overtime for the combined groups totaled only 6 per cent of the entire time worked, considerably less than that for the molding division, and is reflected in the respective labor costs per man-hour.

OUTPUT PER PRODUCTIVE MAN-HOUR

As records were not kept of the actual productive time worked by the productive labor, figures were obtained of the exact time when molding and casting operations commenced and stopped for each edition during each day of the period studied, the time between being considered as productive man-hours. Table 53 gives the number of productive man-hours for each group in both divisions, with the percentage of the total man-hours, and also for each division as a whole. Man-hour production, based on productive man-hours, is also presented for each of the groups and for each division.

TABLE 53.—*Man-hour production for productive labor in newspaper stereotyping room No. 1 in 1916 (based on productive man-hours)*

Occupation	Number of man-hours			Production	
	Total	Productive		Total	Per productive man-hour
		Number	Per cent of total		
Molding division:				*Matrices*	*Matrices*
Molders	643	274.3	42.6	1,666	6.07
Packers	492	216.0	43.9	1,666	7.72
Total	1,135	490.3	43.2	1,666	3.40
Foundry divison:				*Plates*	*Plates*
Autoplate operators	683	307.8	45.1	21,149	68.71
Cylinder tenders	669	307.8	46.0	21,149	68.71
Metal-pot tenders	415	183.2	44.1	21,149	115.44
Shaver tenders	415	183.2	44.1	21,149	115.44
Total	2,182	981.8	45.0	21,149	21.54

The actual operation inside of these hours was, of course, intermittent and provided occasional slight periods of rest while waiting in the molding division for forms from the composing room, or in the casting division for matrices from the molding division, except toward the closing of each edition, when the rush work commenced. The

productive man-hours shown for the molders include only the time engaged in molding of matrices, omitting the time used in preparing the flong. They amounted to 42.6 per cent of the total working time for the group, with an output of 6.07 matrices per productive man-hour, indicating considerable waiting time. Three or four daily editions were customary, involving molding of nearly double the number of pages published in the complete daily issue. It was essential most of the time to mold the matrices as fast as the forms arrived from the composing room, to keep the way clear for the starter [1] when it arrived. Records were obtained of the time each starter was received from the composing room and the time the matrix therefrom was sent to the packers. The total number of starters during the period studied was 132. With six exceptions only 6 minutes were consumed in molding each of them, five requiring 7 minutes apiece and one being turned out in 5 minutes, making an average of 6.03 minutes, clock time.

The matrices were transported in a small electric lift from the molding section, which was located in the composing room, to the packing section adjoining the foundry division. The productive man-hours for the packers shown include only the time for backing up of matrices and do not take the preparation of packing into account. The percentage of the total hours for these packers was slightly higher than for those of the molders—almost 44—but as there were fewer man-hours for the group the hourly production was increased to 7.72 matrices. The time records for the starters show that there was considerable waiting time in this section also, as the backing up of nearly 14 per cent of the starters was accomplished in one minute per matrix, and over 35 per cent required only two minutes each. The average clock time for the 132 was 3.25 minutes per matrix, with a maximum of 13 minutes. On the basis of total productive man-hours for molders and packers, the output of the division was 3.4 matrices per man-hour.

The productive man-hours for the foundry division, given in the table, consist only of the time occupied in casting the plates, and do not include previous melting of the metal nor care of the machinery. For the operators they amounted to a little more than 45 per cent of the total hours worked by the group, and for the cylinder tenders 46 per cent, while for metal-pot tenders and shaver tenders they constituted slightly over 44 per cent each, making a general average of 45 per cent. As the productive man-hours for operators and cylinder tenders were the same, the hourly production on that basis was likewise the same for each group, amounting to 68.71 plates. This figure also represents the actual hourly production for one casting mechanism, based on productive man-hours for the establishment, or 1.15 plates per minute. Figured on the basis of productive man-hours for metal-pot tenders or shaver tenders, which were alike, the average production for each double equipment was 115.44 plates per hour. The output for the entire division, on the basis of its total productive man-hours was 21.54 plates.

The productive hours for the foundry division constituted 66.7 per cent of the total productive man-hours for the two divisions, while those for the molding division were only 33.3 per cent, practically the same relation as existed for the total working hours—65.8 and 34.2 per cent, respectively.

[1] The last page of each edition.

TIME RECORDS FOR PLATE CASTING

One of the important items was the time consumed from the receipt of the starter form from the composing room to the delivery of the first plate to the pressroom, which involved both divisions. The average during the period was 10.23 minutes, with a minimum of 8 minutes and a maximum of 20 minutes.

Twelve perfect casts were ordinarily required from each matrix. The rush, of course, was especially for the last page, or starter, of each edition. The time records show an average, from delivery of this matrix by the molding division until the twelfth plate was turned over to the pressroom, of 7.38 minutes, or 1.6 plates per minute. A minimum time of 6 minutes for production of the 12 plates was attained in 66 out of the 111 times, while the maximum was 17 minutes, occurring only once. Part of the time—especially for the Sunday morning issues—18 casts were required from each matrix. The average time involved for the production of that number was 11.53 minutes per set, or 1.6 plates per minute; a few sets took as long as 23 minutes, but in the majority of cases the set of 18 was turned out in 9 minutes. The average for the total starting pages during the period was 1.6 plates per minute, clock time

NONPRODUCTIVE LABOR

Job men have not been considered in any of the tables except Table 50, as no records were kept of work accomplished by them. The majority of the job work was performed by special labor engaged exclusively in that operation, though when required, some individuals from other groups also worked intermittently at it during their spare time before or after plate casting. As the work was continuous, the total hours for the group shown in Table 50 also represent the productive man-hours for the work. The equipment consisted of the ordinary machines used for the purpose, in duplicate, but included some styles not strictly up to date. Supervisory labor also has not been considered except in Table 50.

STEREOTYPING ROOM NO. 1 IN 1926

PRODUCTIVITY AND LABOR COST FOR PROCESS

The constant expansion of the publication during the decade following 1916 was responsible for considerable change. By the end of that period the number of pages in the daily issues had more than doubled, the dry-flong method had supplanted the wet-flong method, additional equipment had been provided, and the personnel had been increased to meet conditions. Tables similar to those for 1916 have been prepared for the selected period in 1926, providing easy comparison of the two periods. Table 54 contains data for production of plates in 1926, based on the total man-hours for all employees, similar to that for the 1916 period in Table 50. The explanation of specific details given for Table 50 applies also to Table 54.

TABLE 54.—*Man-hour production and labor cost in newspaper stereotyping room No. 1 in 1926 (based on total man-hours)*

Occupation	Man-hours worked in producing 50,733 plates	Average production per man-hour	Labor cost per man-hour	Cost of man-hour production	
				Time cost	Labor cost
Molding division:		*Plates*		*Minutes*	
Molders	1,360		$1.414	8.6	$0.202
Packers	2,088		1.369	13.2	.300
Foundry division:					
Autoplate operators	1,552		1.363	9.8	.222
Cylinder tenders	1,552		1.363	9.8	.222
Metal-pot tenders	845		1.375	5.3	.122
Shaver tenders	796		1.364	5.0	.114
Total, productive labor	8,193	6.19	1.374	51.7	1.183
Job men	1,157		1.462	7.3	.178
Supervisory employees	164		4.154	1.0	.072
Total, nonproductive labor	1,321		1.797	8.3	.249
All employees	9,514	5.33	1.433	60.0	1.433

Comparison of the two tables shows that the man-hours had practically doubled for each group except supervisory labor, and that the total number of plates cast had advanced in about the same ratio. The man-hour production of plates had decreased 3 per cent for all productive labor and 6 per cent for all employees. This is partly explained by a statement that it was necessary to employ sufficient labor to meet the demands of rush conditions during certain periods of each shift. A general increase of 63.7 per cent had taken place in the average labor cost per man-hour, in accord with the general advance in wages for the entire country. The time cost for the different groups in man-hour production is relatively different than that for 1916, due to the adoption of the dry-flong method. The man-hour production for all employees was 5.33 plates in 1926 against 5.67 in 1916, a reduction of 6 per cent, while the labor cost for the one hour's work was $1.433 in 1926 against 87.6 cents in 1916.

PRODUCTIVITY AND LABOR COST FOR MOLDING OF MATRICES

The various changes in the decade are more evident in the next two tables, where the two divisions have been treated separately, each with reference to its individual product, as was done for 1916. Table 55 contains data for molding and backing up 3,580 matrices by the stereotype molding division in 1926, being comparable with Table 51.

TABLE 55.—*Man-hour production and labor cost for productive labor in molding of matrices in newspaper stereotyping room No. 1 in 1926 (based on total man-hours)*

Occupation	Man-hours worked in molding 3,580 forms	Average number of forms molded per man-hour	Labor cost per man-hour	Cost of man-hour production	
				Time cost	Labor cost
				Minutes	
Molders	1,360	2.63	$1.414	23.7	$0.558
Packers	2,088		1.369	36.3	.828
Total	3,448	1.04	1.387	60.0	1.387

Because the dry-flong method had been adopted, the actual preparing of the flong had been eliminated and the only operations necessary were humidifying and seasoning. Molding was done by six men on three direct-pressure hydraulic molding presses, with one additional man for Sunday morning issues. Modern curved gas-heated matrix scorchers were used by the packers for drying. The relation of working hours for the two groups differed greatly from that prevailing in 1916, caused principally through the additional backing up required for the dry flong. The working hours for the molders constituted 39.4 per cent of the total hours for the division, while those for the packers aggregated 60.6 per cent. An average of 2.63 forms were molded hourly, based on man-hours for molders alone, a very slight increase over the 1916 production. Based on man-hours for the division, only 1.04 forms were molded hourly, a decrease of nearly 30 per cent from the 1916 output. No account was kept of imperfect matrices molded. It was stated that in some instances they had gone as high as five in one day, but no spoilage was evident while the molding was observed, and the statement probably refers to the time when the dry-flong method was taken up.

The labor cost per man-hour for the molders had increased 58.4 per cent and for the packers 62.8 per cent. The same basic wage was paid to all, except to two of the molders who received higher rates. As the proportion of overtime for molders was larger than that for packers, and the average wage rate was a little higher, the labor cost for the molders was naturally more than for the packers. The overtime for the two groups aggregated 10.2 per cent of the total time worked by the division, slightly more than the 1916 proportion.

PRODUCTIVITY AND LABOR COST FOR CASTING OF PLATES

Table 56 contains data for casting 50,733 plates by the sterotype foundry division in 1926, and is comparable with Table 52.

TABLE 56.—*Man-hour production and labor cost for productive labor in casting of plates in newspaper stereotyping room No. 1 in 1926 (based on total man-hours)*

Occupation	Man-hours worked in casting 50,733 plates	Average number of plates cast per man-hour	Labor cost per man-hour	Cost of man-hour production	
				Time cost	Labor cost
				Minutes	
Autoplate operators	1,552	32.69	$1.363	19.6	$0.446
Cylinder tenders	1,552		1.363	19.6	.446
Metal-pot tenders	845		1.375	10.7	.245
Shaver tenders	796		1.364	10.1	.229
Total	4,745	10.69	1.365	60.0	1.365

Casting methods were the same as in the former period (described on p. 105), except that both the total output of plates and the total hours worked by the division had more than doubled. Two additional double Junior Autoplate-Autoshaver equipments had been installed, making 4 in all and providing 8 casting mechanisms. All 8 were used on 5 nights of each week, but 7 were sufficient the other 2 nights and even fewer were occasionally adequate, as records show that only 6 and 5 mechanisms were each used 3 per cent of the total

nights. The number of plates cast, based on the total hours worked by the operators, was 32.69 per man-hour, an increase of 5.6 per cent over 1916; based on the total hours for the entire division, the gain was 10.3 per cent. As in the table for 1916, these hours included all idle machine hours, so that the output merely represents average production by necessary labor for the period under the conditions existing.

Similar to the previous period, the labor cost per man-hour varied slightly according to the relative overtime. This was highest for metal-pot tenders, as some from this group were required to come to work early each night in order to have the metal in proper condition for casting. A general average increase in man-hour labor cost of 70 per cent had become effective since 1916. The overtime for the four groups combined totaled 7.2 per cent of the total time worked, as against 6 per cent in 1916.

OUTPUT PER PRODUCTIVE MAN-HOUR

The actual time devoted to matrix-molding and plate-casting operations have been computed in the same way as for the previous period, and the results, showing the productive man-hours for the productive labor in 1926, are presented in Table 57, which is comparable with Table 53. The explanations accompanying Table 53 (see p. 106) apply equally to Table 57.

TABLE 57.—*Man-hour production for productive labor in newspaper stereotyping room No. 1 in 1926 (based on productive man-hours)*

Occupation	Man-hours			Production	
	Total	Productive		Total	Per productive man-hour
		Number	Per cent of total		
Molding division:				*Matrices*	*Matrices*
Molders	1,360	747.6	55.0	3,580	4.79
Packers	2,088	1,263.6	60.5	3,580	2.83
Total	3,448	2,010.2	58.3	3,580	1.81
Foundry division:				*Plates*	*Plates*
Autoplate operators	1,552	686.9	44.3	50,733	73.86
Cylinder tenders	1,552	686.9	44.3	50,733	73.86
Metal-pot tenders	845	482.3	57.1	50,733	105.18
Shaver tenders	796	482.3	60.6	50,733	105.18
Total	4,745	2,338.4	49.3	50,733	21.70

The aggregate productive hours for the molders were 55 per cent of the total time worked by the group, with an output of 4.79 matrices per productive man-hour, a reduction of 21 per cent since 1916. The apparent growth in productive time and drop in hourly production were caused by the increased number of pages in the daily issues, as the length of the regular working-day remained the same and the proportion of overtime was only slightly greater than in 1916. Four or five editions were published daily, resulting in molding more than twice the number of pages published in the complete daily issue. The man-minutes for molding of each matrix had increased, but the records for time consumed in molding the matrices for the starters show that the actual clock time involved for each matrix had been reduced greatly. The total number of starters during the period

was 152. Molding the matrices for three of these required three minutes apiece, while the rest took only two minutes each, making an average per matrix of 2.02 minutes, clock time, a reduction of 66.5 per cent from the clock time in 1916.

The change in the proportionate relation of total hours for molders and packers was reflected in both productive hours for the packers and in their output. The percentage of productive hours for them was also higher than that for the molders, being 60.5 per cent of the total time for the group. The production was only 2.83 matrices per productive man-hour, a decrease of 63.3 per cent from the former period, making a total reduction of 46.8 per cent in the output per productive man-hour for the division. Analysis of the time records for the starters revealed that an average of 6.55 minutes, clock time, was consumed in backing up the matrices for them, with a minimum of two minutes and a maximum of 19 minutes. Three, five, and six minutes were most in evidence, each being recorded for about 16 per cent of the total starters. The average clock time for both operations in production of the completed matrix was 8.57 minutes, while in 1916 the average amounted to 9.28 minutes, a reduction of 7.7 per cent.

The productive man-hours for the Autoplate operators, and also for the cylinder tenders, constituted only a little over 44 per cent of the total hours for each group. For the metal-pot tenders they aggregated over 57 per cent, and for the shaver tenders 60.6 per cent. The smaller proportion for the first two groups was due to operation during part of the period of only one casting mechanism on one of the double equipments. The man-hour production for operators was 73.86 plates, which also represents the actual hourly production for one casting mechanism, based on productive machine hours, equal to 1.2 plates per minute, or 7 per cent increase over 1916. On the basis of productive man-hours for metal-pot tenders or shaver tenders, the average production of each double equipment was 105.18 plates per hour, a decrease of 8.9 per cent. This average production, however, indicates only the output in this particular establishment and is not strictly comparable with output per double equipment in other stereotyping rooms, for all of the casting mechanisms were not in use all of the time. The production per productive man-hour for the entire casting division, was 21.7 plates, or a trifle more than the production in the 1916 period.

The productive man-hours for the foundry division constituted 53.8 per cent of the total hours for the two divisions, while those for the molding division were 46.2 per cent, a more equal relation than that existing during the earlier period, and also than that for the total working hours in the 1926 period, which was 57.2 and 42.8 per cent, respectively.

TIME RECORDS FOR PLATE CASTING IN 1916 AND 1926

The number of perfect casts required from one matrix varied considerably, according to the number of pages in the issue and the consequent number of presses necessary to print the papers inside of the specific time limit. Fourteen casts from each matrix followed closely by 12, predominated for the week-day issues, and 24 were necessary for part of the Sunday issues. Table 58, covers the details of time recorded for the casting of starters during the selected period in 1926, as compared with that for the selected period in 1916.

TABLE 58.—*Clock time consumed in casting of plates from starter forms in newspaper stereotyping room No. 1 in 1926, and per cent of increase or decrease compared with 1916*

Number of plates per matrix	Number of minutes required to cast 1 set of plates					Average number of plates cast per minute		
	1916 average	1926			Per cent of decrease in 1926 compared with 1916	1916	1926	Per cent of increase in 1926 compared with 1916
		Minimum	Maximum	Average				
10		5.0	5.0	5.0			2.00	
12	7.38	5.0	13.0	6.09	18.8	1.63	1.97	20.9
14	7.0	7.0	7.0	7.0		2.00	2.00	
16	13.0	7.0	9.0	8.0	38.5	1.23	2.00	62.6
18	11.53	9.0	9.0	9.0	21.9	1.56	2.00	28.2
20		14.0	31.0	21.17			1.13	
General average for all plates						1.60	1.99	24.4

A decided reduction in casting time, ranging from 18.8 to 38.5 per cent, had taken place for three of the specific sets used in both periods. In 1926 the production of starter plates was practically at the rate of 2 per minute, clock time, an increase of almost 25 per cent since 1916. This and the reduction in time for the molding operation created a shorter interval between the closing of the forms in the composing room and the beginning of printing in the pressroom. The average time between receipt of the starter form and delivery of the first starter plate was 9.36 minutes, a reduction of 0.87 minute from the time during the 1916 period. The minimum time had, however, been lowered from 8 to 4 minutes, a very decided accomplishment. The comparatively high average was due to a few instances, which mounted as high as 22 minutes.

NONPRODUCTIVE LABOR

As no production records were kept for the job men, this group has not been considered in any table except the general one for all employees—Table 54. There had been a substantial advance in this operation between the two periods, as indicated by the total man-hours for the group, which had increased to five times the amount for 1916. The man-hour labor cost for the group had risen 78.6 per cent, more than that for any of the productive labor groups, as a great deal of overtime had become necessary. During the 1916 period the overtime amounted only to 19.2 per cent of the total hours worked, but by the 1926 period it had risen to 53.3 per cent. The working arrangement had changed little, but the old-fashioned part of the equipment had been replaced by modern styles. The supervisory labor group also has been considered only in Table 54. The man-hour labor cost for it more than doubled, but this affected the general results for all employees alone.

Taking it all in all, man-hour production, decreased during the time between the two periods studied, due to speeding up of clock-time production of each unit—matrices or plates—to insure the most essential feature in the publication of a large newspaper—the speedy dissemination of news.

STEREOTYPING ROOM NO. 2 IN 1926

PRODUCTIVITY AND LABOR COST FOR PROCESS

Different working conditions existed in stereotyping room No. 2, which was a comparatively small establishment. The groups were not sharply defined, for some of the labor worked during the shift in several different occupations, according to the needs of the moment. The data are, however, presented in the same manner as for establishment No. 1, as the division of hours for the various occupations were similarly secured and computed. Table 59 contains data for the production of plates in this establishment during the 1926 period, based on total man-hours for all employees. The table is comparable with Table 54 for stereotyping room No. 1.

TABLE 59.—*Man-hour production and labor cost in newspaper stereotyping room No. 2 in 1926 (based on total man-hours)*

Occupation	Man-hours worked in producing 5,030 plates	Average production per man-hour	Labor cost per man-hour	Cost of man-hour production	
				Time cost	Labor cost
Molding division:		*Plates*		*Minutes*	
Molders	360.6		$0.927	12.5	$0.193
Packers	174.3		1.120	6.0	.113
Foundry division:					
Autoplate operators	190.4		1.305	6.6	.144
Cylinder tenders	195.1		1.108	6.8	.125
Metal-pot tenders	173.1		1.132	6.0	.113
Shaver tenders	169.4		1.123	5.9	.110
Total, productive labor	1,262.8	3.98	1.093	43.8	.799
Flong makers	68.8		1.211	2.4	.048
Job men	296.8		1.053	10.3	.181
Supervisory employees	100.0		1.554	3.5	.090
Total, nonproductive labor	465.5		1.184	16.2	.319
All employees	1,728.3	2.91	1.117	60.0	1.117

As with stereotyping room No. 1, this newspaper was published mornings, including Sundays. All work was performed at night, the regular working shift consisting of seven hours, except on Saturday nights, when one additional hour was included. With this exception, and also that in the molding division three groups—flong makers, molders and packers—instead of the last two are included, the explanations covering Table 50 apply also to this table.

The man-hour production of plates, for productive labor and also for all employees, was considerably below that shown in Table 54 for the same period in stereotyping room No. 1. This was due partly to the longer working shifts, and partly to the special conditions of the plant. The labor cost per man-hour was also less, on account of a lower wage rate.

PRODUCTIVITY AND LABOR COST FOR MOLDING OF MATRICES

The individual differences are shown more in detail in Tables 60 and 61, giving figures for the molding division and the foundry division separately. Table 60 contains data for molding and backing up 1,782 matrices by the productive labor in the molding division.

TABLE 60.—*Man-hour production and labor cost for productive labor in molding of matrices in newspaper stereotyping room No. 2 in 1926 (based on total man-hours)*

Occupation	Man-hours worked in molding 1,782 forms	Average number of forms molded per man-hour	Labor cost per man-hour	Cost of man-hour production	
				Time cost	Labor cost
				Minutes	
Molders	360.6	4.94	$0.927	40.5	$0.625
Packers	174.3		1.120	19.5	.365
Total	534.8	3.33	.990	60.0	.990

The wet-flong method was used, which required flong preparation. Two hands worked intermittently at this, utilizing tissue-holding stands, but were occupied in other operations during the rest of the time. The man-hours required for the preparation of flong amounted to 11.4 per cent of the total man-hours for the division, while those for molding were 59.8 per cent and those for packing 28.9 per cent. As the records contained the specific time for flong preparation, the flong makers were omitted from Table 60, but are included in Table 59, as a separate group of nonproductive labor. The output was 25.9 flong per man-hour, including paste making and other work connected therewith. The labor cost per man-hour was $1.211, considerably higher than the average for the productive labor groups in the division, because one of the flong makers received a higher wage rate, while in the group of molders was an apprentice, whose lower daily wage rate reduced the hour cost.

Molding of the forms was performed by 2 hands on 5 nights of the week, and by 3 hands on the other 2 nights on account of the extra work for the large Sunday issues. One matrix rolling machine was employed, with pneumatic steam tables, and one curved, gas-heated, matrix scorcher. Packing was ordinarily done by one man. It was claimed that imperfect matrices, requiring remolding of forms, were exceedingly rare, and that no record was kept of them.

As the wet-flong method was used, the production for this molding division is more comparable with the production of the molding division in stereotyping room No. 1 during the 1916 period (see Table 51) than during the 1926 period. The average number of forms molded per man-hour was nearly double the amount molded in stereotype room No. 1, because only the actual time devoted to molding was recorded for it, the workers being shifted to other operations during their spare time. The output per man-hour for the entire division was also relatively larger. The man-hour costs were not affected greatly by overtime, as the entire amount for the division was only 1.8 per cent of the total man-hours.

PRODUCTIVITY AND LABOR COST FOR CASTING OF PLATES

Table 61 contains data for casting 5,030 plates by the productive labor in the foundry division, comparable with Table 56 for sterotyping room No. 1:

TABLE 61.—*Man-hour production and labor cost for productive labor in casting of plates in newspaper stereotyping room No. 2 in 1926 (based on total man-hours)*

Occupation	Man-hours worked in casting 5,030 plates	Average number of plates cast per man-hour	Labor cost per man-hour	Cost of man-hour production	
				Time cost	Labor cost
				Minutes	
Autoplate operators	190.4	26.42	$1.305	15.7	$0.341
Cylinder tenders	195.1		1.108	16.1	.297
Metal-pot tenders	173.1		1.132	14.3	.269
Shaver tenders	169.4		1.123	14.0	.261
Total	728.0	6.91	1.169	60.0	1.169

Casting was performed on one double Junior Autoplate, supplemented with a Hoe plate-finishing machine. Only one of the casting mechanisms was used, requiring four hands for operation of the equipment, except for the Sunday issue, when both casting mechanisms were utilized, necessitating a crew of six. The number of plates produced, on the basis of total hours worked by the operators, was 26.42 per man-hour, or a little over 80 per cent of the production on the same basis for stereotyping room No. 1. This was partly because fewer plates were cast from each matrix, and partly on account of comparatively more idle machine time between the casts. On the basis of total man-hours for the entire division, the production per man-hour was relatively even smaller, amounting to only 6.91 plates, or about 65 per cent of the production for stereotyping room No. 1. The low rate was caused by the use of a single casting mechanism for the majority of the time, four hands being required for the production of each plate, instead of three hands when two casting mechanisms were used.

The man-hour labor cost was a great deal higher for the operators than for the other groups, because of a higher daily rate paid to one of the operators. The slight variation for the other groups was due to a small amount of overtime, mostly for metal-pot tenders, who came to work earlier to get the metal ready for casting. The overtime for all four groups did not, however, aggregate 1 per cent of the total man-hours involved.

OUTPUT PER PRODUCTIVE MAN-HOUR

As the workers were shifted from one operation to another whenever necessary and the idle machine time in the productive operations permitted it, the actual production time for the productive labor did not vary much from the total time for it. Table 62, which is comparable with Tables 53 and 57, gives the actual total and the productive man-hours and the productive man-hour output for stereotyping room No. 2, the flong making for the molding division and all recorded idle machine time for the foundry division not being included.

TABLE 62.—*Man-hour production for productive labor in newspaper stereotyping room No. 2 in 1926 (based on productive man-hours)*

Occupation	Man-hours			Production	
	Total	Productive		Total	Per productive man-hour
		Number	Per cent of total		
Molding division:				*Matrices*	*Matrices*
Molders	[1] 406.8	360.6	88.6	1,782	4.94
Packers	[1] 196.8	174.3	88.6	1,782	10.23
Total	[1] 603.6	534.8	88.6	1,782	3.33
Foundry division:				*Plates*	*Plates*
Autoplate operators	190.4	190.4	100.0	5,030	26.42
Cylinder tenders	195.1	190.4	97.6	5,030	26.42
Metal-pot tenders	173.1	169.4	97.8	5,030	29.70
Shaver tenders	169.4	169.4	100.0	5,030	29.70
Total	728.0	719.6	98.8	5,030	6.99

[1] Includes nonproductive time devoted to flong preparation.

The data for the molding division are comparable with those in Table 53 for the wet-flong method in stereotyping room No. 1 in 1916. The productive time for molders and packers, constituted 88.6 per cent of the total hours for the group. The nonproductive time for the division was devoted to flong preparation. The output of the molders was 4.94 matrices per productive man-hour, or 18.6 per cent less than that produced in stereotyping room No. 1. The output of the packers was 10.23 matrices per man-hour, or 32.5 per cent more than in room No. 1. Three daily editions were customarily published, one shortly after the shift started and the other two practically continuous during the latter part of the shift. The changes for editions involved molding twice the number of pages published in the regular daily issues. Time records for starters were not available, so no comparison could be made for that item.

Comparison of the data for the foundry division with that in Table 57, for stereotyping room No. 1 in 1926 indicates the difference between a large establishment and a small one. The productive hours for the autoplate operators and shaver tenders were in this case the same as the total hours worked in their respective capacity, for they were occupied in other operations when not actually required at the machines. Cylinder tenders and metal pot tenders were likewise shifted to other operations when circumstances permitted, but show a few extra nonproductive hours in their regular occupations. As in room No. 1 the hours for operators or cylinder tenders exceeded the hours for metal-pot tenders and shaver tenders, on account of the occasional operation of two casting mechanisms, requiring two each of the former to one each of the latter. Ordinarily only two perfect casts were made from each matrix, though occasionally four were called for. The man-hour production for operators was 26.42 plates, decidedly low when compared with 73.86 plates as production for one casting mechanism in room No. 1, and emphasizing the variation contingent on the size of the plant. This is even more apparent when the production for metal-pot tenders or shaver tenders is considered, 29.7 plates per productive hour against 105.18 in the former

establishment, or the output of the entire division, 6.99 plates per productive hour against 21.7 in room No. 1. No records for starters were obtainable for this division either.

The productive hours for the foundry division amounted to 57.4 per cent of the combined productive hours for the two divisions, with those for the molding division constituting 42.6 per cent, while the relation of the total hours worked by each division was respectively 54.7 and 45.3 per cent.

NONPRODUCTIVE LABOR

Job men were not considered except in the general table for all employees (Table 59). The necessary job work was performed intermittently by labor from other operations during their spare hours in their regular occupation. The equipment consisted of a single set of the ordinary machines for the operations. As 16 per cent of the hours were for an apprentice with a relatively low daily wage rate, the man-hour labor cost was reduced considerably below that of the other groups. The man-hours for supervisory labor, which was also considered only in Table 59, were comparatively few, because part of the time was devoted to productive operations, among which it was included.

STEREOTYPING ROOM NO. 3 IN 1926

IN stereotyping room No. 3 the labor was likewise shifted from one operation to another as circumstances required. It consisted of journeymen and apprentices, with some supervisory labor. As no detailed records were kept of the specific hours devoted to each of the different operations, division could not be made of the labor in the same manner as for the establishments heretofore studied, but available figures were tabulated according to the division existing in this stereotyping room. These have been presented as Table 63, for approximate comparison of productivity and labor cost for the process with those of the other establishments studied.

TABLE 63.—*Man-hour production and labor cost in newspaper stereotyping room No. 3 in 1926 (based on total man-hours)*

Occupation	Man-hours worked in producing 13,202 plates	Average production per man-hour	Labor cost per man-hour	Cost of man-hour production	
				Time cost	Labor cost
Productive labor:		*Plates*		*Minutes*	
Journeymen	1,938.5		$0.976	44.3	$0.720
Apprentices	448.0		.470	10.2	.080
Total	2,386.5	5.53	.906	54.5	.801
Nonproductive labor: Supervisory	240.0		1.459	5.4	.136
All employees	2,626.5	5.03	.937	60.0	.937

The newspaper was published evenings for six days in the week, and on Sunday mornings. Both the regular daily working shifts for the evening issues and the night shifts for the Sunday issue consisted of eight hours each. As accurate figures for hours, production, and labor cost by groups could not be obtained, all possible information

was secured from supervisors. The wet-flong method was ordinarily used, but dry flong was employed occasionally in emergencies. The number of workers employed daily varied somewhat, being 9 during 6.7 per cent of the shifts in the selected period, 10 during 23.3 per cent, 11 during 43.3 per cent, and 12 during 26.7 per cent of the shifts. The daily work included flong making, matrix molding and packing, plate casting and finishing, and job casting and finishing.

The molding equipment consisted of one matrix rolling machine, with drying presses, partly steam heated and partly electrically heated, and a steam heated packing table. It was operated by a crew of from two to four hands. The number of forms molded per shift ranged from 50 to 109, with an average of 71.2 for the selected period, estimated at about 2.5 per total man-hour for the division. The rolled matrix, with the form, was ordinarily placed under the platen of the drying press within from 1 to 3 minutes after the form was received from the composing room, and the completed matrix placed in the chute to the foundry from 7 to 9 minutes later, making the customary time consumed in molding and packing a matrix from 8 to 12 minutes, clock time. It was claimed that under customary working conditions a matrix had been molded from wet flong and four plates cast from it delivered to the pressroom in 6.5 minutes, and that such a task had been accomplished in less than 4 minutes during a test. With the use of dry flong in an emergency, it was stated, the matrix could be sent to the foundry in 2 minutes after the form was received from the composing room. Four editions were ordinarily published, but the number of extra forms molded were only one-half of the number in the regular daily issues.

Casting of plates was performed on one double Junior Autoplate-Autoshaver equipment, with coal fuel for the metal furnace, necessitating refueling and constant watching on the part of the metal-pot tender. Ordinarily, only one casting mechanism was used, requiring a crew of four for its operation. When both mechanisms were utilized, as for the Sunday issues, two other men were added. Six perfect plates were usually required from each matrix for the evening issues, while eight were customary for the Sunday issue. It was claimed that three sets of 32 plates each, or 96 plates, were ordinarily produced in one hour, clock time, using one casting mechanism. As four hands were required for the operation, this was equal to approximately 24 plates per man-hour for the division. The equipment for job casting and finishing consisted of the usual machines for the operation, partly in duplicate.

The man-hour production of plates, based on the total man-hours for all employees, was a little less than that shown in Table 54, for room No. 1 during the 1926 period. The difference was practically due to the same reasons as those for the larger variation shown for room No. 2. The average labor cost per hour was much smaller than that for room No. 1, on account of several factors, such as customary lower rate for daywork and the relatively small proportion of overtime, which in the aggregate was less than 0.4 per cent of all man-hours. In addition, it was affected by the inclusion of apprentices, who received a much lower daily rate, as their total man-hours during the period amounted to over 17 per cent of the total man-hours for all employees.

STEREOTYPING ROOM NO. 4 IN 1926

PRODUCTIVITY AND LABOR COST FOR PROCESS

Working arrangements in stereotyping room No. 4 were subject to still another phase of newspaper publication, the issuing of many editions, which is practically necessary for an evening newspaper in a large city where competition is keen. Table 64 contains data for the production of plates during the selected period in 1926, based on total man-hours for all employees.

TABLE 64.—*Man-hour production and labor cost in newspaper stereotyping room No. 4 in 1926 (based on total man-hours)*

Occupation	Man-hours worked in producing 29,033 plates	Average production per man-hour	Labor cost per man-hour	Cost of man-hour production	
				Time cost	Labor cost
Molding division:		*Plates*		*Minutes*	
Molders	1,134.0		$1.287	8.8	$0.189
Packers	1,270.5		1.250	9.9	.206
Foundry division:					
Autoplate operators	1,127.0		1.267	8.8	.185
Cylinder tenders	1,127.0		1.267	8.8	.185
Metal-pot tenders	746.5		1.249	5.8	.121
Shaver tenders	575.5		1.273	4.5	.095
Total, productive labor	5,980.5	4.85	1.266	46.5	.980
Job men	358.5		1.218	2.8	.059
Laborers	1,037.0		.684	8.1	.092
Supervisory employees	345.0		1.600	2.7	.071
Total, nonproductive labor	1,740.5		.988	13.5	.223
All employees	7,721.0	3.76	1.203	60.0	1.203

The newspaper was published evenings during the six week days with regular working shifts of 7½ hours for the workers but with a daily working period for the establishment of 15 hours, to handle the many different editions. The explanations given for Table 50 (see p. 104) apply also to this table, except that in this table the nonproductive labor includes an additional group designated "laborers," as it was necessary to transport the plates between the foundry and the pressroom on small electric lifts, situated some distance from the plate-making equipments. The man-hour production of plates, on the basis of man-hours for either total productive labor or all employees, was much smaller than that shown for stereotyping room No. 1 (see Tables 50 and 54) principally on account of the longer daily working periods.

PRODUCTIVITY AND LABOR COST FOR MOLDING OF MATRICES

Table 65 contains data for molding and backing up 2,263 matrices by the molding division, on the basis of total man-hours for the productive labor in the division:

TABLE 65.—*Man-hour production and labor cost for productive labor in molding of matrices in newspaper stereotyping room No. 4, in 1926 (based on total man-hours)*

Occupation	Man-hours worked in molding 2,263 forms	Average number of forms molded per man-hour	Labor cost per man-hour	Cost of man-hour production	
				Time cost	Labor cost
				Minutes	
Molders	1,134.0	2.00	$1.287	28.3	$0.606
Packers	1,270.5		1.250	31.7	.660
Total	2,404.5	.94	1.267	60.0	1.267

To save time in molding, dry flong was used for most of the starters, or for approximately 15 per cent of the total number of matrices molded, eliminating that portion of flong preparation. Records were not available of the time spent in preparing the wet flong for the rest, which was done between the intermittent periods of actual molding, and for which individual tissue-holding tables were employed. Molding was done on two or three matrix rolling machines, each operated by one man. Two assistants were employed in each case to plane down the forms, to bring the flong from the storage room, and to send the molded matrices down the chute to the packing section near the foundry. Pneumatic steam tables were employed for the wet flong, while both a flat and a curved gas-heated scorcher were used in the packing section, especially for the dry flong but also occasionally for the final drying of the wet-flong matrices. The working hours for the molders constituted 47.2 per cent of the total hours for the division, while the working hours for the packers amounted to 52.8 per cent. An average of 2 forms were molded per man-hour, based on man-hours for molders alone, while based on total man-hours for the division the production was reduced to 0.94 matrice per man-hour, both lower than those shown for room No. 1. The figures are, however, not strictly comparable, on account of the variation in conditions of publishing and shop arrangements. No account was kept of imperfect molds, the number being claimed to be practically insignificant.

The basic wage rate was the same for all of the productive labor and, as the publication was an afternoon paper entailing day work, was lower than that for the morning papers, but in this case the actual man-hour labor cost was increased considerably through the proportionately large amount of overtime. This amounted to 39.2 per cent of the total time for the molders and 30.9 per cent of the total time for the packers, creating a difference of 3.7 cents in man-hour labor cost between the two groups. The aggregate overtime for the combined groups was 34.8 per cent of the total man-hours for the division.

PRODUCTIVITY AND LABOR COST FOR CASTING OF PLATES

Table 66 contains data for casting 29,033 plates by the foundry division, on the basis of total man-hours for the productive labor in the division.

TABLE 66.—*Man-hour production and labor cost for productive labor in casting of plates in newspaper stereotyping room No. 4, in 1926 (based on total man-hours)*

Occupation	Man-hours worked in casting 29,033 plates	Average number of plates cast per man-hour	Labor cost per man-hour	Cost of man-hour production	
				Time cost	Labor cost
				Minutes	
Autoplate operators	1,127.0	25.67	$1.267	18.9	$0.399
Cylinder tenders	1,127.0		1.267	18.9	.399
Metal-pot tenders	746.5		1.284	12.5	.261
Shaver tenders	575.5		1.273	9.7	.205
Total	3,576.0	8.12	1.264	60.0	1.264

Casting was performed on double Junior Autoplate-Autoshaver equipments. Two of these were customarily employed during the major portion of each shift, providing 4 casting mechanisms and requiring 12 workers for operation. Fewer pages were changed in the late editions than in the early ones, and during the latter part of each shift only one equipment was used, or 2 casting mechanisms, reducing the crew to 6. Once a week an additional equipment was employed during the busiest part of the day, providing 6 casting mechanisms in all, with a total of 18 workers. The number of plates cast, on the basis of all hours worked by operators, was 25.67 per man-hour, or 78.5 per cent of the man-hour production on the same basis in room No. 1. The production per man-hour on basis of total hours for the entire division was 8.12 plates, or 76 per cent of that for room No. 1 in 1926. The reduction was due to the longer daily periods of work, necessary because of the many editions.

The basic wage rate for all of the productive labor was the same as in the molding division, and the man-hour labor cost was influenced by the relatively lower rate for daywork and the comparatively large amount of overtime. The overtime amounted to 34.8 per cent for operators and cylinder tenders, 30.7 per cent for metal-pot tenders, and 36.1 per cent for shaver tenders, or an average of 34.1 per cent of the total time for all the groups. For none of the groups did the man-hour labor cost mount quite as high as that for the molders, nor as low as that for the packers, nor was it as high as those shown for room No. 1 in 1926.

OUTPUT PER PRODUCTIVE MAN-HOUR

The productive time for molding of matrices and casting of plates, computed in the same manner as for the other establishments and presented in Table 67, show only a relatively slight variation from the total time involved. This table is comparable with similar tables for the other establishments.

TABLE 67.—*Man-hour production for productive labor in newspaper stereotyping room No. 4, in 1926 (based on productvie man-hours)*

Occupation	Man-hours			Production	
	Total	Productive		Total	Per productive man-hour
		Number	Per cent of total		
Molding division:				*Matrices*	*Matrices*
Molders	1,134.0	1,095.1	96.6	2,263	2.07
Packers	1,270.5	1,253.9	98.7	2,263	1.80
Total	2,404.5	2,349.0	97.7	2,263	.96
Foundry division:				*Plates*	*Plates*
Autoplate operators	1,127.0	1,096.6	97.3	29,033	26.48
Cylinder tenders	1,127.0	1,096.6	97.3	29,033	26.48
Metal-pot tenders	746.5	548.3	74.4	29,033	52.95
Shaver tenders	575.5	548.3	95.4	29,033	52.95
Total	3,576.0	3,289.7	92.0	29,033	8.83

The figures for the molding division presented somewhat different problems from those for the previous establishments. Both wet flong and dry flong were used, and separation could not be made of time devoted to each class. Nine or ten editions were published of each daily issue, with occasionally an additional one, involving molding and casting more than three times the number of pages contained in one copy. The first edition was issued early in the daily working period, and the last one late in the period, making the productive time as computed appear larger than actually correct because a great amount of idle machine time existed between editions. The productive time for the molders, as shown, constituted 96.6 per cent of the total working hours for the group, while the productive time for the packers was 98.7 per cent of the total hours worked by them. The output per productive man-hour figured only 2.07 matrices for the molders, 1.8 matrices for the packers, and 0.96 matrix for the combined groups. Comparison with Table 57, for room No. 1 during the same period, shows that this output was 43.2, 63.6, and 53.0 per cent, respectively, of the output for the same groups in the molding division of room No. 1, all indicative of much idle machine time. Dry flong was used for the starter forms, and two matrices were molded from each as a precaution against accident. The average clock time consumed in molding from the starter forms was 2.75 minutes, with a minimum of 1 minute and a maximum of 9 minutes. The average clock time consumed in packing was 6.25 minutes, with a minimum of 2 minutes and a maximum of 17 minutes.

The productive man-hours for the Autoplate operators and also for the cylinder tenders, constituted over 97 per cent of the total man-hours for such groups, while those for the metal-pot tenders were almost 75 per cent and those for the shaver tenders over 95 per cent of the total man-hours for the respective group, making a general average of 92 per cent. As with the molding division, the productive time evidently included a large proportion of idle machine hours, which was reflected in the production. The average output of the operators and of the cylinder tenders was 26.48 plates per productive man-hour, only 35.9 per cent of the production for the same groups in

room No. 1 in 1926. It was, however, the output of one casting mechanism in this particular establishment, under the conditions necessary for the work required. As complete double equipments were used at all times, either 2, 4, or 6 casting mechanisms, the productive hours for metal-pot tenders, and for shaver tenders, equaled exactly one-half of those for the operators, but a variation in the total hours for these groups changed the percentage the productive hours were of total hours to 74.4 for metal-pot tenders and to 95.4 for shaver tenders. The production for each of these two groups, on the basis of productive man-hours, as well as for each double equipment, was 52.95 plates, or 50.3 per cent of that for room No. 1. The productive man-hours for the division aggregated 92 per cent of the total hours, with an output of 8.83 plates per hour as against 21.7 plates for the foundry division in room No. 1.

The productive hours for the molding division constituted 41.7 per cent of the total productive hours for the two divisions, while those for the foundry division aggregated 58.3 per cent, nearly the same relation as between the total working hours for the two groups, which were 40.2 and 59.8 per cent, respectively.

TIME RECORDS FOR PLATE CASTING

The number of perfect casts required from each matrix, determined by the number of presses operated for the particular edition, ranged from 2 to 14. Four, 8, and 12 plates predominated. Table 68 shows the details as to clock time for the casting of starters, and is comparable with Table 58 for room No. 1.

TABLE 68.—*Clock time consumed in casting of plates from starter forms in newspaper stereotyping room No. 4, in 1926*

Number of plates per matrix	Number of minutes required to cast 1 set of plates			Average number of plates cast per minute	Number of plates per matrix	Number of minutes required to cast 1 set of plates			Average number of plates cast per minute
	Minimum	Maximum	Average			Minimum	Maximum	Average	
2	3.0	7.0	5.0	0.40	11	6.0	6.0	6.0	1.83
3	3.0	3.0	3.0	1.00	12	4.0	10.0	5.62	2.14
4	2.0	3.0	2.86	1.40	13	9.0	9.0	9.0	1.44
5	3.0	3.0	3.0	1.67	14	7.0	15.0	9.50	1.47
6	4.0	4.0	4.0	1.50					
7	2.0	5.0	3.86	1.82	General average for all plates				1.73
8	3.0	5.0	3.93	2.07					
10	5.0	6.0	5.50	1.82					

The average number of plates cast per minute ranged from 0.4 to 2.1, partly determined by the number cast from each matrix, with a general average for all plates of 1.73 per minute, or 81.9 per cent of the speed attained in room No. 1 in 1926. A smaller number of plates was, however, produced from each matrix part of the time, and the average production of plates was practically the same in both places when the same number was cast from one matrix. The average clock time between receipt of the starter form from the composing room and delivery of the first plate from it to the pressroom was 9.71 minutes, or 0.35 minute longer than for the same function in room No. 1 in 1926, with the same minimum of 4 minutes, and a maximum of 21 minutes as against 22 minutes in room No. 1.

NONPRODUCTIVE LABOR

As for the previous establishments, job men were considered only in the general table for all employees (Table 64) because no record was kept of the work accomplished. The majority of the job work was performed by special labor, engaged exclusively in that occupation, but also occasionally by labor ordinarily employed in other capacity when accumulation of job work necessitated, and then usually on overtime. The overtime for the group, however, amounted only to 13.4 per cent of the total hours, or about two-fifths of the percentage for the productive groups, reflected in the lower labor cost per man-hour. The equipment consisted of a single set of the usual machines for such work. The supervisory group, which was also included only in Table 64, showed a relatively higher man-hour labor cost, due to the proportionately higher daily wages, though not subject to overtime.

The nonproductive labor in this establishment differed from that in the others by the inclusion of a third group, designated as "laborers" because the work did not require any mechanical skill. They transferred the new, finished plates to lifts for transportation to the pressroom, removed the used plates from the lifts to trucks, and cleaned the floors. The regular daily wage rate for members of this group was only a little over half of the daily rate for productive or other skilled labor, but the cost per man-hour was increased considerably through overtime, which constituted 33.5 per cent of the total time for the group.

STEREOTYPING ROOM NO. 5 IN 1926

PRODUCTIVITY AND LABOR COST FOR PROCESS

STEREOTYPING room No. 5 was operated in nearly the same manner as room No. 4, but differed through the newspaper being a morning issue, Sundays included, and having daily working periods in the stereotyping room of 9 hours each, as well as having a smaller number of editions. Table 69 contains data for the production of plates during the selected period in 1926, based on total man-hours for all employees.

TABLE 69.—*Man-hour production and labor cost in newspaper stereotyping room No. 5, in 1926 (based on total man-hours)*

Occupation	Man-hours worked in producing 30,303 plates	Average production per man-hour	Labor cost per man-hour	Cost of man-hour production	
				Time cost	Labor cost
		Plates		*Minutes*	
Molding division:					
Molders	854		$1.367	7.9	$0.179
Packers	909		1.347	8.4	.188
Foundry division:					
Autoplate operators	1,051		1.362	9.7	.219
Cylinder tenders	1,051		1.362	9.7	.219
Metal-pot tenders	585		1.365	5.4	.122
Shaver tenders	585		1.365	5.4	.122
Total productive labor	5,035	6.02	1.361	46.3	1.050
Job men	238		1.417	2.2	.052
Laborers	800		.744	7.4	.091
Supervisory employees	450		2.089	4.1	.141
Total nonproductive labor	1,488		1.258	13.7	.287
All employees	6,523	4.65	1.337	60.0	1.337

The newspaper was published every morning, Sundays included. The regular working shift for individual workers was six hours for six nights of the week, but on Saturday nights one and one-half hours were added. The total working period for the establishment stretched over nine hours per night. In other respects the conditions described for room No. 4 existed also in room No. 5, including the additional group of nonproductive labor. The man-hour production of plates, on the basis of man-hours for either total productive labor or all employees, exceeded that for room No. 4, but did not reach that attained in room No. 1.

PRODUCTIVITY AND LABOR COST FOR MOLDING OF MATRICES

Further analysis of conditions have been presented in Tables 70 and 71. Table 70 contains data for molding and backing up 2,208 matrices by the productive labor in the molding division, on the basis of the total man-hours worked by it:

TABLE 70.—*Man-hour production and labor cost for productive labor in molding of matrices in newspaper stereotyping room No. 5, in 1926 (based on total man-hours)*

Occupation	Man-hours worked in molding 2,208 forms	Average number of forms molded per man-hour	Labor cost per man-hour	Cost of man-hour production	
				Time cost	Labor cost
				Minutes	
Molders	854	2.59	$1.367	29.1	$0.662
Packers	909		1.347	30.9	.694
Total	1,763	1.25	1.357	60.0	1.357

Wet flong was used most of the time, but with dry flong being employed occasionally for the starters. Records for time devoted by the molders to preparation of the flong were not available, preventing accurate segregation of the data. Individual tissue-holding tables were employed for the operation. Molding was performed on two or three matrix-rolling machines, with one operator on each and two assistants for all. Pneumatic steam tables were also used. Two gas-heated scorchers, one flat and one curved, were employed in the packing section for final drying and particularly for the dry flong when used. The working time for the molders constituted 48.4 per cent of the total hours for the division, while those for the packers aggregated 51.6 per cent. An average of 2.59 forms were molded per man-hour, based on man-hours for the molders alone, slightly less than during the same period in room No. 1, where the dry-flong method was used exclusively, but nearly 30 per cent more than in room No. 4, where both wet and dry flong were used. Based on total man-hours for the division, an output of 1.25 completed matrices was attained, 20.2 per cent over the production in room No. 1 on similar basis, and 33 per cent more than in room No. 4. The big difference between room No. 5 and room No. 4, where the actual work was conducted in similar manner, was due principally to the difference in length of the daily working period. Imperfect molds were claimed to be practically unknown, and no account was kept of them.

The basic wage rate was the same for all of the productive labor. It was higher than that for room No. 4, in spite of the comparatively lower proportion of overtime, because of the work being performed at night. This amounted to only 15.7 per cent of the total time for the molders and 7.6 per cent for the packers, or 11.5 per cent for the two groups combined. The labor cost was somewhat less than for the same occupations in room No. 1, because of the special rates paid in the latter place.

PRODUCTIVITY AND LABOR COST FOR CASTING OF PLATES

Table 71 contains data for casting 30,303 plates by the productive labor in the foundry division, on the basis of total man-hours worked by it.

TABLE 71.—*Man-hour production and labor cost for productive labor in casting of plates in newspaper stereotyping room No. 5, in 1926 (based on total man-hours)*

Occupation	Man-hours worked in casting 30,303 plates	Average number of plates cast per man-hour	Labor cost per man-hour	Cost of man-hour production	
				Time cost	Labor cost
				Minutes	
Autoplate operators	1,051	28.83	$1.362	19.3	$0.437
Cylinder tenders	1,051		1.362	19.3	.437
Metal-pot tenders	585		1.365	10.7	.244
Shaver tenders	585		1.365	10.7	.244
Total	3,272	9.26	1.363	60.0	1.363

Casting was done on double Junior Autoplate-Autoshaver equipments. During 5 nights of the week only 5 casting mechanisms were used, requiring 2 crews of 6 workers each and 1 crew of 4 workers, but during the other 2 nights 6 casting mechanisms were operated, adding 2 workers to the third crew. The number of plates turned out per man-hour, on the basis of man-hours worked by operators was 28.83, over 12 per cent more than that produced in room No. 4 on the same basis, but only a little over 88 per cent of the production in room No. 1. On the basis of total hours for the division, the output was 9.26 plates per man-hour, as compared with 8.12 in room No. 4 and 10.69 in room No. 1 in 1926. Only perfect plates, delivered to the pressroom, were included and no records were kept of imperfect casts.

The basic daily wage rate, which was the same for all productive labor in the division, was also the same as that for the molders. Overtime amounted to 12.1 per cent of the total time both for operators and for cylinder tenders, and 10.8 per cent of the total time both for metal-pot tenders and for shaver tenders, making a general average of 11.6 per cent for the division, nearly the same as for the molding division, but only approximately one-third of the percentage for room No. 4. The labor cost per man-hour was almost equal for the four groups, considerably higher than in room No. 4, and practically the same as that for the same occupations in room No. 1.

OUTPUT PER PRODUCTIVE MAN-HOUR

The productive time, occupied over 90 per cent of the total time and included a good deal of idle machine time between actual operations. Data therefor are presented in Table 72, which is comparable with other tables of similar character.

TABLE 72.—*Man-hour production for productive labor in newspaper stereotyping room No. 5, in 1926 (based on productive man-hours)*

Occupation	Man-hours			Production	
	Total	Productive		Total	Per productive man-hour
		Number	Per cent of total		
Molding division:				*Matrices*	*Matrices*
Molders	854	778.3	91.1	2,208	2.84
Packers	909	863.2	95.0	2,208	2.56
Total	1,763	1,641.4	93.1	2.208	1.35
Foundry division:				*Plates*	*Plates*
Autoplate operators	1,051	974.5	92.7	30,303	31.09
Cylinder tenders	1,051	974.5	92.7	30,303	31.09
Metal-pot tenders	585	543.3	92.9	30,303	55.78
Shaver tenders	585	543.3	92.9	30,303	55.78
Total	3,272	3,035.7	92.8	30,303	9.98

The productive hours in the molding division included some of the time devoted to preparation of the wet flong and the packing, as this could not be separated from the time for actual molding. For the molders the productive hours, as listed, amounted to 91.1 per cent of the total time for the group, while for the packers it constituted 95 per cent of the total time, making a general average for the division of 93.1 per cent. While working equipment and conditions were practically the same as in room No. 4, several features existed which created differences that affected the productivity. The number of editions of each issue published was far smaller than in the former establishment, and fluctuated considerably. During one-third of the time only three editions were published, but during another third there were five each night, while for the remainder of the time there were either four or six editions. Fewer editions naturally meant fewer forms to mold and fewer matrices to back up. The number of pages contained in one copy of the evening newspaper for room No. 4 and in one copy of the ordinary morning newspaper for room No. 5 were nearly the same, but the number of forms molded daily for the six week-day issues in room No. 5 amounted only to 75 per cent of the number molded in room No. 4. This proportion was changed somewhat through the Sunday morning issue, which contained approximately three times as many pages as the week-day issue. Part of the plates for it were turned out during the previous night and part on Saturday night. Most of the Sunday issue was published in one edition, and only the latest sections, containing current news, were subject to the changes of pages for several editions. Including the Sunday issue, practically the same number of forms were molded and the same number of matrices were backed up each week in the two

establishments, but in room No. 4 this was accomplished in six days while in room No. 5 it was performed in seven nights. Approximately 45 per cent of the forms molded were for pages not included in the final daily issues. The difference in time of actual working periods for the division increased the man-hours proportionately for room No. 4, so that the aggregate number was considerably higher than that in room No. 5, affecting the comparative production. The output was 2.84 matrices per productive man-hour for molders in room No. 5 as against 2.07 in room No. 4, and 2.56 matrices per man-hour for packers in room No. 5 as against 1.8 in room No. 4, or 37.2 and 42.2 per cent more, respectively. The production of the entire division, based on total productive man-hours, was 1.35 matrices in room No. 5, compared with 0.96 in room No. 4, about 40 per cent higher. Compared with room No. 1, the production of room No. 5 was entirely different, the output for molders, packers, and the two groups combined being only 59.3, 90.4 and 74.6 per cent, respectively, of the output there, due mostly to the varied amount of idle time included in the productive time and to the difference in wet and dry-flong methods. Time consumed in molding and packing of starter matrices could not be separated, but the average clock time involved in molding the starter forms and backing up the matrices, which was dry flong part of the time, was 14.73 minutes, with a minimum of 7 minutes and a maximum of 26 minutes.

The productive hours for Autoplate operators, cylinder tenders, metal-pot tenders, and shaver tenders constituted nearly 93 per cent of the total time worked by the group. The prevailing conditions of the establishments, heretofore explained, such as the number of editions published daily, the relative number of pages for the week-day issues, the inclusion of the Sunday issue, and the length of the daily working period, affected also the productivity of the foundry division. Fewer editions meant fewer plates to be cast, with other arrangements, such as number of pages in the issue and the number of presses operated, being equal. The number of plates cast daily for the six week-day issues was approximately only two-thirds of the number cast in room No. 4. A larger number of presses were operated for the Sunday morning issue than for the week-day issues; consequently, more plates were required, so that the entire weekly output of plates in room No. 5 exceeded that in room No. 4, but as in the molding division, the work was performed in seven nights while in room No. 4 only six days were involved. The longer daily working period, increasing the productive as well as the total man-hours for room No. 4, was likewise responsible for the additional production in room No. 5. The average output of the operators, and also of the cylinder tenders (equal to production of one casting mechanism), was 31.09 plates per productive man-hour for room No. 5, against 26.48 plates for room No. 4, or 17.4 per cent more. The average production for metal-pot tenders and for shaver tenders (equal to the production of one double equipment) was 55.78 plates per productive man-hour for room No. 5 as against 52.95 plates for room No. 4. This was only 5 per cent more, and was caused by the partial idleness of one casting mechanism in room No. 5. The average output for the division, which was also affected by the odd number of casting mechanisms, was 9.98 plates per productive man-hour for room No. 5 as against 8.83 plates for room No. 4, or 13 per cent more. Com-

parison with the production of room No. 1 in 1926, on the basis of productive hours, indicates the presence in room No. 5 of much idle machine time, which could not be segregated. The production per man-hour for operators and cylinder tenders, for metal-pot tenders and shaver tenders, and for the division in room No. 5, were respectively 42.1 per cent, 53 per cent, and 46 per cent of the output obtained in room No. 1.

The productive hours for the molding division constituted 35.1 per cent of the productive hours for the two divisions combined, while those for the foundry division aggregated 64.9 per cent, a wider variation than for room No. 4, but corresponding practically with the relation between the total working hours for the divisions.

TIME RECORDS FOR PLATE CASTING

The number of perfect casts required from each matrix ranged from 6 to 28 plates per matrix, according to the number of pages in each issue, which determined the amount of presses to be operated. Table 73 shows the clock time recorded for casting of the starter plates and is comparable with similar tables for other establishments:

TABLE 73.—*Clock time consumed in casting of plates from starter forms in newspaper stereotyping room No. 5, in 1926*

Number of plates per matrix	Number of minutes required to cast 1 set of plates			Average number of plates cast per minute	Number of plates per matrix	Number of minutes required to cast 1 set of plates			Average number of plates cast per minute
	Minimum	Maximum	Average			Minimum	Maximum	Average	
6	3	8	4.33	1.38	16	5	12	8.5	1.88
8	7	12	9.50	.84	17	5	5	5	3.40
9	9	9	9.0	1.00	18	15	15	15	1.20
10	5	9	7.0	1.43	22	24	26	26	.85
11	5	21	8.68	1.27	28	19	19	19	1.47
12	5	23	10.77	1.11					
13	6	6	6	2.17	General average for all plates				1.22
14	14	14	14	1.00					
15	20	20	20	.75					

The average number of plates cast per minute ranged from 0.75 to 3.4, being regulated partly by the number of duplicates from each matrix. The general average for all plates was 1.22 per minute, as against 1.73 in room No. 4, or 1.99 in room No. 1 in 1926, considerably lower than that in either of the last-named rooms. The average clock time between receipt of the starter form from the composing room and delivery of the first plate from it to the pressroom was 15.93 minutes, as against 9.71 minutes for room No. 4, or 9.36 minutes for room No. 1, presumably on account of using the wet-flong method in room No. 5. The minimum was 8 minutes and the maximum 27 minutes, as against 4 minutes and 21 minutes for room No. 4, or 4 minutes and 22 minutes for room No. 1. The figures for room No. 5 correspond more nearly to those for room No. 1 during the 1916 period, when wet flong was used there also, giving a minimum time for delivery of the first plate of 8 minutes, but a maximum of 20 minutes and a general average of 10.23 minutes.

NONPRODUCTIVE LABOR

The job men were, as in establishment No. 4, considered only in the general table for all employees (Table 69). The job work was performed mostly by special laborers working only on such work. The equipment was composed of a single set of the ordinary machines used for the purpose. Overtime for the group was 26.9 per cent of the total hours worked, more than for any of the productive labor groups. As the basic rate was the same for these as for other skilled labor, the man-hour labor cost was consequently higher for this group than for the others. The supervisory group, data for which were also given only in Table 69, showed a correspondingly high man-hour cost, on account of the higher daily wage rates for the individuals, though no extra compensation was included for overtime.

Room No. 5 further resembled room No. 4 in including a third group of nonproductive labor, designated "laborers," for handling the plates and cleaning up. The regular wage rate for these laborers, also referred to in Table 69 alone, was 72 per cent of that for skilled labor, and the overtime for the group amounted to less than 10 per cent of the total hours for it, making the difference in man-hour labor cost still larger.

COMPARISON OF PRODUCTIVITY AND LABOR COST IN STEREOTYPING, 1916 AND 1926

MOLDING DIVISIONS AND FOUNDRY DIVISIONS

THE various stereotyping rooms from which the information was collected differed essentially in working arrangements, each being a fair example of some condition commonly encountered throughout the country. The man-hour production and labor cost for all of them for productive labor in the molding divisions and productive labor in the foundry divisions are presented as Table 74 for purposes of comparison.

TABLE 74.—*Man-hour production and man-hour labor cost for productive labor in the molding and foundry divisions of five newspaper stereotyping rooms*

Establishment	Molding division			Foundry division		
	Average production per—		Labor cost per total man-hour	Average production per—		Labor cost per total man-hour
	Total man-hour	Productive man-hour		Total man-hour	Productive man-hour	
	Matrices	*Matrices*		*Plates*	*Plates*	
1916: No. 1	1.47	3.40	$0.859	9.69	21.54	$0.801
1926:						
No. 1	1.04	1.81	1.387	10.69	21.70	1.365
No. 2	3.33	3.33	.990	6.91	6.99	1.169
No. 3	[1] 2.50	----	[1] .947	----	[1] 24.00	[1] .861
No. 4	.94	.96	1.267	8.12	8.83	1.264
No. 5	1.25	1.35	1.357	9.26	9.98	1.363

[1] Estimated.

The table emphasizes the variation in production, which was influenced in the molding division by the kind of flong used, by the number of editions published daily, and by the length of the daily

working periods and the relative amount of idle time therein as well as by shop arrangements. Production in the foundry division, also, was affected by conditions of a like character, as well as by the number of plates produced from each matrix and by the amount of equipment utilized. The man-hour labor cost differed according to the prevailing wage rate for the locality in which the establishment was located, but was also affected by the proportion of overtime.

AVERAGE MAN-HOUR PRODUCTION AND LABOR COST IN STEREOTYPING

For further comparison Table 75 has been compiled, covering man-hour production and labor cost for plates in all establishments, on the basis of man-hours for productive labor and for all employees. The general average was computed by dividing the total number of plates produced in all establishments and the labor cost by the total man-hours for productive labor and for all employees.

TABLE 75.—*Average man-hour production and man-hour labor cost for production of plates in five newspaper stereotyping rooms (on basis of total productive labor and of all employees)*

Establishment	Average production per man-hour for—		Labor cost per man-hour for—	
	Productive labor	All employees	Productive labor	All employees
	Plates	*Plates*		
1916: No. 1	6.38	5.67	$0.821	$0.876
1926:				
No. 1	6.19	5.33	1.374	1.433
No. 2	3.98	2.91	1.099	1.117
No. 3	5.53	5.03	.906	.937
No. 4	4.85	3.76	1.266	1.203
No. 5	6.02	4.65	1.361	1.337
Average for 1926	5.60	4.56	1.277	1.282

Production was regulated in each establishment by the peculiar conditions existing therein, as described in detail heretofore, determining in each case its relation to the general average, as computed. The operations in stereotyping room No. 1 for the selected period in 1916 were virtually the same as those found in some of the other establishments during the period in 1926, but the items therefor have been excluded from the general average, principally because of the low wage rate prevailing at that time as compared with modern wage rates for similar work. The table shows a general average of 5.6 plates produced per man-hour, based on total man-hours for productive labor in the stereotyping rooms of all the establishments, and of 4.56 plates produced per man-hour, based on total hours for all employees in all of the stereotyping rooms. Comparison of the man-hour production for establishment No. 1 in the two periods shows a decrease for 1926 of nearly 3 per cent for productive labor, and of about 6 per cent for all employees. Improvements had been made in equipment, which rendered the labor easier, bettered shop conditions, and permitted faster time for actual sterotyping of one page. These arrangements, however, necessitated additional working hours, and consequently created decrease in hourly production.

The general labor cost in 1926 was $1.277 per man-hour for the productive labor, and $1.282 for all employees, which included some unskilled lower priced labor and some higher priced supervisory labor. The 1926 wage rates were for several localities and varied considerably for these groups. The increase over the 1916 labor cost in establishment No. 1 was 67.3 per cent for productive labor, and 63.6 per cent for all employees. It was due practically to the general increase in wages of all kinds throughout the country during the interval.

CHAPTER 9.—DEVELOPMENT OF PRESSWORK

PRESSWORK BEFORE 1870

HAND AND CYLINDER PRESSES

MECHANICAL appliances are necessary to produce an imprint from type or from stereotype plates. In the beginning the imprint was obtained by placing inked type, covered with a sheet of paper, between two flat surfaces, which were then pressed together by means of a screw, turned by hand. The method was laborious and slow, resulting in only 600 impressions per day for two hands, and from very small forms. By the early part of the nineteenth century improvements in the hand presses permitted production of about 1,500 impressions per 10-hour day for one hand, approximately eight times the early production when the increased size of the product is also considered. Application of mechanical power increased the output to a maximum of 1,000 impressions per clock hour on 24 by 36 inch sheets, with a crew of three hands on each power-driven flat, or platen press.

The invention of the cylinder press permitted faster production and the printing of larger forms, reaching 2,000 impressions per clock hour on 36 by 48 sheets. The type form was placed on a flat bed, which was passed under a cylinder that held the sheet and supplied the impression. Application of power reduced the operating force for a machine to two hands.

ROTARY TYPE PRESSES

Type-revolving presses multiplied the output, according to the number of impression cylinders on the machine, giving an actual production of 1,500 impressions per clock hour per cylinder, or about 7,000 impressions per man-hour on a 10-cylinder machine. The type was placed on a central, revolving cylinder, surrounded by several impression cylinders, to which the sheets were fed.

ROTARY STEREOTYPE PRESSES

The process was revolutionized by the introduction of the Bullock rotary press in 1863, which used curved stereotype plates molded from the type forms and paper manufactured in a continuous web in roll form. The substitution of stereotype plates for type forms permitted printing at a maximum speed of about 10,000 copies of a 4-page paper per hour on a single machine with a crew of four hands. The larger newspapers met their increasing circulation by replacing their cylinder or type-revolving presses with rotary stereotype presses, using single rolls, and by installing additional machines.

Production was retarded for many years through the necessity of folding the papers by hand after printing, or of combining the product of two or more presses when the issue consisted of more than four pages. Considerable trouble was experienced with the paper, which lacked uniform quality and strength, and with the ink, which was not suitable. Experiments by printing-press manufacturers finally eliminated these difficulties, and laid the foundation for the multiple

newspaper presses of the present day. There is no standard pattern for these, not even for those built by one manufacturer, for conditions as to space differ widely in the various newspaper plants and the presses are usually designed to meet individual requirements. So far as operation of modern newspaper presses or production thereon goes, the various makes of the same construction period are very similar.

While the newer styles of presses constantly superseded the older styles on the larger newspapers, both platen and cylinder presses of many varieties were used for the printing of newspapers in 1870 and for many years afterward. Even at the present time quite a few newspapers, especially country weeklies, are turned out on cylinder presses.

R. HOE & CO.

EARLY EXPERIMENTS

The principal early improvements in newspaper rotary web presses were brought out by the firm of R. Hoe & Co., manufacturers of platen and cylinder presses. According to Ringwalt [1] a patent was obtained in 1859 by R. M. Hoe, of New York, for "an improvement, the combination of the feeding mechanism, cutting apparatus, and printing machine, for the purpose of feeding the paper from a roll to the press, and cutting or partially cutting it into sheets as it passes along to be printed. Also in combination with the cutting cylinder, the employment of two pressure rollers for keeping the sheet distended." A roll-fed rotary press, printing from stereotype plates, was brought out by R. Hoe & Co. after many experiments, supplemented by cooperation from paper makers and ink manufacturers in providing paper of uniform quality and thickness and a suitable ink. In this machine the web was perforated after printing and separated by means of accelerating tapes, and the sheets were delivered by a fly.

A number of improvements were invented by the experts of the firm, particularly by Stephen D. Tucker, or were secured from other parties. In 1868 Hoe and Tucker had managed to direct successive sheets into alternate pathways, one long and one short, at the delivery end of the press, which would bring one sheet on top of the other, so that both could be delivered together by one operation of the fly. This was patented in 1872. Later the sheets were sent around a collecting cylinder until six had been gathered, when they were released for a single delivery by a fly, but still delivered flat. It expedited delivery and gave the press a capacity of 18,000 papers per hour, though the average actual production was 12,000 per hour. The first press equipped with such a delivery was installed in the office of Lloyd's Weekly Newspaper at London, England, in 1874; the first one used in the United States was in the office of the Tribune at New York.

In 1875 Tucker patented a "folding cylinder," carrying a rotating blade which forced the sheet between a pair of folding rollers, by which it was delivered. A rotary device had been previously used by Andrew Campbell, of New York, on presses built by him for the Jersey City Evening Journal and the Cleveland Leader, but he had failed to secure a patent. Tucker combined collecting and folding on one cylinder, by which several sheets could be collected, pasted

[1] Ringwalt, J. Luther: American Encyclopedia of Printing, Philadelphia, 1871.

and folded. The first of these folders was placed on a machine built for the Philadelphia Times and operated at the Centennial Exhibition in 1876.

Anthony, owner of an English newspaper, and Taylor secured patents in England during 1876 for rounded bars set at an angle to the travel of the web, by which, after being printed on one side, the web could be reversed to present the other side to the printing cylinder. The patents were obtained by Hoe, as were those of E. L. Ford, New York newspaper publisher, granted in 1877, for uniting the products of two or more printing mechanisms and producing a multiple number of pages at one time. Assembling in such manner had previously been accomplished by Andrew Campbell, of New York, on presses built for the Cleveland Leader, where the webs of two presses were run into one folding mechanism, assembled, and folded as a single product. This idea had also been utilized in 1875 on the English machine, the Victory press, invented by G. A. Wilson, of Liverpool.

Several patents were also purchased from Luther C. Crowell, inventor, of Boston, Mass., who had devised an ingenious, high-speed paper-bag machine. Among them was a longitudinal folder, patented by Crowell in 1873, in which the web was pulled down over a V-shaped iron frame, called a "former," by two rollers at its lower point, giving it a fold along the center margin. The stereotype plates had previously been curved so that the columns of the print ran crosswise of the web, to accommodate the first or transverse fold of the chopping blades, but with this folder the plates were curved so that the columns ran with the web, making the center margin of the two pages the center of the web, where it received the first or longitudinal fold.

The early presses were provided with two plate cylinders, each two plates wide. As only half the circumference of a plate cylinder was occupied by one curved stereotype plate, two of these were required to complete the circle. They were ordinarily duplicates, so that two complete 4-page papers were produced by each revolution of the plate cylinders. By using plates from separate pages, instead of duplicates, and a collecting cylinder, by which two sheets could be placed together, a complete 8-page paper could be produced without hand manipulation. This was quite a factor, as by 1870, 8-page papers had become popular and considerable hand work had been necessary to place two 4-page sheets together. Producing 8-page papers in such manner cut the output in two, as only one paper was printed per revolution, so in 1874 a 4-plate-wide press was devised for turning out an 8-page paper per revolution. It was designated a double perfecting web press.

HOE DOUBLE-SUPPLEMENT PRESS

All of these improvements effectually reduced both labor and time involved in the process, and finally culminated in the first of the modern newspaper presses, the double-supplement press, which again revolutionized the methods of fast newspaper printing. The first one was installed in the office of the New York Herald in 1882, and consisted of a 4-plate-wide press, supplied with a double width web, which was split in the center after printing. The resulting two 2-page-wide webs were conducted over turning bars to a folder, in which they were brought evenly on top of each other. Another press,

two plates wide, was placed at right angles to the main press, geared to the same drive, and the 2-page-wide sheet from this supplement press was associated with the other two at the top of the folder. All three were pulled together down over the inclined "former," receiving the longitudinal fold. A folding cylinder below the point, or nose, of the former was provided with movable pins, which carried the folded webs ahead. It revolved against a knife cylinder, in which was mounted a sharp, serrated blade that cut the webs into page lengths. A revolving tucker blade in the folding cylinder forced the cut-off section between two folding rollers, giving it the second or half-page fold, and into a revolving fly with curved fingers, another of Crowell's inventions. The papers were deposited on endless traveling belts in a continuous stream, and overlapping, each paper being dropped about three-eighths of an inch back of the previous one. A device was later incorporated, by which every tenth, twenty-fifth, or fiftieth paper was projected a couple of inches, indicating the count.

If the full capacity of the press was used, with double plates of each page, a 4-page-wide roll of paper in the main press and a 2-page-wide roll in the supplement press, two complete 12-page papers were turned out for each revolution of the plate cylinders. Two 2, 4, 6, 8, or 10 page papers could also be produced, according to the number of plates clamped on the cylinders and corresponding widths and number of webs used. By operating the collecting device and using one plate for each page, either 16, 20, or 24 page papers could also be produced, but only at the rate of one complete paper per revolution.

After the assembled webs had passed down over the former, the first cut was carried around the knife cylinder or a separate collecting cylinder, and picked up by the pins in the folding cylinder together with the second cut, both being folded together into a single paper of two sections. These principles were retained in succeeding presses, though improved from time to time. For awhile mechanical devices were employed for pasting the sheets together, but they were later discontinued on account of the delays usually created by their use. This style of press rapidly supplanted others previously used in offices large enough to warrant production of 10 or 12 page papers at the rate of 20,000 per hour, and 16 or 24 page papers at half that rate. The maximum production was 24,000 and 12,000 papers per hour, but changing of rolls and other delays reduced the output. Some establishments installed several presses, as one was not sufficient to handle the growing circulation and the increased number of pages. This style of press became popular in England also, where eight of them were installed in 1887 to print Lloyd's Weekly Newspaper.

OPERATION OF DOUBLE-SUPPLEMENT PRESSES

The minimum number of hands required to operate a double-supplement press was three. One of these, the pressman in charge of the press, supervised the running of the machine, regulated the flow of ink, made adjustments to facilitate proper travel of the web, looked after the pasting device, and oiled important bearings when required. In a small pressroom, using only one press, the foreman performed these duties, but in large establishments a pressman was placed in charge of each press, and the foreman acted only in a supervisory capacity. Another worker, commonly known as a brakeman or tension man, was stationed at the belt-shifting lever by which the

press was started or stopped. He was required to watch the webs closely and to shut down the press at once when there was danger of a web breaking or choking in the rapidly moving machinery. He also adjusted the tension on the paper rolls, by tightening or loosening the wooden friction blocks, clamped around a small pulley on one end of the roll shaft, which controlled the passage of the web through the press. The third hand, ordinarily an apprentice, removed the papers from the delivery, and usually kept count of the spoiled copies so that these could be deducted from the total shown on the press counter, thus determining the number of perfect papers printed. When a new roll of paper had to be inserted in the press, all hands usually participated. The rolls were made large, and about 10,000 papers were obtained from the two full rolls. When more than 15,000 papers were printed on one press, an extra hand was usually added to take care of the oiling and to prepare additional paper for the press.

PRELIMINARY WORK

The actual productive operation of the press was, however, only a portion of the work involved, getting it ready for operation occupying considerable of the total working time. With most newspapers, especially the dailies, a certain number of copies had to be delivered to railroad depots, post offices, news stands, and carrier routes at a certain time, to insure distribution at a seasonable hour. For that reason continuous production was necessary at maximum speed after the press had been started, and all preparations were made with that object in view. On daily newspapers the preparations also had to be completed at a certain time, so there would be no delay in starting the press after the last plate had been received from the stereotyping department. The old stereotype plates had to be removed from the cylinders and returned to the stereotyping room. The composition rollers required washing, to free them from the paper dust and grit accumulated during the previous run and also needed testing and adjusting from time to time to insure perfect contact for distribution and application of the ink. The ink fountains required filling, and at times washing out to remove sediment. In those days ink was furnished by the manufacturers in barrels containing about 500 to 600 pounds, and from these barrels the ink was commonly drawn into coal scuttles, and then poured into the fountains. From 1½ to 3 pounds were used for every 1,000 eight-page papers of modern size.

The muslin tympans on the impression cylinders required changing to prevent smutting and to keep the accumulations of ink from soaking into the blankets. The second impression cylinder was originally made three times the size of the plate cylinders, to provide additional tympan space, and was later reduced to double circumference, but equal-size cylinders were finally adopted to reduce the size of the presses. The tympans on the smaller cylinders, of course, required more frequent changing. The felt blankets on the impression cylinders required removal of the high bolsters or ridges formed in the margins by the constant beating of the plates on the contact parts. As the blankets wore down, underlays were required to maintain the correct diameters of the cylinders, and eventually both the felt blankets and the rubber blankets under them required replacing, a task which at one time involved considerable extra work. The cuting mechanism required changing of knife blades when dull and occasionally of cutting sticks in the folding cylinder.

The entire machine required inspection from time to time, to prevent bolts, nuts, screws, or keys from working loose enough to interfere with operation or to cause breakdowns. During the run considerable oil, ink, and paper dust accumulated on the machine, which necessitated regular cleaning. The webs were usually pulled out of the press to permit thorough cleaning and in such case required leading in again. The paper rolls, which in the majority of places were stood on end in the storeroom, required removal of the wrappers, transporting to the press, insertion of spindles on which they were locked, and placing in the brackets for them in the press or in positions close by for quick changes. As 4-page-wide rolls ordinarily weighed 1,000 pounds, and sometimes as high as 1,500 pounds, considerable physical exertion was required. In small establishments the pressroom workers also often assisted in placing the paper rolls in the stock room as they were brought to the plants. In the early days considerable waste was created through damage to the paper rolls, due mostly to insufficient wrapping or to careless handling. This waste had to be taken care of, as well as the wrappers and other waste paper from the pressroom. A baling machine was commonly used for the waste paper. The belting for driving the press required occasional overhauling, and at times even the operation of the steam engine was one of the duties.

Before a run of any appreciable size all working parts in the machine had to be carefully oiled to prevent stoppage through hot bearings. The new stereotype plates required clamping on the cylinders in their respective locations, a feat which involved some exertion, because the plates weighed about 50 pounds apiece, and also some speed (especially for the last plates on the daily newspapers) so that the press could be started as soon as possible. Considerable extra work resulted at times through changes in the number of pages for the different editions, necessitating removal of paper rolls already in the press and substitution of required sizes, as well as complete changes in adjustment of the working parts.

QUADRUPLE PRESSES

The double-supplement press in turn became too small, when papers with more than 12 pages were required for the daily issues or more than 24 pages for the Sunday issues, in order to carry the advertisments. It was soon necessary to make two runs to secure sufficient pages and then insert one of the sections in the other by hand, again slowing up production. To meet this condition, R. Hoe & Co. introduced in 1887 a larger press—known as a right-angle quadruple press, built in the same style as the double-supplement press but with the supplement part four plates wide—which would print two 16-page papers at each revolution of the plate cylinders, twice as fast as on the other style, or one 32-page paper in two sections but folded. It also admitted of the printing of 14 or 28 page papers, which was not possible on the other press. The press was equipped with two folders, placed side by side, and both paper rolls were at floor level, making handling easy. The webs could be carried full width toward the folders, slit on top of the formers, and delivered through both folders, or slit and carried over angle bars into either folder. The first one was installed in the pressroom of the New York World. It became very popular, especially after the second impression cylinder had been reduced to the same size as the plate cylinder, condensing the equipment. Together with the double-supplement press, it

displaced almost all other presses in the larger offices of the United States, as well as in Great Britain and Australia. The name "quadruple" was given to this machine because it contained four single presses. As the earliest rotary presses consisted of two pairs of printing cylinders, each two pages wide and capable of producing eight pages per revolution, a single press had come to mean a machine of that size, and larger machines were ordinarily designated according to the number of such presses they contained. The capacity of the quadruple press was 48,000 copies of an 8-page paper, 24,000 of a 16-page paper, or 12,000 papers of either 20, 24, 28, or 32 pages each, by assembling.

Further improvements followed in rapid succession, by R. Hoe & Co. and by other press builders, on the same general lines of combining several presses, printing from several rolls of paper, and assembling the webs in a folding mechanism, where they were delivered as single papers with the desired number of pages. Ideas embodying time and labor saving devices were sometimes perfected before it was discovered that they interfered with patents held by others, resulting in considerable litigation. For a number of years practically all inventions for improvements were purchased by R. Hoe & Co., and it became difficult to build rotary stereotype presses without infringing on Hoe patents. Presses in a variety of sizes and styles were designed to meet the conditions of the different offices, as each newspaper had problems of its own which required individual treatment. Principal among these were size of page, number of pages in issue, number of copies to be produced within a certain time limit, size of space in which the press was to be erected, and shape of this space. The last two items were responsible for the placing of printing couples above each other, either irregularly or in regular tiers or decks, where the floor space was limited. A double press could be constructed in this manner with 2-plate-wide cylinders arranged parallel in two tiers, with two rolls of paper, one above the other, at one end, the webs being assembled in a folder at the other end. A quadruple could be constructed with either four decks and 2-plate-wide cylinders, or two decks with cylinders four plates wide, to suit available space.

SEXTUPLE PRESSES

Quadruple presses also proved too small, and in 1891 R. Hoe & Co. installed a sextuple press in the office of the New York Herald to supersede the two quadruples there. As implied by its name "sextuple," this machine consisted of six presses, combined in one frame. Four-plate-wide parallel cylinders were used, giving two printing units on the floor and a third one on a deck above, each supplied from a 4-page roll of paper. A double folder was attached at one end. The machine would produce 24-page papers at the rate of 2 per revolution, or collected 48-page papers at the rate of 1 for each revolution. In addition to the varied, smaller sizes, it would also produce 18 or 22 page papers. Its capacity per hour was 48,000 copies of a 12-page paper, 36,000 of a 16-page paper, 24,000 of a 24-page paper, or 12,000 of a 48-page paper. Machines of similar capacity were also constructed with the printing units arranged on three decks.

LARGER PRESSES

As still larger papers were demanded, the firm constructed an octuple press, brought out in 1895, which printed from 4 rolls, was provided with 4 folders, and had a maximum hourly capacity of 96,000 copies of an 8-page paper, 24,000 of a 32-page paper, or 12,000 of a 64-page paper. Again increasing the capacity, decuple presses, with a capacity of two 40-page papers per revolution, were brought out, followed with a double sextuple press, installed in the New York Journal in 1901, consisting of two 3-deck sextuple presses with the four folders arranged in the center, back to back. The following year double octuple presses, 4 decks high, were constructed, with a maximum hourly capacity of 144,000 papers up to 16 pages in size, or 72,000 of sizes from 18 to 32 pages.

As the contents of the daily issues increased, newspaper publishers replaced their presses with others of larger or more suitable capacities. It was found that 14, 16, 28, or 32 pages could be produced to best advantage on quadruple presses, while sextuple presses were better adapted for papers ranging from 18 to 24 pages, and octuples for papers consisting of 2 sections of unequal size, such as 26 and 30 pages or 28 and 32 pages, folded. The presses removed from the larger establishments were usually installed in other, and smaller plants that also needed additional facilities, with the result that many of the old-style presses are still in service throughout the country and a great number of models can be found in use. In many plants increased capacity was obtained by the addition of decks on the presses used at the time, such as decks placed on double-supplement presses, changing them into quintuple or sextuple presses, or on quadruple presses, changing them into sextuple or octuple presses.

OTHER DESIGNS

Other styles had also been introduced by R. Hoe & Co., such as the 3-plate-wide press introduced in 1888, which had a capacity of 24,000 copies of a 4 or 6 page paper per hour, or half that amount of collected 8 or 12 page papers. In 1897 a 5-plate-wide press was also introduced, to permit special combinations and a 20-page product from a single unit. Some styles were built with upper decks which could be adjusted to operate at half speed, when used for the production of papers which were not multiples of four pages. The sheets were cut off above the former, and conducted down over it to the folding cylinder by tapes. While these models did not become popular, compared with the other common styles, each filled its own particular need. Linear construction was introduced in 1907. The printing units were arranged end to end, lengthwise of the press, which was merely a return to the arrangement of the main press in the right-angle construction of 1882, requiring a right-angle turn of the webs to enter the folder. About 1912 another design was introduced, the Simplex newspaper press, intended especially for small daily newspapers with a circulation of 5,000 up to 25,000. It was of the deck type, but arranged so it could be installed as a 16-page press, consisting of 2 decks with 1 folder, and increased by 8-page units up to 48 pages.

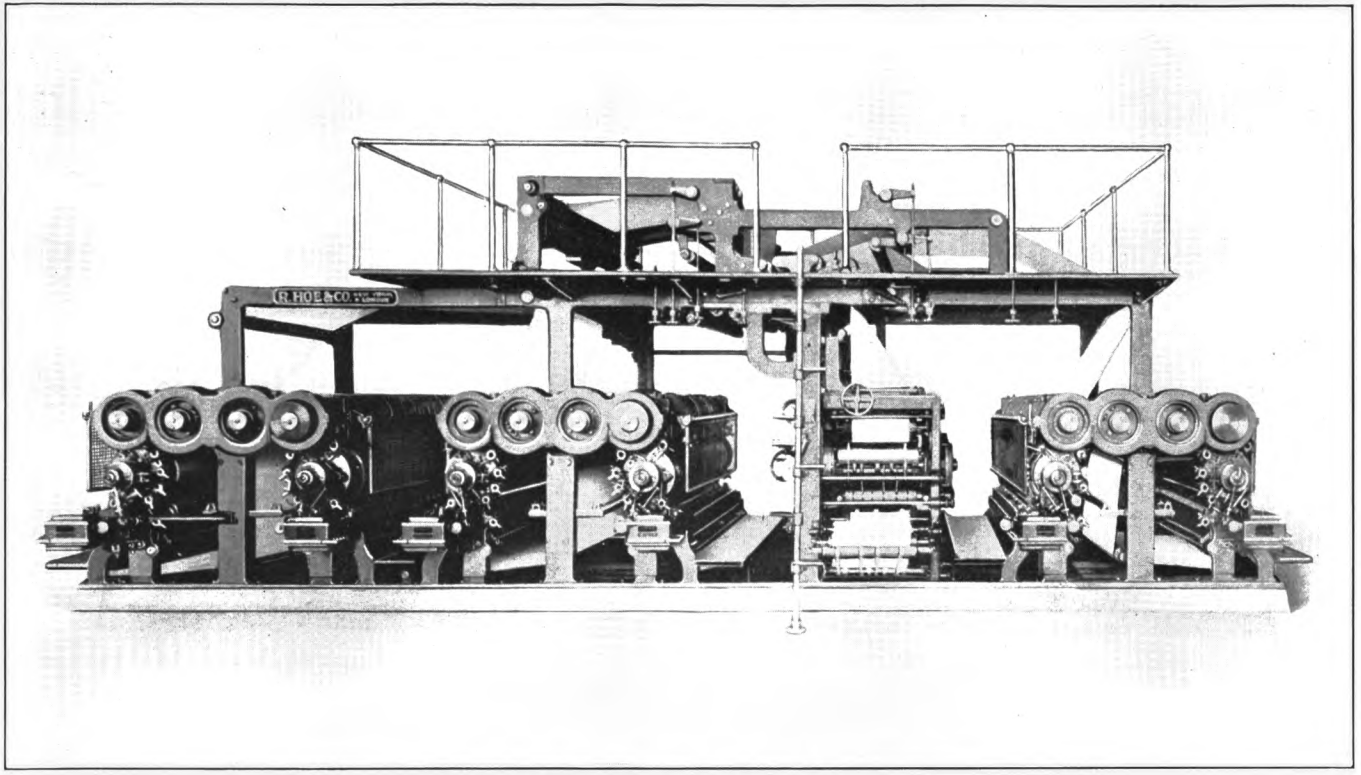
INCREASE IN PRODUCTIVE CAPACITY

The next step in advancement was made through the invention, patented by R. Hoe & Co., of the rotary lightning folder in 1908. It embodied a geared folder blade in place of the cam-driven blade, which would not work satisfactorily at higher speed. In many places these folders were substituted for the older style, increasing the productive capacity of the same presses 50 per cent without additional labor or extra expense. Substitution of the new folder gave a sextuple press a maximum capacity of 72,000 papers per hour of 4, 6, 8, 10, or 12 pages in one section; 54,000 papers of 16 pages, two-thirds of them in one section and the remainder in two sections; 36,000 papers of 14, 16, 18, 20, 22, or 24 pages in one or two sections; or 18,000 papers of 28, 32, 36, 40, 44, or 48 pages in two sections.

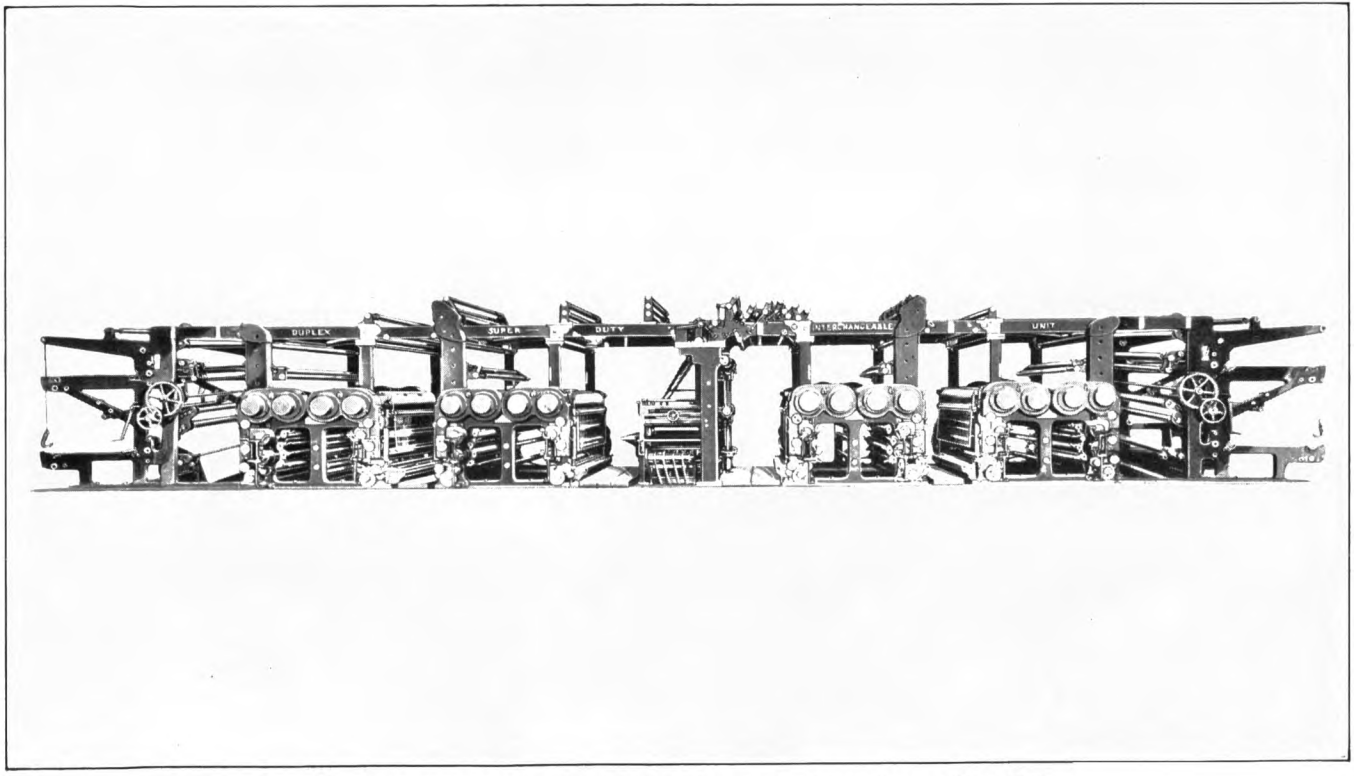
SUPERSPEED PRESSES

Further increase in capacity was created through the invention of the automatic ink-pump distribution, patented by R. Hoe & Co. in 1915, as the old method of supplying the ink from the fountain to the distribution cylinder by means of a swinging composition ductor roller would not permit of higher speed. The ink was forced by means of air pressure or gravity from the main supply tank to a small pump box for each inking mechanism, and by pumps in this box through fine slots onto the distribution cylinder in a fine film. Combined with some improvements of the folder and a new arrangement of printing units, it resulted in the Twentieth Century Superspeed press. The first of these was installed on the New York Times in 1915. It was a return to the low-type unit system, all on the floor, as previously employed in the double-supplement press, but with the units placed tandem in any desired number and interspersed with double folding mechanisms. Each unit consisted of a double press, complete in itself, capable of printing up to 16 pages. The cylinders of all units were placed parallel, and each unit could be silenced at will or operated independently of the other units. The products of several units could be assembled in one of the double folding mechanisms. The units could also be arranged in two or more lines, and different combinations could be obtained by cross association, transferring webs from one line to folders in another.

The maximum speed of a Superspeed sextuple press per hour was 80,000 papers up to 12 pages; 60,000 papers of 16 pages; 40,000 papers of 14 pages and from 18 to 24 pages; or 20,000 papers of 28 to 48 pages, an increase of 11.1 per cent over the productive maximum of the High Speed press. In the large offices the deck style was abandoned for the multiunit style, where possible, so that when page output increased, it was not necessary to substitute entire new equipment for that previously used, but facilities could be enlarged by adding one or more units. Some newspapers installed 12 to 36 or more units each, and increased the number as needed. For example, one afternoon paper, the Philadelphia Evening Bulletin, installed 30 Superspeed units in 1921, 15 more in 1922, and ordered 48 additional in 1924. By the middle of 1926, an installation of 11 more units brought the total up to 104 units, in decuple and octuple combinations.



HOE UNIT-TYPE SUPERSPEED SEXTUPLE PRESS, 4 PAGES WIDE



DUPLEX METROPOLITAN SUPER-DUTY, SEMICYLINDRICAL PLATE, OCTUPLE PRESS, 4 PAGES WIDE

DUPLEX PRINTING PRESS CO.

OTHER manufacturers had entered the field and competed strenuously in devising time-saving and labor-saving improvements, which were embodied in their particular makes of rotary newspaper presses, usually known under the name of the firm. Among these were the present day manufacturers, Duplex Printing Press Co., Goss Printing Press Co., Walter Scott & Co., and Wood Newspaper Machinery Corporation. Notable among firms now out of existence, but whose presses can still be found in operation in various places, usually small, were the Campbell Printing Press & Manufacturing Co., C. Potter, Jr., & Co., and Seymour & Brewer Printing Press Co.

The tendency to crowd the printing mechanisms together in skyscraper style, making access to some of the parts difficult, was countered by a new style rotary press in 1906, brought out by the Duplex Printing Press Co. of Battle Creek, Mich., which previously had manufactured the Cox Duplex flat-bed perfecting web press for use in small newspaper plants. The first of these, a quadruple press, was installed in the office of the Journal of Commerce and Commercial Bulletin at New York. It consisted of two sections, each a double press or four plates wide, placed end to end, with the folding mechanism at one end but turned at right angles. The webs were brought up from the cylinders and slit into 2-page-wide ribbons, each of which was given a right-angle turn, over an angle bar, and conducted into the folder. As the entire press was only 6 feet in height, it could easily be operated in a room with 8 feet to the ceiling. Each set of inking rollers was held in a swinging frame and could be swung out by turning a handwheel, permitting the rollers to be washed without removing them one at a time from the press. Its capacity was rated at 30,000 per hour for 4 to 16 page papers, or 15,000 per hour for 20 to 32 page papers A second folder, added later, increased the capacity for 4, 6, or 8 page papers to 60,000 per hour. Five-plate-wide sections were also constructed.

TUBULAR PLATE WEB PRESSES

In 1909 Henry F. Bechman, superintendent of the firm, succeeded in perfecting a press to carry tubular plates—plates extending clear around the cylinders. As early as 1863 John C. MacDonald and Joseph Calverley, stereotypers on the London Times, obtained patents in England for casting plates in tubular form, but there was no record of any press being constructed to utilize them. The first tubular-plate web press constructed, which was installed in the pressroom of the Kalamazoo Evening Press, Kalamazoo, Mich., in 1909, and eventually found its way to Honolulu, Hawaii, was a 2-plate-wide machine, with a capacity of 16 pages. The tubular plates were provided with a slot along the entire length that permitted slipping them over one end of the plate cylinders, which rested in journals with special supports. The printing parts were arranged in decks, with the rolls of paper at one end, and the webs were carried straight into a folder at the other end. The single-plate-for-page system permitted printing any number of even pages up to plate capacity at a maximum speed of 30,000 papers per hour, in one section, but no products were collected. The style was intended for newspapers requiring up to 24 pages, and for any circulation. Two-

plate-wide presses were consequently built up to 24-page capacity, but later the Metropolitan Tubular Plate web press was introduced, with cylinders four plates wide adaptable to any number of pages as well as to any circulation. The first of these, a quadruple press, was installed in the office of the Detroit Times in 1916.

The popularity of the low-construction unit press resulted finally in the manufacture of a similar design, the Duplex Metropolitan Super Duty press, constructed for use with semicircular plates. It was intended for operation at the rate of 300 revolutions per minute, giving a maximum production per hour of 36,000 24-page papers on a sextuple press.

GOSS PRINTING PRESS CO.

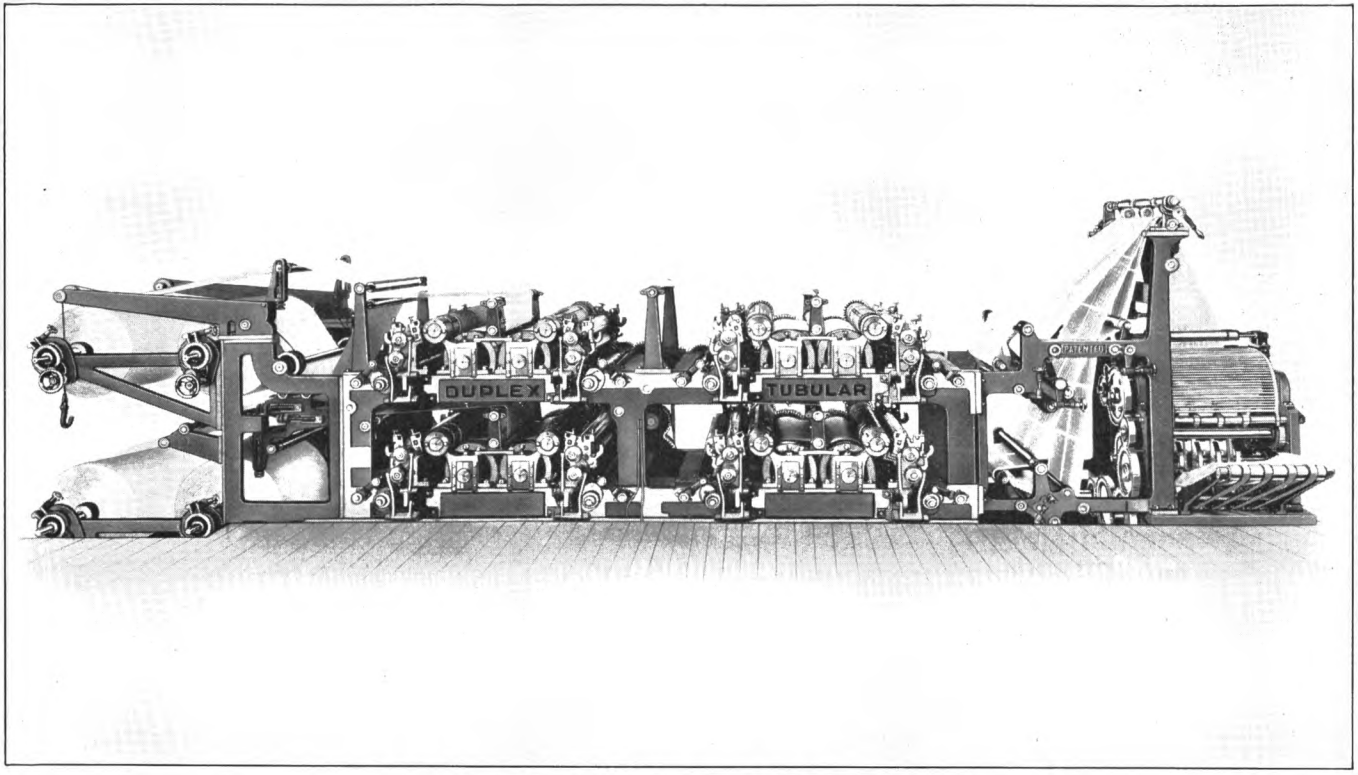
JOSEPH L. FIRM, foreman of the pressroom in Frank Leslie's publishing house, took out patents in 1889 for a straight-line construction, arranging the printing couples with the cylinders parallel, either tandem or in tiers above each other, so that the webs could be carried in a parallel plane from the roll to the folding and delivery mechanism at one end, regardless of the number of printing units in the frame. In 1891, Firm constructed a sextuple press on these principles for the New York World, but it was so crude and so badly built that it was condemned.

Firm disposed of his patent to the Goss Printing Press Co., of Chicago, Ill., with whom he became associated, and which manufactured 2-plate-wide or 4-plate-wide presses of all sizes, very similar to the Hoe deck type presses, but included also five decks among the varieties. In the beginning the speed capacity was only 20,000 papers per hour in single sections, with 2 papers for each revolution of the cylinders, or 10,000 collected papers. This was increased to 25,000 and 12,500 papers, and high-speed presses, brought out later, raised the capacity to 36,000 and 18,000, respectively, both for the deck type and for the tandem low-construction Unit-Type, which was also adopted by the Goss Printing Press Co.

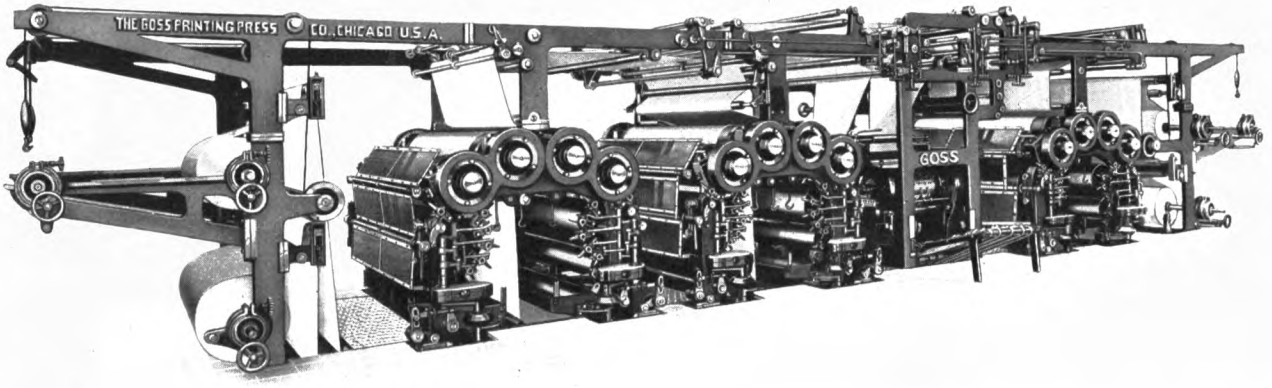
Three-page-wide presses had likewise been turned out by the firm, as well as a Goss Junior Straightline press, with 1 plate-wide cylinders and type columns lengthwise of the cylinders. Only one plate was used for each page, except on 6 or 10 page papers, when there were 2 more plates than pages. The maximum capacity per hour of a 3-deck press of that type was 20,000 papers of 12 pages, and of a 5-deck press the same number of papers of 20 pages.

WALTER SCOTT & CO.

THE first successful attempt to attach a folding mechanism to the Bullock rotary web press was made by Walter Scott, foreman on the Chicago Inter-Ocean, who invented a press in 1872, and later established the firm of Walter Scott & Co., which erected a plant at Plainfield, N. J., in 1884. The firm manufactured at first some small single-roll presses, but then devoted itself to producing deck types, similar to the Hoe or Goss presses, 2 to 4 decks high and 2 plates wide or 4 plates wide. These were rated at a maximum capacity of 25,000 papers per hour in single sections, with 2 papers for each revolution of the cylinders, or 12,500 collected papers. The speed was increased to 26,000 and 13,000, later to 30,000 and 15,000, and



DUPLEX TUBULAR PLATE ROTARY STEREOTYPE 16-PAGE PRESS, 2 PAGES WIDE



GOSS HIGH-SPEED, LOW CONSTRUCTION, SEXTUPLE PRESS, 4 PAGES WIDE

finally to 36,000 and 18,000 papers, respectively, for deck types. The latter speed was also claimed for the Multi-Unit low-construction presses, designed under end-to-end patents and multiple-drive patents of 1906, 1913, and 1914. The units were arranged with the cylinders lengthwise of the press, and the presses were built either in a single row or a double row of units, which could be operated independently or in combinations. Such an equipment, consisting of 24 units with 12 folders, was installed in the pressroom of the Detroit News in 1917. The modern, tandem arrangement was also adopted by Walter Scott & Co. in the Straight-Unit newspaper presses, with the units arranged in a single row, and cylinders crosswise of the press, for which a running speed of 400 revolutions per minute was claimed on straight products, or 350 revolutions per minute on collected products. This would give a maximum capacity for a sextuple press of 96,000 papers per hour of 4, 6, 8, 10, or 12 pages in 1 section; 63,000 papers of 16 pages, partly in 1 and partly in 2 sections; 48,000 papers of 14, 16, 18, 20, 22, or 24 pages in one or 2 sections; or 21,000 papers of 28, 32, 36, 40, 44, or 48 pages, collected in 2 sections or associated and collected in 4 sections. Like other manufacturers, Walter Scott & Co. also turned out a 3-plate-wide press, and in the earlier days manufactured a single-plate machine, the Speed King, to produce per hour 24,000 papers of up to 16 pages, using two 2-page rolls of paper.

WOOD NEWSPAPER MACHINERY CORPORATION

ABOUT 1896 Henry A. Wise Wood, of New York, took out patents in connection with perfecting flat-bed web presses, which were assigned to the Campbell Printing Press & Manufacturing Co. He later developed the Autoplate stereotype casting machine, and founded the firm of Wood Newspaper Machinery Corporation. In 1916 a new style of rotary web press, of extra heavy construction, was brought out by the firm, which shortly before had located in Plainfield, N. J. The first one was built for the New York Herald, but due to the death of the publisher was not installed until later, and then in the plant of the New York Daily News.

The second press was placed in the pressroom of the Philadelphia Evening Bulletin in 1917, and two others were installed in the plant of the Philadelphia Inquirer. These were sextuples of the straight-line type, 3 decks high with 4-plate-wide cylinders, and claimed to possess a running speed capable of producing 60,000 copies per hour each of 24-page papers, when operated as 2 independent sextuples, or a total of 180,000 copies of 16-page papers when operated in combination as 3 quadruples, requiring 500 cylinder revolutions per minute. They were provided with air brakes, to permit instant stopping. The speed of 500 cylinder revolutions per minute was not found practical, because the paper was of too poor a quality and inking rollers, made out of composition, could not stand the attendant strain.

In 1925 another press, of the unit-type design, was installed in the new pressroom of the Philadelphia Inquirer. It consisted of 12 units, placed tandem, with 1 double folder in front of each 3 units and each folder provided with 3 formers. The special ink mechanism was simple and easily adjustable, free from ductor rollers, as well as pumps and pipes. Strain on the paper was claimed to have been

reduced by special control, and the press was declared to be capable of maintaining a daily working speed of not less than 50,000 copies per hour of 68, 72, 76, 80, 84, 88, 92, or 96 page products, or smaller ones in proportion, and that it could be operated safely in emergencies, during long periods at a time, up to 60,000 copies per hour.

A small press, the Wood Bee-Line press, was also placed on the market in 1925. It was provided with a single folder, and consisted of one or two units, with the cylinders lengthwise of the press, and was principally intended for the use of small city dailies. Later an inserting mechanism was attached, which increased the flexibility by permitting the addition of pages by twos instead of fours. This inserting mechanism could also be provided for the larger press, where it would permit increase by twos on large as well as on small products.

OTHER ROTARY NEWSPAPER PRESSES

CAMPBELL PRESSES

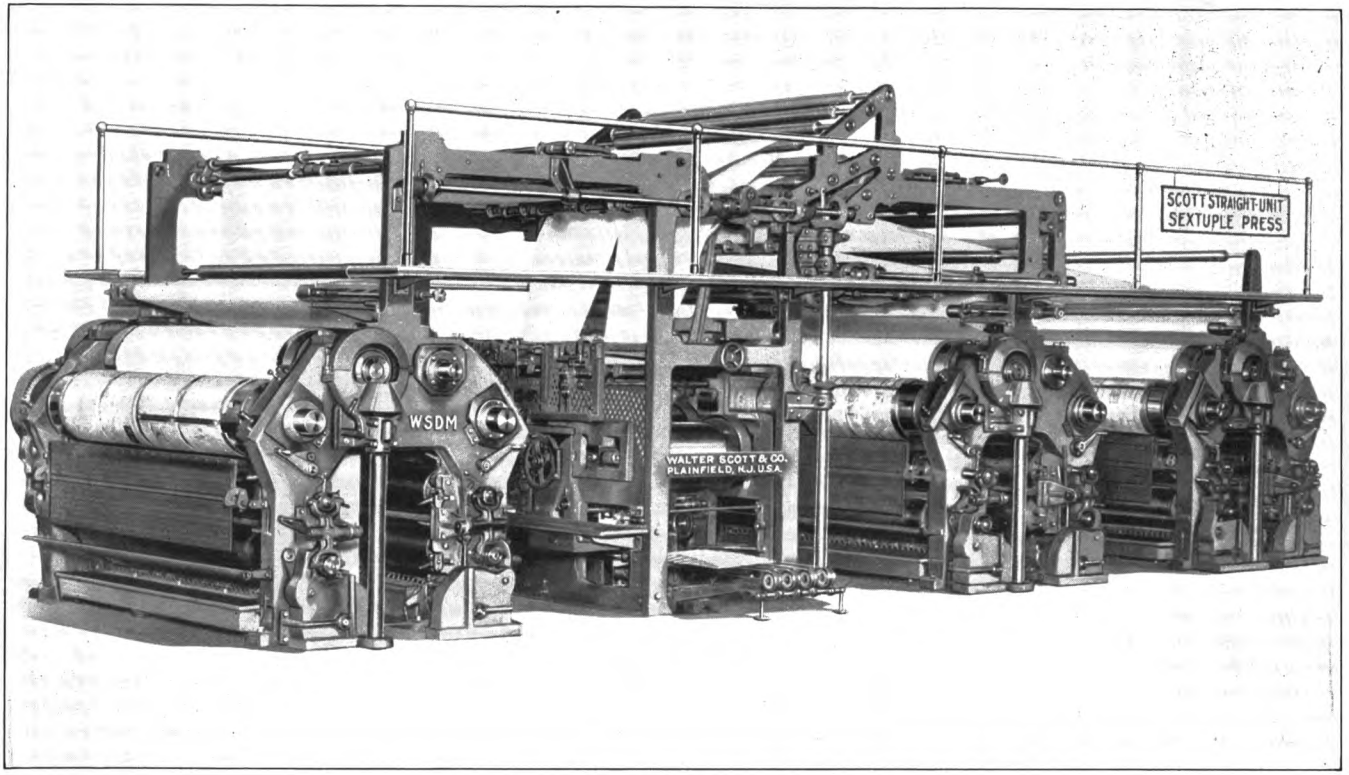
ONE of the prominent cylinder press manufacturers, Andrew Campbell, of New York, established the Campbell Printing Press & Manufacturing Co., and in 1873 constructed a perfecting press for Frank Leslie's printing office. It was fed from a roll, was arranged for either stereotype or electrotype plates, and was said to print 60 sheets per minute, running moderately. Other machines of similar type were constructed, also flat-bed web presses for newspaper work, and later a small, so-called New Model rotary web press was brought out, with an hourly capacity of 15,000 copies of a 4 or 8 page paper. Andrew Campbell is claimed to have been the first press builder to employ rotary folding mechanism and to assemble the product of several presses.

POTTER PRESSES

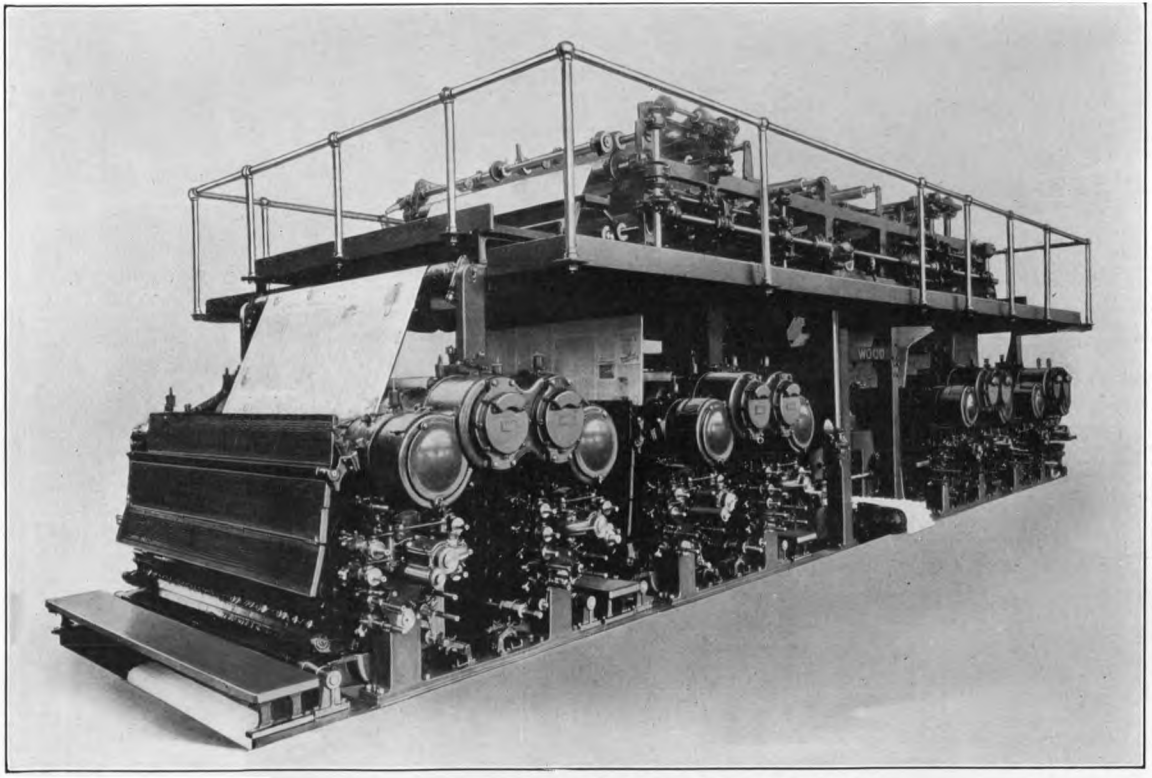
Another noted manufacturer of cylinder presses, Charles Potter, jr., of Westerly, R. I., established in 1879 the firm of C. Potter, Jr. & Co., later changed to Potter Printing Press Co., and introduced a single-roll rotary web press, with a capacity of 20,000 copies of a 4-page paper per hour. As the folding mechanism was not provided with a former, the columns of type ran lengthwise on the cylinders. It became very popular on newspapers publishing four pages, and with a circulation of about 10,000 copies. As the circulation increased other presses were added if floor space permitted, as on the Chicago Times-Herald, where one of these presses was installed when the newspaper was established in 1881. One press was added each year for the next four years. Five additional presses were installed in 1891, and two years later decks were placed on 8 of the 10 presses, doubling their capacity.

SEYMOUR & BREWER PRESSES

About 1893 a rotary web press was manufactured by the Seymour & Brewer Printing Press Co., of Chicago, Ill. It was of the deck type, with 2-plate-wide cylinders, and 1, 2, 3, or 4 decks. The folding mechanism contained many tapes, but the capacity rating was 25,000 papers per hour for single section products, or 12,000 per hour for collected products.



SCOTT STRAIGHT-UNIT SEXTUPLE PRESS, 4 PAGES WIDE



WOOD ULTRA-MODERN OCTUPLE NEWSPAPER PRINTING PRESS, 4 PAGES WIDE

COLOR PRESSES

FIRST NEWSPAPER COLOR PRESS

UP TO 1890 no attempt had been made to produce newspapers in more than one color by the rotary method in the United States. The advance made in that respect by European publishers prompted the Chicago Inter-Ocean to purchase an English rotary color press in 1891, for printing supplements in different colors. Learning that the press was an infringement on American patents, a halt was called on the installation, and a multicolor rotary web press was ordered from Walter Scott & Co., who installed it in 1892. The first printing couple was similar to those on the ordinary web presses, but the second impression cylinder was large and provided with four-plate cylinders, grouped around it, one for each color. The web was printed on one side in the first mechanism, then carried around the large impression cylinder, where the other side received successive imprints from the yellow, red, blue, and black plate cylinders, each provided with a separate inking mechanism, and finally to the cutting, folding, and delivery mechanisms. The first color supplement was printed in 1892. In the beginning 40,000 copies were turned out on this press in the course of a week, but productivity increased with experience, resulting before long in a weekly output of 320,000 copies. This press was used by the Inter-Ocean until 1902, and not many years ago was turning out color printing for a weekly newspaper in Chicago. A press on similar principles, but capable of printing four additional pages in a single color, was installed on the New York World.

OTHER STYLES OF COLOR PRESSES

Other press manufacturers gradually entered the field. R. Hoe & Co., who had patented a multicolor rotary press in 1893, installed one double press the following year for the New York World and one for the New York Herald. This style was provided with angle bars and capable of printing a 2-page-wide web in four colors on both sides. It was the beginning of separate impression cylinders for each color, with the web passing successively through the different printing couples to the folder, the system finally adopted for newspaper color work. In 1895 R. Hoe & Co. introduced combination color and black presses, and in 1898 presses of that style were installed by the New York World and the New York Journal. These were straight-line presses, capable of producing four pages in five colors and four pages in two colors, at the rate of two 8-page papers per cylinder revolution. The production of color supplements became very popular, resulting in the development of color presses in size and flexibility as well as in speed. In many of the smaller plants, where the expense prohibited installation of a special color press, the regular black press was modified for color work by the addition of a few rollers to guide the web and adjust the length of travel between the printing units. So-called color decks were introduced in 1902 by the Goss Printing Press Co., as additions to the regular presses, and consisted of one extra pair of cylinders, with inking mechanism, to print one or more lines in a different color, a very popular procedure for many years.

HOE UNIVERSAL UNIT PRESS

In 1914 R. Hoe & Co. introduced a new type of color press called the Universal Unit color and black newspaper press. The cylinders were arranged in pairs of printing couples and in vertical tiers, and were reversible so they could print on either side of the web. The inking mechanisms were mounted on movable carriages, and could be pushed away for easy access to the printing cylinders. Two folders, with four formers, permitted great flexibility in combination of products. The first of these was a 12-cylinder machine, on which more than 600 different combinations could be turned out. The number of cylinders was increased at various times, culminating in the 24-cylinder machine, brought out in 1923. Many of these machines are being used at present in large newspaper plants. When printing in four colors, on three rolls of paper, this machine was rated to deliver 384,000 pages of finished newspapers per hour. By reducing the colors, the pages were increased proportionately. It would print 40 pages, with 16 of them in 4 colors and 4 in 3 colors, in 1, 2, 3, or 4 sections of varying number of pages in any desired relation to each other, folded and delivered together.

EFFECT OF COLOR PRINTING

With the introduction of the modern color presses considerable change took place in pressroom work. While the presses embodied the same principles as those used for the regular newspaper, several important differences existed, both in construction of the presses and in their operation, which affected labor productivity. The plates required adjustments on the cylinders to insure register of the different colors. Electrotype plates, 0.1875 inch thick, were commonly used in place of stereotype plates, which were usually 0.4375 inch thick. At times underlays were required to correct inequalities in thickness of a plate. Instead of the resilient, soft blankets on the impression cylinders, these cylinders were usually covered with so-called hard packing, consisting of one or more sheets of special cardboard and paper, which necessitated careful make-ready to produce a proper impression surface. This involved building up the surface of the packing with pieces of paper to bring up low parts of the printing surfaces and give different degrees of impression to various tones in the forms, a slow process which greatly increased the nonproductive time for the crew on a press. Oil-wiping devices to prevent offset were commonly employed, consisting in a felt roller, soaked with oil, running in contact with the impression cylinder. A slower speed, rarely exceeding 10,000 cylinder revolutions per hour, was ordinarily employed for color presses to insure a better quality of printing, which increased the productive time for a given quantity of papers as well. Production of the color and magazine sections of the larger newspapers grew more similar to the production on the large rotary presses in magazine or book and job printing establishments, where these had rapidly gained favor since the construction by R. Hoe & Co. in 1886 of a rotary perfecting machine for the DeVinne Press, in New York, to print the plain and advertising forms of the Century Magazine. The rotary press, with its greater production, had in many cases supplanted the cylinder press in such plants, just as the cylinder press had previously superseded the platen press.

TYPE-PRINTING NEWSPAPER WEB PRESSES

A NUMBER of small newspaper establishments issuing 4 or 8 page papers, and even 12 or 16 page papers, each with a circulation of less than 10,000 copies, installed type-printing web presses to escape both cylinder presses and rotary web presses. For cylinder presses the sheets had to be cut to size and fed by hand or by an automatic sheet feeder, passed through the press a second time, and then folded by hand or by a special folding machine, which was too slow and complicated. For rotary web presses, printing from one or more rolls of paper, the type required stereotyping after being set up, involving installation and maintenance of a sterotyping plant, which was too expensive for some.

HOE ROTARY TYPE PERFECTING PRESS

The earliest type-printing web press in the United States was a rotary type endless-sheet perfecting press, brought out by R. Hoe & Co. in 1881, reverting to the type-revolving principle but adapting it to a continuous web. It was intended especially for evening newspapers that wanted to avoid the time or expense of stereotyping. The type forms for both sides of the paper were placed on a central, horizontal cylinder, which was surrounded by impression cylinders and inking rollers. The web was passed through one side of the press, where the first impression was received, then over turning bars and through the other side, where the reverse impression was made, to the folder at the other end. With four impression cylinders the maximum speed was about 12,000 copies per hour. A machine with eight impression cylinders was also manufactured, which was provided with a roll of paper and a folder at each end, where twice that production was obtained.

COX DUPLEX PERFECTING PRESS

In 1879 patents were issued to Joseph P. Cox, of Battle Creek, Mich., for a flat-bed printing machine, using both forward and return movement of the bed with a single cylinder. In 1884 the Duplex Printing Press Co. was organized to develop the inventions of Cox. Perfecting presses were built for the Grand Rapids Democrat, the Burlington (Iowa) Hawkeye, and others. These printed and folded about 2,000 papers per hour. Reciprocating cylinders were later substituted for the reciprocating beds by Joseph L. and Frank Cox in a press brought out in 1890, known as the Cox Duplex perfecting press and folding machine. It made two impressions with each alternate movement, printing two complete papers with each revolution of the drive wheel.

The first Cox Duplex press was installed on the Rutland (Vt.) Herald, where it printed that paper, an 8-column folio sheet, mornings, and the Telegram, a 7-column folio sheet evenings, at the rate of 4,000 copies per hour. The press was provided with two beds, arranged one above the other. Crossheads, carrying impression cylinders and inking mechanisms, were reciprocated by means of a locomotive drive. Paper was supplied uniformly from a roll. During the forward travel of the cylinders they printed two or four pages in width, according to the size of the press. During the return stroke of the crossheads sufficient paper was pulled into the press to receive the

next impression, and the slack was taken up by an equalizing device. After printing, the surplus paper was gradually distributed by another equalizing device to the folder, which delivered the papers at regular intervals. When a 4-page-wide web was used, it was slit into 2-page ribbons, that were brought over angle bars and a former to the cutting and folding mechanism. Chopping-blade folders were used. An improved style printed on both strokes, delivering two papers for each revolution of the drivewheel, or at the rate of 5,000 to 6,000 papers per hour. Ten and 12 page presses, with wider beds to accommodate the additional forms, were also manufactured.

GOSS COMET PRESS

After the early patents on the Cox Duplex press had expired, the Cox Brothers, who in the meantime had associated with the Goss Printing Press Co., introduced in 1911 the Goss Comet press—a roll-feed single-action press on similar principles. The beds were placed end to end, and reciprocated under the impression cylinders by means of a locomotive drive. Its capacity was 3,500 papers of 4, 6, 8, or 10 pages per hour. Both Cox Duplex and Goss Comet presses were installed in many offices, where they were operated until their capacity became inadequate. Such a press was usually handled by one pressman and one helper.

OTHER STYLES

In 1890 a flat-bed perfecting press with roll feed was manufactured by Walter Scott & Co. It was provided with a reciprocating bed, and permitted attachment of a folder, but would print only 1,600 impressions per hour on both sides. Another was introduced that year by C. Potter, Jr., & Co., utilizing the drive, etc., from the 2-revolution cylinder presses manufactured by the firm, and using grippers for handling the sheets.

AUXILIARY PRINTING

SOME of the small country newspapers were supplied with sheets of paper containing printed newspaper matter on one side, while the other was left blank to be filled with local news, editorials, advertisements, etc., at the local printing office. This ready-print service, also called auxiliary newspaper service, or patent inside service, or syndicate service, was started in this country in 1846, when a Boston newspaper supplied a small newspaper in Vermont with sheets of paper partly filled with the text of the President's message to Congress. The blank spaces were filled with local news by the publisher. Similar individual service was given later by other large newspapers, followed by ready-print service of one newspaper to several others in 1861, and the regular establishment of commercial patent inside service in Chicago, in 1865, for small country newspapers. The demand for patent insides resulted in the establishment of several syndicates. According to Ringwalt,[2] there were nearly 1,000 newspapers in the United States in 1871 receiving such service from New York, Chicago, and other cities. Some of the central plants also furnished stereotype products, plates, or matrices, to other news-

[2] Ringwalt, J. Luther: American Encyclopedia of Printing, Philadelphia, 1871.

papers, and at present more than 15,000 offices are supplied with one form or another of syndicate service. Printing of patent insides in the central plants was ordinarily performed on cylinder presses, often equipped with automatic sheet feeders, which supplied the sheets at regular intervals faster than could be done by hand, and consequently increased production. Automatic sheet feeders had also been used on cylinder presses in some offices having large editions of newspapers, before such presses were displaced by rotary presses. After color supplements became popular, some of the newspaper syndicates, with papers in several cities, printed their color and magazine sections in central plants for distribution to the other papers, and some also established commercial syndicate service of color sections.

CHANGES IN OPERATION OF PRESSES

AS the presses grew larger more hands were, of course, required for the operation of each machine. While a single or double press could be operated by 2 or 3 hands, a crew of 10 or 11 was sometimes necessary on an octuple press, with additional hands to get the paper rolls ready for use. No fixed uniform standard existed and the number employed on the same style of press varied according to the requirements of individual establishments. Increase in circulation made longer press runs, which the larger papers handled by installation of more presses, while in the smaller establishments employment of more help was often necessary, not especially to operate the machine but to assist in getting the press ready for operation.

INCREASE IN CIRCULATION

The remarkable growth in circulation of daily newspapers during the past 30 years is revealed by extracts from a statement of average daily circulation during that period of an evening newspaper, which claimed the third largest circulation in the United States, presented in Table 76:

TABLE 76.—*Average daily circulation of one evening newspaper, in specified years, from 1895 to 1925*

Year	Circulation	Year	Circulation
1895	6,317	1905	211,134
1896	33,625	1910	244,063
1897	59,281	1915	356,531
1898	113,973	1920	488,687
1900	124,855	1925	524,662

CAPACITY OF PRESSROOM EQUIPMENT

The magnitude of equipment necessary for such a publication can be realized from Table 77, showing the maximum capacity of the 104 separate 16-page units in this establishment in 1926.

TABLE 77.—*Maximum capacity per hour and per minute of total equipment in one evening newspaper*

Number of pages	Copies per hour	Copies per minute
8	2,346,000	39,100
16	1,173,000	19,550
24	782,000	13,033
32	586,500	9,975
36, 40, 44, or 48	469,200	7,820

CAPACITY AND ACTUAL PRODUCTION OF PRESSES

Capacity, or running speed, of a press differs essentially from the actual production of papers, which is on an average only 70 per cent of the capacity. In theory a speed of 300 cylinder revolutions per minute, if continued for an hour and with two papers per revolution, should produce 36,000 copies per hour, but in practice only about 24,000 copies would be turned out. Stoppage of presses for change of paper rolls, or at least slow-downs, reduces the number of operative minutes in the hour. Breakage of the web, a frequent source of stops and delays, is responsible for further reduction. A low-speed press will show a higher percentage than a high-speed press, so that presses running at 300 cylinder revolutions per minute, or 36,000 papers per hour, will actually produce about 24,000 copies per hour, or 66 per cent of capacity, while presses operated at a speed of 200 cylinder revolutions per minute, or 24,000 papers per hour, will actually produce about 18,000 copies per hour, or 75 per cent. This is partly due to the difference in the number of rolls changed during the course of an hour, as in a press running at 300 revolutions per minute a roll of paper with a diameter of 32 inches would be run off in 17 minutes, while in a press running at 200 revolutions per minute it would last about 25 minutes. A roll of paper with a diameter of 32 inches contains about 21,000 linear feet of paper, and will produce approximately 10,000 papers, depending on length of page.

ELECTRICAL PRESS CONTROL

A number of factors have entered into the increase in production. One of these was the application of electricity, which supplanted steam or gas for motive power, just as these had slowly supplanted hand power. According to the United States census of 1880, there existed at that time 122 daily newspapers in the country with presses worked by hand, while in 849 others, steam power or water power was utilized. When electric power was first applied to printing presses, it was merely a case of substituting the motor for the steam engine. Shafting and belting were retained and, along with the motor, required overhauling from time to time by pressroom workers, unless the plant was large enough to employ electricians or machinists.

During 1894 attempts were made to apply individual motors to printing presses, resulting in the perfecting of direct drives, in the beginning by belt connection but later by gear or chain connections. Development of the controller followed. A lever or handle was first used for the mechanical operation of the controller, requiring practically constant attention of one person during the operation of the press or when it required turning for threading the web, putting on the plates or taking them off, or for other functions, just as with the

previous belt system. Finally a push-button system was evolved, which changed the manual control to automatic magnetic control and permitted adjustments from any number of small stations. These were placed on various parts of the presses, in convenient locations, so each worker could revolve the press as needed. A control station consisted of a small box, provided with push buttons for the various operations required, permitting the press to be revolved slowly, brought up gradually to full speed, slowed down gradually to a stop, or stopped quickly. A safety button was also provided, which could be pushed in to render all stations inoperative until it was pushed out, and to prevent anyone from starting the press while someone was working on it. On some of the larger presses more than two dozen stations were installed.

Different systems were put out, notably the Kohler, by Kohler Bros., now manufactured in improved style by the Cutler-Hammer Manufacturing Co., of Milwaukee and New York, and renamed after that firm, also the Cline, manufactured by the Cline Electric Manufacturing Co., of Chicago. Among others were the Jenney, manufactured by the Jenney Electric Manufacturing Co., of Indianapolis, later of Anderson, Ind., and the Sprague, manufactured by the Sprague Electric Works, of New York, and later manufactured by the General Electric Co., of New York, and known under that name. The automatic push-button control released the brakeman from standing by the lever during the operation of the press, because if trouble occurred the machine could be stopped by any one of the crew and at any station. An electric automatic cylinder brake was also developed and perfected by the Cutler-Hammer Co. in 1916. Breaking of a web caused a lever to drop, which shut off the power and automatically applied an individual brake on each impression cylinder. A press running at high speed could be stopped in that manner in 10 or 20 revolutions, while without the cylinder brakes it would usually take about 15 seconds from the time the stop button was pressed until the machine was still.

AUTOMATIC TENSION CONTROL

Each tension device was originally operated separately, though by a special device on presses turned out by Walter Scott & Co., after 1909, a single lever would, when starting or stopping the machine, decrease or increase all tensions simultaneously. It was later developed into the Jones Automatic Tension, patented by Thomas J. Jones, of Jersey City, N. J., in 1921, which automatically held the tension where desired, regardless of speed, and required no supervision when the press was started or stopped. It resulted in doing away with an extra tension man, previously necessary to adjust tensions and side margins on the top rolls of large deck presses. On the early style right-angle presses the tension man could observe the line-up of the webs himself, even where required to stand at the control lever, but on the straight-line presses it was difficult. It was often necessary for the man in charge of the press to watch the delivery end closely, and to signal the tension man or men to tighten or loosen the tension on a certain roll, or how to adjust the side margins so the webs would be in alignment. This is still the practice in many places on the older styles of presses.

CHANGING PAPER ROLLS

Floor-fed presses were satisfactory and efficient under certain conditions, as the rolls could be changed quickly, but limited on account of roll stands or floor space for extra rolls required. For deck presses it was necessary to hoist the rolls into positions on brackets, and, as a set of brackets would accommodate only one extra roll, other rolls had to be hoisted during the run, as required. It was at first an arduous task, during a long run, to supply the paper to a press with four or five decks, because the rolls were raised by means of a chain block. Some presses were later provided with wire cables and drums, turned by handwheels, or with hand-power geared roll hoisting arrangements. In a number of establishments small hydraulic lifts were used to lift the rolls to the proper levels, so that they could be rolled on to the brackets. In other places a double-action lift with a V-shaped platform, invented about 1905 by A. W. Cochran, mechanical engineer on the Portland Oregonian, was employed. It was a rapid and easily controlled lift, which could be moved to and from the press as well as up and down. The most popular method was by means of the Sprague electric hoist, which traveled on overhead I beams and was provided with a spreader bar having suspended hooks to support the roll spindles. Such electric hoists, with ceiling beams, were also utilized for transporting rolls around the pressroom, or from the storeroom to the pressroom, if on the same level. This was a better method than trucking them on the old-fashioned 2-wheeled dollies.

Changing of rolls required cutting the web, lifting the spindle with the empty core out of the bearings, substituting the new roll, tearing off any damaged paper, applying a streak of paste across the web, and fastening it to the web in the press. Skilled hands could ordinarily change a roll in about 40 seconds, depending on arrangement and location of the roll, though on deck types it might take two minutes. During this interval the press was standing idle, and in addition the operation involved a gradual slowing down to a stop, and afterwards starting slowly and attaining speed by degrees, which reduced production. Multiplicity of rolls increased the number of stops for replacement and devices were invented to facilitate replacement of rolls.

MAGAZINE PAPER REELS

In 1900 Irving Stone, mechanical superintendent of the Chicago News, invented a roll stand, which supported three rolls of paper, known as the Stone magazine reel and manufactured by the Cutler-Hammer Manufacturing Co. The stands were placed in the reel room under the pressroom, one reel for each unit and directly under it, and the web was fed up through a slot in the floor into the press. When a roll was about to run out the press was slowed down somewhat. A touch on a push button revolved the reel, swinging the full roll on the top of the reel into the position formerly occupied by the exhausted roll. The turn brought the end of the new roll, previously covered with sticky gum, in contact with the old web, to which it adhered and which carried it through the press. Dropping of a chain severed the web from the old core, completing the so-called flying paster without stopping of the press, which was again accelerated to speed. The empty core was removed from the reel, and a new roll inserted in

place thereof. The rolls were transported to the reels on small trucks, operating on runways of steel imbedded tracks in the floor, provided with turntables.

A similar reel, the Cline multiple roll stand, manufactured by the Cline Electric Manufacturing Co., was provided with an automatic tension device. Sidewise shifting of the reels from the pressroom floor, to adjust the alignment of the webs, was provided for by push-button systems. An attachment has recently been announced by the Wood Newspaper Machinery Corporation, to be used in connection with their new Ultra-Modern press. The attachment is claimed to paste automatically the end of a full paper roll to that of an almost finished roll without stopping or slowing down the press, and thus convert the entire running time into productive time. Several of the manufacturers have adopted a balcony or mezzanine style of construction for their unit-type presses, to permit the installation of regular roll stands or reels on the pressroom floor, feeding the webs up to the units on the balconies above them.

LIMIT OF SPEED

The speed of the presses was to a certain extent limited by the strength of the paper, as a defect or weak spot in a web might pass through the press at slow speed but would cause a break at high speed. Breakage of the web was often responsible for considerable delay, especially on large deck presses, where it ordinarily took from 5 to 10 minutes to thread up again. On the unit type of presses only about two minutes were required. An example was given in a statement by Henry A. Wise Wood, president of the Wood Newspaper Machinery Corporation, regarding one of the presses manufactured by that firm, four years after it had been installed. He claimed that the press was restricted to two-thirds of its natural running speed on account of the quality of paper, which had not then returned to pre-war conditions. The press was intended for a maximum speed of 500 revolutions per minute, or 60,000 copies of a 32-page paper per hour. On a basis of 70 per cent actual production, 42,000 papers should have been turned out, but production reports from the establishment showed the net output to be around 30,000 per hour, as may be seen by Table 78:

TABLE 78.—*Production of 32-page papers on octuple press on three specified days*

Date	Copies printed	Spoiled copies	Minutes operated	Number of paper breaks	Average production per hour
Mar. 28	50,400	350	92	0	32,870
Mar. 29	55,040	490	109	2	30,206
Apr. 15	49,300	571	102	2	29,000

INK DISTRIBUTION

Another factor, which affected the production was the liability of glue and glycerin composition rollers to melt through the friction created by fast speed, and scatter over the different surfaces of a press, causing breakage of webs and long delays because of the cleaning up necessary before the press could be started again. This has

been partly solved during recent years by the adoption of rubber composition rollers, which are not affected by friction nor by hot weather. Although a patent was issued in 1858 to Alex Schimmelfennig and Julius Ende, of Washington, D. C., covering the manufacture of printing rollers out of elastic gums, such as gutta percha, caoutchouc, etc., no developments followed until about 1918, when rubber rollers were introduced by the B. F. Goodrich Rubber Co., of Akron, Ohio. They were first tested in the plant of the Cleveland Plain Dealer. Since that time various makes have appeared on the market and have been used on a number of different presses. Adjustment of the ink distribution was made quicker by concentrating controlling devices at the ends of the fountains, making them easily accessible. With the introduction of the automatic pump system on Hoe presses, previously referred to, it was simplified further by placing the adjustment devices for each fountain together at one end, and locating them at one side of the machine.

DAMPENING OF PAPER

Wetting of paper, which had been practically discontinued, was revived by the Chicago Herald about 1916. A vaporizer was employed to dampen the webs as they unwound from the rolls, to prevent breaks and reduce ink consumption. It was claimed to have increased hourly production from 15,000 to 20,000 papers, and considerably less ink was used. In using dry paper 58½ pounds of ink had been required to print fifty-four thousand six hundred and eighty-six 8-page copies, but by using dampened paper 62,836 copies were printed with the same quantity of ink, a gain of 8,150 copies, or 14.9 per cent. The method was, nevertheless, abandoned definitely.

AUTOMATIC DELIVERY OF PAPERS

When newspapers were printed in small plants and had limited circulations, the papers were taken from the press deliveries by flyboys and carried to near-by tables, where they were bundled up or distributed by the mailing-room force. As the plants increased in size and editions grew larger and heavier, the mailing and delivery rooms were moved farther away, necessitating the use of trucks or horizontal belt conveyors, if on the same level, or of elevators or hoists, if on different levels. It became customary to locate mailing rooms above the pressrooms and, though elevators answered the purpose to a certain extent, in large pressrooms too much carrying distance was involved. They are still used in a number of places, though usually modified from the old, hand-operated style to electrically controlled lifts, which rise at the touch of a button and return automatically when the papers are removed. A number of establishments installed esculators, or conveyors, to transport the papers which eliminated manual removal of the papers from the deliveries, though a flyboy was required to watch the functioning. The Dispatch Conveyor, named after the St. Paul Dispatch where it originated, consisted of a system of flat leather belts in parallel pairs, supported and driven, which carried the papers between them, as fast as printed, in a constant stream from the press delivery to the distributing point in the mailing room. It did not solve the problem altogether. The frequent slack in the belts necessitated continual

adjustment, and the deposits of ink on the surfaces of the belts necessitated frequent cleaning. The system was not adaptable to space conditions in many plants. The substitution of coiled steel wire springs, running over rollers at suitable intervals, removed the difficulties and the system worked well on the moderate speed presses of 1911, which printed comparatively light papers. Four years later it was acquired by the Cutler-Hammer Manufacturing Co., under whose name it is now known, which improved it and adapted it to the high-speed presses in up-to-date newspaper plants, the majority of which are equipped with conveyors. The papers could be carried horizontally, vertically, or on an incline, in any direction, at a lineal speed of about 100 feet per minute, and laid down on the delivery table in practically the same relation as originally laid down by the press.

When a large number of papers were to be sent by mail, a third fold was arranged for by a mail, or quarter-page, folder. It was provided with a revolving blade and folding rollers, to which the papers were led by tapes after receiving the half fold. Mail folders, which were often detachable, did not become popular, as they did not work well at high speed, especially on a large number of pages; and in large newspaper establishments special mailing machines in the mailing room did the folding as well as the wrapping of the papers.

AUTOMATIC OILING DEVICES

Close-fitting bearings, coupled with the high speed of operation and the pressure created, necessitated careful lubrication of the various parts during the run, as well as before it. Instead of more work being required on the faster presses, the manual part was gradually reduced through the introduction of ball bearings and automatic oiling devices, but especially through force feed lubricators. These supplied the proper amount of oil to the bearings during the run, starting and stopping with the machine, while oil could be applied by means of a hand crank to all connected bearings when the press was standing still. Use of several lubricator units, with a central supply tank, practically rendered all oiling of a press entirely automatic, and eliminated the manual task altogether where it was adopted.

FUDGE DEVICES

A special attachment, called the fudge device, was utilized in a number of places for the printing of important late news without involving changes of plates. While it did not affect productivity materially, it was important from the viewpoint of the publisher, as it eliminated the stereotyping and permitted publication in exceedingly short time. It was invented by William Loveland and Harry Sloane, of the Philadelphia Evening Bulletin, and consisted of a small cylindrical box, provided to hold one or more linotype slugs. In the style developed by R. Hoe & Co., patented in 1899, the slugs were held in place by wedges, similar to the arrangements used on the former type-revolving presses. In the fudge boxes developed by the Goss Printing Press Co., the slugs were cast tapered, in special molds. A special inking mechanism was provided. If the news were intended to appear on the first page, the usual custom, the fudge device was arranged to print against the regular second im-

pression cylinder, but if desired on some other page it was located correspondingly. Where the design of the press would not permit the use of the regular impression cylinders, an additional cylinder was provided. The corresponding space on the regular plate for the page was left blank, or cut below printing height.

It required ordinarily about 12 minutes to get a short news item into type, inserted in the page, and a matrix molded from it. With five minutes more for casting two plates and locking them on the press, a total of 17 minutes would be consumed from the time the news was received in the composing room to be set up until the presses were beginning to print. By the use of the fudge device the time was customarily about 12 minutes, and for special, anticipated events, such as baseball scores in the world series, papers have appeared on the street in 10 seconds after the telegraph flash for the final score had arrived in the editorial department.

CHANGES IN PRELIMINARY WORK

VARIOUS improvements also reduced the time required to get presses ready for operation. This varied greatly in the different establishments, according to the style of presses used, and even in the same plant if several different constructions existed there. The same type of press often varied considerably in accessibility, as an individual press was often designed by the draftsmen in the factory to occupy a special space, and in that case convenience of the workers was a secondary consideration. Deck presses involved more or less climbing, lifting or carrying the plates up on the footboards, etc.

PLATING OF PRESSES

The length of the page was always a fixed measure on each press, one-half the circumference of the dressed cylinders, but four different sizes were used, 21⅝, 22, 23 $\frac{9}{16}$, and 24¾ inches. The latter was eventually dropped, leaving three different sizes in use at present. The width of the page was flexible, within certain limits. For many years 7 columns, 13 ems wide, were commonly used, but with varying margins between the pages and on the outside edges. About 1912 publications began to change the width of the page to 8 columns, 12½ ems wide, to reduce the number of pages published, as this would give the equivalent of an 18-page paper in 16-page form. This change, which gained favor rapidly, meant proportionately fewer plates to be handled by the workers.

On the older-style presses plates were clamped to the cylinder by three or four independent clips, which had to be tightened separately. The newer styles were provided with rapid safety plate clamps, patented in 1908 and adopted by several of the manufacturers. Only one central screw required tightening, simplifying the work and reducing the time for locking up plates more than three-fourths. On the older-style presses it was also necessary to raise the top composition form-inking rollers to place the plates on the cylinders, but the positions of the cylinders were later changed to render this unnecessary. Installations in many plants of automatic plate conveyors, which carried the plates from the stereotyping room direct to the sides of the presses, displaced the boys formerly required to carry the plates around. Some of the conveyors were

reversible, to carry the used or so-called dead plates back to the stereotyping room. Color plates, where used, required considerable extra work in adjusting them to proper printing positions.

BLANKETS

Attempts were made to use specially prepared tympans to eliminate part of the changes required through the absorption of ink. Several of these proved successful for a while, but they were rendered obsolete by the introduction of the so-called automatic felt blanket, which was provided with a nonabsorbent surface to which the ink would not adhere. Where adopted it did away with the use of tympans and the work connected therewith. The automatic blanket was patented in 1919 by the New England Newspaper Supply Co., of Worcester, Mass. This firm also brought out an oil-proof faced rubber blanket, and the Monocork press blanket, which had been patented in 1917 by A. W. Cochran and F. M. Youngs, of the Portland Oregonian. Each of these types was intended as a substitute for the rubber or fiber blankets previously used on the impression cylinders under the felt blankets. As neither of them was affected by oil seepage, which blistered the ordinary rubber blankets, fewer changes were necessary.

INK SUPPLY

The common plugs or spigots in the ink barrels were superseded in the better pressrooms by ink pumps, and filling fountains by means of a scuttle was later eliminated by the portable tank, provided with a pump and hose, which cut down the clock time for the operation but required two men, so that the difference in total working time was probably very slight. Eventually storage tanks appeared, from which the ink was forced to the fountains through fixed pipes, by gravity or air pressure. In the large modern establishments the ink is at present delivered by tank wagons, which fill the storage tanks through supply pipes, doing away with all handling of ink for the pressroom workers. The automatic fountain reduced the preparatory work for the inking mechanism still further, by elimination of the ductor roller. Ductor rollers necessitated use of sizes corresponding to the total width of the plates on the cylinder, either 1, 2, 3, or 4 pages, and frequently required changing. On the automatic fountain, the supply for each page could be shut off by separate valve control when not needed. The adoption of rubber rollers, which did not require washing, saved considerable time of the press crew. Less adjustment for proper contact was also required as the rollers were not affected by heat or by humidity. Where a press used ordinarily for the daily paper was also used on an extra run once a week to produce color supplements for the Saturday evening or Sunday morning issue, it involved considerable additional work. The fountains and other ink mechanisms required careful cleaning, especially in changing from black to color.

OTHER CHANGES

A number of other minor improvements, such as self-locking roller sockets, roller washing machines, electric burning irons for removing bolsters from the blankets, etc., assisted in reducing time and labor. Compressed air came into general use for removal of the paper dust produced in large quantities by the revolving knives which slit the webs into ribbons, while on some presses suction was employed for removing this dust at the source.

In the larger plants special laborers, or paper handlers, took care of the paper rolls, stripped off the wrappers, and delivered the rolls to the pressroom ready for insertion of the spindles and placing in the presses. In small establishments the preparation of the rolls continued as one of the duties of the press workers, though simplified in some of them by the use of electric roll hoists, or of revolvators, for tiering the rolls, and by placing the rolls on their sides instead of on their ends. In most of the plants the amount of paper to be handled was reduced somewhat by adoption of narrower margins for the pages, cutting down the width of the webs.

On large presses more men were, of course, required than on smaller ones, both for the preliminary work and for the actual operation, but larger presses produced proportionately more pages and, with the increases in speed, produced them a great deal faster. An instance is cited by Theodore T. Ellis, of the New England Newspaper Supply Co., in a recent issue of the American Pressman.[3]

> Thirty years ago the writer worked on a newspaper in the pressroom where they had five presses running with 45 men employed, printing ninety thousand 32-page papers on Saturday nights. Hours of labor were from 6 p. m. to 5 a. m., waste average 6 per cent. And to-day in a different office 9 men, working from 9 p. m. to 5 a. m., print on one high-speed octuple press one hundred and ten thousand 32-page papers every Saturday night, average waste one and a fraction per cent.

VOCATIONAL DIVISION OF PRESSROOM WORKERS

IN MOST of the large establishments there was considerable shifting of workers from one position to another. In some plants the duties of each member of the crew were sharply defined, and the different functions during operation of the machine were specialized. This resulted at first in vocations designated as head pressman and first, second, third, or fourth assistant or helper. Later more specific terms were used, such as man in charge (of press), tension man, oiler and plater, and floor man or paper hustler. All of these were journeyman pressmen, presumably capable of performing any of the duties. In very large plants additional semiskilled hands were employed as paper handlers, to prepare the paper rolls for use in the presses, and to take care of the waste. Apprentices usually acted as fly boys. Each vocation carried certain specified duties in preparing the press, but the systems varied in the different localities and often even in plants located in the same city.

Another condition also developed. As long as small 8 or 16 page presses were used, or even 24-page presses, one really skilled man, with the assistance of semiskilled help, could perform the necessary adjustments and keep the machine in good order. The adoption of the modern mammoth presses created a necessity for several highly skilled hands, because one man could not handle all the complicated manipulations in the comparatively short time often allotted to print the paper. While the question of skilled or unskilled hands did not affect the hourly productivity, except that with unskilled help the time would have been prolonged and the production retarded, it affected the pay roll and the hourly labor cost materially. These items naturally also advanced through the years, as did wages and living costs in general. The hourly labor cost was still further increased by the reduction in weekly hours.

[3] The American Pressman, published monthly by the International Printing Pressmen and Assistants' Union of North America, at Pressmen's Home, Tenn.

UNION WAGE RATES FOR PRESSROOM WORKERS

REGULAR weekly working hours and rates of wages for pressroom workers in 1899 were published in the fifteenth annual report of the Commissioner of Labor.[4] The nineteenth annual report[5] gave hours and wage rates for 1890 to 1903, and later data were published by the Bureau of Labor Statistics in yearly bulletins[6] since 1912. The wage rates, however, did not indicate the actual hourly labor costs, because these would naturally be increased by the amount of overtime worked. Early scales provided additional pay for overtime, as shown by the scale of Pressmen's Association of Philadelphia, Pa., in 1857. Wages for hand pressmen were $11 per week, 10 hours per day; also 25 cents per hour for regular time and 30 cents per hour for overtime. Wages for power pressmen on Adams or cylinder presses were $12 per week, 10 hours per day, and 30 cents per hour for overtime.

MANNING OF PRESSES

THE minimum number of pressmen required for the operation of newspaper presses was often stipulated in agreements between employers and workers, being ordinarily arranged to suit conditions for the specific locality. As considerable variation exists in conditions it resulted in the establishment of a wide range in the number of hands necessary, as is shown in a tabulation of prevailing minimum requirements in 1926 for different cities of the United States, presented in Table 79:

TABLE 79.—*Minimum number of pressmen required for operation of newspaper presses in various cities*

City	Minimum number of pressmen required on—					
	Single press	Double press	Triple press	Quadruple press	Sextuple press	Octuple press
Akron, Ohio				4	5	
Atlanta, Ga				4	5	6
Austin, Tex		2	3	5	7	9
Baltimore, Md.[1]				5	5	8
Bellingham, Wash	2	2	3	4		
Boston, Mass[1]	3	5–7	4–7	4–9	9–11	12–14
Butte, Mont				3		
Chicago, Ill				4	5	7
Cincinnati, Ohio[1]	2	2	3	4	5	
Cleveland, Ohio					6–7	8
Columbus, Ohio				5	7	9
Dallas, Tex			3	4	5	7–8
Danville, Ill		[2] 3½				
Dayton, Ohio[1]				4	5	
Denver, Colo				3–5	6	8
Des Moines, Iowa			3	4	5	7
Detroit, Mich.[1]		2	3	4	5	7
Dubuque, Iowa				3		
East Liverpool, Ohio			2			
Fort Worth, Tex.[1]				4–5	6	7
Fresno, Calif.[1]	2	3		4	5	
Hoboken, N. J				6		
Indianapolis, Ind				5	6	
Kansas City, Mo.[1]			3	4	5–6	7
Los Angeles, Calif.[1]	2	3	3	4	6–7	8–10
Louisville, Ky				5	6	
Memphis, Tenn	2	3	4	5	7	9
Meriden, Conn.[1]	2		3	4	6	

[1] Figures for this city include one apprentice pressman on each press.
[2] One man works one-half of time in stereotyping room.

[4] United States Commissioner of Labor. Fifteenth annual report, 1900, 2 vols. Washington, 1900.
[5] United States Commissioner of Labor. Ninteeenth annual report, 1904, 2 vols. Washington, 1905.
[6] U. S. Bureau of Labor Statistics bulletins on union scales of wages and hours of labor.

TABLE 79.—*Minimum number of pressmen required for operation of newspaper presses in various cities*—Continued

City	Minimum number of pressmen required on—					
	Single press	Double press	Triple press	Quadruple press	Sextuple press	Octuple press
Milwaukee, Wis				5	5	6
Minneapolis, Minn	2		3	4	6	
Mobile, Ala.[1]		2	2	3	4	
Montgomery, Ala	2	3	4	4	6	
Muncie, Ind			3	3–4		
Nashville, Tenn			4	4	5	
Newark, N. J		4	4	5	6	9
New Haven, Conn.[1]			3	4	6	
New Orleans, La	3	3	4	5	6	
New York, N. Y	3	4	5	5	6	9
Oakland, Calif				5	6	10
Oklahoma City, Okla	3	4	4	5	7	9
Pawtucket, R. I	1	2	3	4	5	7
Philadelphia, Pa				4	5	
Pittsburgh, Pa				5–6	5–6	10
Portland, Me.[1]	2	3		7	7	
Portland, Oreg	2	3		4	5	7
Providence, R. I	1	2	3	4	5	7
Rock Island, Ill			2	2	3	
St. Joseph, Mo.[1]	2	3	3	4		
St. Louis, Mo	2	3	3	4	6	8
St. Paul, Minn				4	6	8
Salt Lake City, Utah [1]				4	5	
San Antonio, Tex.[3]		2	4	5	7	
San Diego, Calif.[1]			3–4	4–5	5–6	6–7
San Francisco, Calif				5	6	10
Schenectady, N. Y				5		
Scranton, Pa			3	4	5	
Seattle, Wash.[1]	4	5		6	7	9
Shreveport, La.[1]	2	3				
Springfield, Ill.[1]	2		3	4	5	
Springfield, Mass.[1]					4	
Tacoma, Wash.[1]	2	3	4		6	8
Terre Haute, Ind.[1]			4	5		
Toledo, Ohio				5	5	
Trenton, N. J			3	4	5	
Tulsa, Okla				4	5	
Washington, D. C.[1]				4	5	7
Wichita Falls, Tex.[1]		3	4	6	7	10
Worcester, Mass				6	7	10
Zanesville, Ohio	2					
Average	2.2	3.0	3.3	4.4	5.7	8.3

[1] Figures for this city include one apprentice pressman on each press.
[3] Figures for this city include flyboys.

Many agreements do not specify the number of pressmen but provide that the prevailing number on specified sizes of presses shall be changed only through proper adjustment. Some also contain provision for changes in the number of men in the event of adoption or removal of labor-saving devices.

According to the table the average minimum requirements for the 69 cities are 2.2 for single presses, 3.0 for double, 3.3 for triple, 4.4 for quadruple, 5.7 for sextuple, and 8.3 for octuple presses. In over one-third of them each quota included one apprentice pressman, which may possibly be the case for some of the others. While the minimum requirement ordinarily constituted also the maximum employed, conditions in some cities necessitated more pressmen in a crew, such as at Atlanta and Detroit, where one additional pressman was used on quadruple crews; Dallas, where two additional pressmen were used on all crews; Des Moines, where two additional pressmen were used on quadruple and sextuple crews, or one additional pressman on octuple crews; Louisville, where two additional pressmen

were used on quadruple crews, or one additional pressman on sextuple crews; and Memphis, where one additional pressman was sometimes used on all crews. Larger presses necessitated still larger press crews, which then customarily included two pressmen in charge. Minimum crews for decuple sizes were 15 to 17 in Boston and 11 in New York. The Boston requirements for these, as well as for other types of presses are considerably above the others, because the flyboys there are also pressmen, while in other places semiskilled workers are employed as flyboys.

The variations according to locality naturally affected man-hour production of complete copies, as well as of 4-page sections, while the latter item was also influenced by the number of pages contained in the issues.

CHAPTER 10.—DETAILED STUDY OF PRODUCTIVITY AND LABOR COST FOR PRESSWORK IN 1896

THE 1895–96 survey by the Department of Labor included presswork and the report thereof [1] carried special tables for printing and folding of newspapers by both hand and machine methods. These tables have been converted to show production and labor cost per man-hour for comparison with the tables containing similar information for the 1926 study.

HAND METHOD OF PRODUCTION

PRESSROOM NO. 1 IN 1852

In one of the establishments records had been obtained for production and labor cost in 1852 for comparison with production and cost for similar work at the time of the survey. Table 80 contains data for printing and folding 120,000 copies of 4-page newspapers by hand power in 1852.

TABLE 80.—*Man-hour production and labor cost for printing and folding in newspaper pressroom No. 1, in 1852*

Occupation	Man-hours worked in producing 120,000 copies of 4-page papers	Average production per man-hour	Labor cost per man-hour	Cost of man-hour production	
				Time cost	Labor cost
Productive labor:		*Copies*		*Minutes*	
Pressmen	1,440	83.3	$0.167	23.6	$0.066
Inkers	1,440		.083	23.6	.033
Folders	720	166.7	.100	11.8	.020
Total	3,600	33.3	.120	59.0	.119
Nonproductive labor: Supervisory employees	60		.250	1.0	.004
All employees	3,660	32.8	.122	60.0	.122

The personnel was divided into productive labor, which actually performed the productive work, or operated the press and folded the papers, and nonproductive labor, which in this case consisted of the foreman who supervised the operations. This method has been adhered to throughout the other tables compiled for the 1895–96 survey.

The working-day consisted of 12 hours, and the data obtained in the survey covered a full day's output for the press, or 1,000 copies of a 4-page paper, together with the time required for folding the papers and the portion of the supervision by the foreman devoted to this press. In the original table, however, the figures had been converted to cover 120,000 copies, for comparison with other tables.

The printing was performed on a hand press, operated by one pressman and one inker, at the rate of 83.3 copies of 4-page papers

[1] U. S. Commissioner of Labor. Thirteenth annual report, 1898. Hand and Machine Labor, 2 vols. Washington, 1899.

per clock hour. No information was given regarding the particular kind of hand press used, nor the size of the pages, but it is presumed that two pages could be printed at one time, making 166.7 impressions per hour. Folding, which was done by hand with a bone folder, was performed in half the clock time consumed by the presswork, so that it took 43.2 seconds for the two hands to print one newspaper and 21.6 seconds additional for a third hand to fold it, or a total of 64.8 seconds, clock time, to turn out a complete 4-page newspaper.

The pressman was paid $2 per day, or 16.7 cents per hour, while the inker, who presumably was a boy, received one-half that amount. The folder was paid at the rate of 10 cents per hour. Supervision by the foreman, who received $3 per day, was not constant, and the proportionate amount of his time chargeable to this press was only one-half hour per working-day, resulting in a relatively small cost for supervision.

The man-hour production, on the basis of all employees, was 32.8 copies of a 4-page paper at a labor cost of 12.2 cents.

PRESSROOM NO. 2 IN 1895

While data for 1852 had been obtained for one establishment alone and data for the 1895 and 1896 periods did not cover that identical pressroom, the figures for establishment No. 1 can well be considered typical for the early period and those for establishments Nos. 2 and 3 as typical for the later period. Conditions had changed materially during the 40-year interval, as shown by Table 81, which contains data for printing and folding 90,000 copies of 4-page newspapers by hand power in 1895.

TABLE 81.—*Man-hour production and labor cost for printing and folding in newspaper pressroom No. 2, in 1895*

Occupation	Man-hours worked in producing 90,000 copies of 4-page papers	Average production per man-hour	Labor cost per man-hour	Cost of man-hour production	
				Time cost	Labor cost
Productive labor:		*Copies*		*Minutes*	
Pressmen	630	142.9	$0.200	17.5	$0.058
Inkers	630		.083	17.5	.024
Folders	270	333.3	.100	7.5	.013
Total	1,530	58.8	.134	42.5	.095
Nonproductive labor: Laborers	630		.042	17.5	.012
All employees	2,160	41.7	.107	60.0	.107

While data had been secured only for the production of 1,000 copies of a 4-page paper by the four workers, in the original table published the figures had been converted to cover 90,000 copies.

The regular working-day had been reduced to 10 hours. The printing was performed on a hand press, operated by one pressman and one inker. It was apparently a more efficient machine than the one used in the 1852 period, but as information was lacking on both the style of the press and the size of the pages, it could not be determined whether the higher efficiency was due to increased speed

facilities or to the ability to print four pages at one impression instead of two pages. The production had increased to 142.9 copies of 4-page papers per clock-hour, represented by the output of the pressman, or 71.5 per cent more than for the 1852 establishment. Folding, which was done by hand, was performed in less than half the clock time required for the printing, so that one newspaper was printed in 25.2 seconds, or produced, printed and folded, in 36 seconds, clock time, 44 per cent less time than that required in 1852.

The pressman, who presumably acted also as supervisor, received $2 per day. The inker, who probably was a boy, was paid 83.3 cents per day, and the folder received 10 cents per hour. An additional hand was employed, termed "pressman's helper," who may have assisted on the press part of the time but was probably occupied in general work, transporting the sheets, etc., and who was paid 42 cents per day. While the productive labor turned out over 76 per cent more copies than in the 1852 establishment, the addition of this fourth hand reduced the man-hour production, on the basis of all employees, to 41.7 copies, or only 27 per cent above the 1852 output. It assisted, however, in reducing the labor cost per man-hour for all employees to 10.7 cents, or over 12 per cent less than the 1852 man-hour cost.

PRESSROOM NO. 3 IN 1896

A third table was published for the hand-press method, presented here in modified form as Table 82, which contains data for printing and folding 40,000 copies of 4-page newspapers by hand power in 1896:

TABLE 82.—*Man-hour production and labor cost for printing and folding in newspaper pressroom No. 3, in 1896*

Occupation	Man-hours worked in producing 40,000 copies of 4-page papers	Average production per man-hour	Labor cost per man-hour	Cost of man-hour production	
				Time cost	Labor cost
Productive labor:		*Copies*		*Minutes*	
Pressmen	320	125.0	$0.200	17.8	$0.059
Inkers	320		.167	17.8	.049
Folders	120	333.3	.167	6.7	.019
Total	760	52.6	.181	42.2	.127
Nonproductive labor: Laborers	320		.200	17.8	.059
All employees	1,080	37.0	.186	60.0	.186

Data had been obtained only for the production of 1,000 copies of 4-page papers by the four workers, but for the original table published the figures had been converted to cover 40,000 copies.

As in establishment No. 2 the regular working-day consisted of 10 hours. A hand press was employed, operated by one pressman and one inker. This press seemed more efficient than the one used in 1852, but not so fast as the style used in pressroom No. 2, which the report stated might be considered representative. Information was lacking as to the particular style of press, as well as the size of the newspaper pages, preventing deduction of the actual reasons for the difference in production. In this case the output of the machine

per clock-hour, represented by the production for the pressman, was 125 copies of 4-page papers, 50 per cent more than in 1852, but 12.7 per cent less than in pressroom No. 2. Folding, which was performed by hand with the aid of a bone, was executed in less than half the clock time necessary in 1852. One newspaper was printed in 28.8 seconds, or both printed and folded in 39.6 seconds, clock time, as against 36 seconds for pressroom No. 2, and 64.8 seconds for the 1852 period.

The pressman, who in this case seemingly acted also in a supervisory capacity, received the same rate as in pressroom No. 2, $2 per day, but the inker was paid $1.67 per day, twice the rate paid in the former establishment. The folder also received this rate, increasing the hourly labor cost for both of these positions, presumably on account of different wage standards for the localities in which the establishments were situated. An additional hand was employed as helper, for general work, who received the same rate of wages as the pressman, $2 per day, raising the hourly labor cost for this pressroom materially above the cost in the other establishments.

The man-hour production, on the basis of all employees, was 37 copies of 4-page papers, 13 per cent more than that in 1852 but 11 per cent less than that in pressroom No. 2. The man-hour labor cost, on the basis of all employees, was 18.6 cents, 52.5 per cent more than that in 1852, and 73.7 per cent higher than that for pressroom No. 2.

MACHINE METHOD OF PRODUCTION

THE use of machines, on which both printing and folding were performed in one continuous, mechanical operation, made a decided increase in clock-time production. The number of man-hours for operation of a single machine was also increased, but in a relatively smaller degree, so that a material increase was effected in man-hour production also, as shown by Tables 83, 84, and 85.

PRESSROOM NO. 4 IN 1896

Table 83 contains data for printing and folding 10,000 copies of 16-page newspapers by mechanical power on double and quadruple presses in 1896:

TABLE 83.—*Man-hour production and labor cost for printing and folding in newspaper pressroom No. 4, in 1896*

Occupation	Man-hours worked in producing 10,000 copies of 16-page papers	Average production per man-hour	Labor cost per man-hour	Cost of man-hour production	
				Time cost	Labor cost
		Copies		*Minutes*	
Pressmen in charge	0.65	15,463.9	$1.362	6.6	$0.150
Other journeymen	2.89		1.066	29.5	.524
Flyboys	1.12		.423	11.4	.081
Total, productive labor	4.66	2,146.7	.952	47.5	.755
Laborers	.31		.417	3.1	.022
Supervisory employees	.92		.963	9.3	.150
Total, nonproductive labor	1.22		.826	12.4	.172
All employees	5.88	1,701.2	.926	60.0	.926

Data had been obtained for the production of 196,850 copies of 16-page papers, but in the original table published the figures had been converted to cover only 10,000 copies.

The publication was a morning newspaper. The regular working shift was only six hours, on which basis the hands were paid, though additional time was often worked at overtime rate. Part of the time in each shift was devoted to preparing the presses for the actual printing operation, but the only time considered in the original data was the actual running time of the machines, or productive hours for the productive labor, together with the hours for the nonproductive labor during the same clock time. The equipment consisted of three quadruple presses and one double press, the steam power to run them being furnished from a separate establishment. Each quadruple press was operated by 1 pressman in charge, with a crew of 5 other journeymen and 2 flyboys. The other journeymen consisted of 1 brakeman, 1 tension man, 1 oiler, and 2 helpers. The crew for the double press was 2 helpers and 1 flyboy less.

In the original table no separation was made of the production for the double press and the quadruple presses, the entire production being treated as a whole, although a double press could not produce more than one 16-page paper for each revolution of the cylinders, whereas a quadruple press would turn out two 16-page papers each cylinder revolution. Consequently, the production for the double press, with five hands, could have been only approximately one-seventh of the total production, while each quadruple press, with a crew of eight hands, delivered two-sevenths of the total production. On that basis, the average clock-hour production of the double press was 8,836.5 copies of collected 16-page papers, which also represents the man-hour production for the pressman in charge, while the man-hour production, on the basis of time for the productive labor on it, was 1,778.7 copies of collected 16-page papers.

The average clock-hour production of one of the quadruple presses was twice that of the double press, or 17,673 copies of 16-page papers, probably also in two sections folded together, as two flyboys were used, which likewise represents the man-hour production for the man in charge. As the crew consisted of only eight hands, while there were five hands on the double press with only half the production, the output per man hour on a quadruple press, based on total productive labor, was 2,244.6 copies of 16-page papers, or over 26 per cent more than on the double press. The production probably was not the same on all three quadruple presses, even though operated at the same speed, as delays due to changes of rolls or possible breakage of webs would create variations. The text accompanying the original tables contained a statement that one of the quadruple presses printed and folded 61,300 copies of a 16-page paper in 3.25 hours, clock time, which was an average of 18,861.5 papers per clock hour, or per man hour for the man in charge, while on basis of time for total productive labor the output was 2,357.7 papers per man hour.

All of these figures, like others for the 1894 investigation, did not include any time for the preparatory work, but covered only the actual running time of the machines, or productive hours. Based on the average clock time for the quadruple presses, 4.91 copies of a 16-page paper were produced each second. This was a decided contrast to the hand-press method in the same year, as shown for

establishments Nos. 2 and 3, in which it would have required 11.8 or 13.0 minutes, respectively, to print and fold an equivalent number of pages in 4-page sections. As the output of the double press was only half that of a quadruple press, or 2.45 copies of a 16-page paper per second, the same production on the hand presses would have required 5.9 and 6.5 minutes, respectively.

The basic wage rates varied for the different positions. One of the pressmen in charge received $4.50 per shift, while the other three were each paid $4.28 per shift. The four brakemen received $3.50 per shift each, and the other 14 journeymen $3.33 per shift each. The rate for each of the seven flyboys was $1.33 per shift. One additional laborer was employed for general work, and was paid $2.50 per shift. The supervisory force consisted of a foreman, at $9 per shift, and two assistant foremen, at $5 and $3.33 per shift, respectively. The actual man-hour labor costs for pressmen in charge, other journeymen, and flyboys indicate, however, that these groups worked considerable overtime, because their earnings were a great deal higher than at the basic rates.

The average man-hour production, on the basis of all employees, was 1,701.2 copies of a 16-page paper, equal to 6,804.6 copies of a 4-page section, over 163 times that in pressroom No. 2 or nearly 184 times that in pressroom No. 3, both of which used hand presses and folded the printed papers by hand.

PRESSROOM NO. 5 IN 1895

The 16-page papers produced in pressroom No. 5 required the full plating capacity of the double and quadruple presses used there, but sometimes issues were published, containing a different number of pages, which did not call for the full plating capacity of the equipment. This was the case in pressroom No. 5, covered by Table 84, which contains data for printing and folding 10,000 copies of a 36-page newspaper by mechanical power on quadruple presses in 1895.

TABLE 84.—*Man-hour production and labor cost for printing and folding in newspaper pressroom No. 5 in 1895*

Occupation	Man-hours worked in producing 10,000 copies of 36-page papers	Average production per man-hour	Labor cost per man-hour	Cost of man-hour production	
				Time cost	Labor cost
Productive labor:		*Copies*		*Minutes*	
Pressmen in charge	1.44	6,944.4	$0.581	8.7	$0.085
Other journeymen	7.92		.470	47.9	.375
Total	9.36	1,068.4	.487	56.6	.460
Nonproductive labor: Supervisory employees	.56		.929	3.4	.052
All employees	9.92	1,008.1	.512	60.0	.512

Data had been secured for the production of 125,000 copies of 36-page papers, but the figures had been converted to cover only 10,000 copies in the original table published.

The publication was a morning newspaper, with a regular working shift of seven hours. Only actual running time was recorded in the

original table, all preparatory time being eliminated. The equipment consisted of 3 quadruple presses, each operated by a pressman in charge, assisted by 1 brakeman, 1 tension man, and 3 helpers, a total of 6 for each press.

As a quadruple press could not print more than 32 pages at one time, it was necessary to make two runs for the production of a complete 36-page paper, the sections afterwards being placed together by hand. This latter operation, termed "stuffing," was not considered in the original data. While information was lacking on just how these two runs were arranged, it is reasonable to suppose that the first run consisted of one 12-page section, requiring only three-fourths of the plating capacity of each press, and producing two of the 12-page sections each cylinder revolution per press. That would leave 24 pages to be printed during the second run, in two collected sections, likewise involving three-fourths of the plating capacity on each press, one copy of which was turned out for each cylinder revolution. It took just as long to produce 36 pages in this manner as it would have taken to turn out 16 pages in the first run and 32 pages in the second run, or a total of 48 pages, as far as actual running time of the presses was concerned, and it also required just as many hands to operate each press. The average clock-hour production of 36-page papers for each quadruple press was only 6,944.4 complete copies, equal to 62,500 four-page papers, because it required one and one-half turns of the plate cylinders to produce 36 pages on a quadruple press. Consequently only 1.93 complete papers were printed and folded per second, clock time, a number which looks relatively small when compared with the output of complete papers in the previous establishment, but each paper in this pressroom contained 36 pages, as against 16 pages for pressroom No. 4. A proper comparison in this case would be to treat the 36-page products as three 12-page issues, since it would take just as long on a quadruple press to print a 12-page section as a 16-page section. On that basis the average production per clock-hour for each quadruple press was 20,833.3 copies, a considerably higher output than in pressroom No. 4. It meant turning out 5.79 copies of 12-page sections per second, clock time, or nearly one paper more than was produced on the same size press in pressroom No. 4.

The basic wage rates in this pressroom varied also according to positions. Each of the three pressmen in charge received $3.50 per shift, and the same rate was paid to the three brakemen, while the other 12 journeymen received $3 per shift. The actual man-hour labor costs for the two groups were somewhat higher, due to the inclusion of some overtime in the total time worked. The supervisory force consisted of a foreman, who was paid $6.50 per shift. No flyboys or laborers were listed, so the usual work done by these in other establishments was probably done by journeymen. In the original table there was included the proportionate time and labor cost of a machinist, at $5 per shift, to keep the machines in order, and a combination engineer and fireman, at $3 per shift, to furnish steam power. These two items were omitted from Table 84, as at the present time machinists are seldom employed directly in the pressrooms and the motive power is ordinarily electric and generally purchased outside.

The man-hour production, on the basis of total time for all employees, was 1,008.1 copies of complete 36-page papers, but figured on the real productive basis of 12-page sections, it was 3,024.3 copies.

duced to 4-page sections, it equaled 9,072.9 copies per man-hour, 33 per cent more than in pressroom No. 4. The labor cost per man-hour, on the basis of all employees, was 51.2 cents, or only 55.3 cent.of the man-hour cost for pressroom No. 4.

PRESSROOM NO. 6 IN 1896

In some pressrooms more pages per issue were required, especially for the Sunday issues, and larger presses had been installed to avoid printing an issue in several separate sections. A sufficient number of copies could not always be produced, however, on such larger presses and smaller ones which formed part of the equipment were used in conjunction with them. This was the case in pressroom No. 6, covered by Table 85, which contains data for printing and folding 10,000 copies of 48-page newspapers by mechanical power on sextuple, quadruple, triple, and double presses in 1896.

TABLE 85.—*Man-hour production and labor cost for printing and folding in newspaper pressroom No. 6 in 1896*

Occupation	Man-hours worked in producing 10,000 copies of 48-page papers	Average production per man-hour	Labor cost per man-hour	Cost of man-hour production	
				Time cost	Labor cost
		Copies		*Minutes*	
Pressmen in charge	1.97	5,076.1	$0.527	6.5	$0.057
Other journeymen	9.46		.392	31.0	.202
Flyboys	3.35		.200	11.0	.037
Total productive labor	14.78	676.7	.366	48.4	.295
Laborers	3.15		.135	10.3	.023
Supervisory employees	.39		.916	1.3	.020
Total nonproductive labor	3.54		.221	11.6	.043
All employees	18.32	545.7	.338	60.0	.338

Data had been obtained for the production of 444,000 copies of 48-page papers, but the figures had been converted to cover only 10,000 copies in the original table published.

The publication was a Sunday morning newspaper, with a working shift of 8 hours, but only the actual running time of the machines for producing the 10,000 copies of 48-page papers was considered in the original table. As with the former establishments, preparatory time, which would have reduced the man-hour production considerably, was omitted. The equipment consisted of 1 sextuple press, 6 quadruple presses, 1 triple press, and 2 double presses.

The capacities of these presses per cylinder revolution were: Sextuple press, 48 pages; quadruple press, 32 pages; triple press, 24 pages; and double press, 16 pages. The sectuple press was the only one on which 48 pages could be produced at one time, and the original table did not contain any data on how the sections were distributed on the various presses, nor the number of pages in each of the different sections. Consequently it could not be determined what portions of each press was used, nor what time or labor cost belonged to each. The sextuple press was stated in the text to be the largest found in the industry at that time, and to have printed and folded 72,000

copies of 48-page papers in 8 hours and 45 minutes, clock time. was equal to 8,228.57 complete papers per clock hour, contain 394,971.36 pages, or 2.29 complete papers per second, clock time. required one and one-half times as long to turn out the same nun of 48-page papers on one of the quadruple presses, twice as lon produce it on the triple press, or three times as long to print and it on one of the double presses, which could produce only 16 pages per cylinder revolution. The actual clock-hour production for the various presses can not be separated. Averaging the collective time for all of the presses, the clock-hour production of complete 48-page papers for the entire pressroom was reduced to 5,076.1 copies, the same as the man-hour production for pressmen in charge, equal to 60,913.7 copies of 4-page sections.

While the number of hands required for manning the various sizes of presses were not specified, the data indicated that the respective crews consisted of 11 hands on the sextuple press, 8 hands on each quadruple press, 6 hands on the triple press, and 5 hands on each double press. Consequently the man-hour production on one of the quadruple presses or on the triple press, based on the same clock hours for each style of press, would have been less than 92 per cent of the man-hour production on the sextuple press, while the man-hour production on one of the double presses, on the same basis, would have been only a little more than 73 per cent thereof.

As in the other establishments the basic wage rates varied for the different positions inside of the specific groups. One of the pressmen in charge received $5 per shift, while the other nine were each paid $4.57 per shift. The rates for the other 48 journeymen were: Brakemen, $3.58; tension men and rear side men, $3.43; helpers, $3.28 per shift. The 17 flyboys were paid $1.75 per shift each. The nonproductive labor consisted of 16 laborers, at $1.18 per shift, and a supervisory group containing one foreman, at $9 per shift, and one assistant foreman, at $7 per shift. The original table included an engineer, at $4 per shift, and a fireman, at $2.50 per shift, for furnishing steam power. These two items were omitted from Table 85, as was done for pressroom No. 4. While overtime presumably existed on some days, and would naturally increase the man-hour labor cost during a longer period, none was included for the time covered by the data, and the actual labor costs per man-hour corresponded with the basic wage rates.

The man-hour production, on the basis of total time for all employees, was only 545.7 copies of complete newspapers, about one-half the number produced in pressroom No. 5, or one-third the output for pressroom No. 4, but each paper contained 48 pages as against 36 pages for room No. 5 and 16 pages for room No. 4. Reduced to 4-page sections the man-hour production was 6,548.4 copies, equal to 72.2 per cent of the number turned out in pressroom No. 5, or 96.3 per cent of the number produced in pressroom No. 4.

AVERAGE MAN-HOUR PRODUCTION AND LABOR COST BY HAND AND BY MACHINE METHODS

TO facilitate comparison of hand and machine methods for the six establishments, Table 86 is presented, in which the production of all of them has been reduced to the equivalent of 4-page newspapers. In addition to presenting the data for each establishment,

Red
or erages are shown for establishments Nos. 2 and 3 as representative
n: f the hand method in 1895 and 1896, and also the per cent of increase
pei compared with establishment No. 1, representative of the hand
thod in 1852. In the same manner averages are given for the three
tablishments using the machine method and also the per cent of
increase as compared with those using the hand method in 1895 and 1896. The averages were computed by dividing the total production or labor cost, as the case may be, for each group by the total number of man-hours worked by such group.

TABLE 86.—*Comparison of man-hour production and man-hour labor cost in six newspaper pressrooms in 1852 and 1895–96*

Establishment	Method of production	Average number of copies of 4-page papers produced per man-hour by—		Labor cost per man-hour for—	
		Total productive labor	All employees	Total productive labor	All employees
1852:					
No. 1	Hand	33.3	32.8	$0.120	$0.122
1895–96:					
No. 2	do	58.8	41.7	.134	.107
No. 3	do	52.6	37.0	.181	.186
Average	do	56.8	40.1	.150	.134
1895–96:					
No. 4	Machine	8,586.8	6,804.8	.952	.926
No. 5	do	9,615.6	9,072.9	.487	.512
No. 6	do	8,120.4	6,548.4	.366	.338
Average		8,680.6	7,324.2	.500	.490
		Per cent	*Per cent*	*Per cent*	*Per cent*
Increase for hand method of 1895–96 over hand method of 1852		70.6	22.3	25.0	9.8
Increase for machine method over hand method of 1895–96		15,181.7	18,164.8	233.3	265.7

The man-hour production of 4-page papers in 1852, on the basis of total man-hours for all employees, was 32.8. The weighted average man-hour production by the hand method in 1895–96 on the same basis was 40.1, an increase of 22.3 per cent. Adoption of the machine method made a decided change, as the weighted average man-hour production of 4-page papers by this method in the 1895–96 period was 7,324.2, an increase of 18,164.8 per cent over the hand method in the same period.

The figures for the machine method were, however, based on actual operating time for the machines, omitting the preparatory man-hours, which ordinarily would equal the operative man-hours. Consequently the actual man-hour production for each of the three establishments would be only approximately one-half of the amount shown in the table, while the averages would be approximately 4,340 for total productive labor and 3,660 for all employees. This would reduce the increases for the machine method over the hand method of 1895–96 to about 7,500 per cent for total productive labor and approximately 9,000 per cent for all employees.

The man-hour labor cost, on the basis of all employees, was 12.2 cents in 1852. By 1895–96 the weighted average labor cost for the hand method had advanced to 13.4 cents, an increase of 9.8 per cent

only. The man-hour labor cost for the machine method had, however, reached 49 cents, an increase of 265.7 per cent over the hand method in same period. Consequently, the man-hour production by the hand method advanced over twice as fast as the man-hour labor cost between 1852 and 1895, though neither one changed radically. The difference between the hand method and the machine method was more marked, as the actual increase in production was 30 times larger than the increase in labor cost.

The figures covering the output for the total productive labor reveal that the advancement in methods permitted employment of more nonproductive labor, to handle the general work. This increased the difference in man-hour production on basis of productive labor and all employees. The majority of the nonproductive labor was ordinarily less skilled and lower paid workers than the productive labor, so that employment of relatively more nonproductive labor meant lower labor cost per man-hour than it otherwise would have been.

CHAPTER 11.—DETAILED STUDY OF PRODUCTIVITY AND LABOR COST FOR PRESSWORK IN 1916 AND 1926

DATA for actual accomplishments in regular work in pressrooms were obtained during the productivity survey of 1926 by the Bureau of Labor Statistics, in a similar manner to that for composing rooms and stereotyping rooms. Such information was also reduced to a man-hour basis, and the results are presented in Tables 87 to 135. The numbering of the different establishments was continued from those of the previous survey to facilitate comparison for one of the pressrooms, which was included in both surveys. In the general table for each pressroom, the workers were divided into productive and nonproductive labor, as each consisted of different groups. The productive labor was composed of three groups—pressmen in charge (of presses), other journeymen, and flyboys, while the nonproductive labor contained two groups—laborers and supervisory help. As the number of pages in the daily issues varied with the different establishments, and even from day to day in each establishment, the production was in each case reduced to 4-page papers rendering the general tables uniform and affording easy comparison.

Only part of the man-hours for the productive labor was for actual operation of the machines; and therefore additional tables were prepared for each establishment, covering such productive man-hours for the productive labor, together with the number of copies produced, both in complete papers and in equivalent 4-page papers. A "complete" paper is a paper of the regular size, except that for a Sunday paper each of the several sections is considered a "complete" paper. As a quadruple press would produce only 32 pages each cylinder revolution, while a sextuple press would produce 48 pages and an octuple press 64 pages per revolution, the data for hours and production are presented in separate tables for each of these groups, according to sizes of presses and different manufactures or speeds.

PRESSROOM NO. 7 IN 1916

PRODUCTIVITY AND LABOR COST FOR PRESSWORK

IN ONE of the establishments data were also secured on production, hours and wages for 1916, which permits comparison of presswork in the same plant during two periods, 10 years apart, and shows the progress thereof. Table 87 contains data for printing and folding newspapers in 1916, on quadruple and sextuple presses, based on total man-hours for all employees.

TABLE 87.—*Man-hour production and labor cost in printing and folding 15,244,302 copies of 14, 16, 18, 20, 22, and 24 page newspapers in newspaper pressroom No. 7 in 1916*

Occupation	Man-hours worked in producing 78,162,576 copies of 4-page papers	Average production per man-hour	Labor cost per per man-hour	Cost of man-hour production	
				Time cost	Labor cost
		Copies		*Minutes*	
Pressmen in charge	1,434.0	54,506.5	$0.871	6.1	$0.089
Other journeymen	8,160.0	----------	.731	34.9	.425
Flyboys	2,977.7	----------	.349	12.7	.074
Total productive labor	12,571.7	6,217.3	.656	53.8	.589
Laborers	777.0	----------	.321	3.3	.018
Supervisory employees	670.0	----------	1.237	2.9	.059
Total nonproductive labor	1,447.0	----------	.745	6.2	.077
All employees	14,018.7	5,575.6	.665	60.0	.665

The publication was issued mornings, including Sunday morning. The complete Sunday issue contained a larger number of pages than the ordinary morning issue, but was printed in several sections as the combined number of pages exceeded the capacity of the presses. Each of these sections was treated as a separate issue of the respective size. The daily issue on week mornings and the last sections on Sunday mornings ordinarily consisted of three or four editions, requiring a change of two or more plates for each press. Two or more presses were held each morning after the quantity ordered had been produced, awaiting the final O. K. from the mailing room. The regular working shift was 6 hours per night, except on Saturday night for the Sunday issue, when an additional 1.5 hours were included. The equipment consisted of Hoe sextuple presses, two decks high, provided with Kohler system of control, Stone magazine reels for the paper rolls, Cutler-Hammer newspaper conveyors to the mailing room above, one for each press, and air-pressure system on the ink, which was piped from a storage tank to the fountains. These presses were operated as individual quadruples on runs of 14 or 16 pages, producing two papers each cylinder revolution, but as sextuples when the issue contained 12 pages, printing four papers of that size each cylinder revolution, or when the issue contained either 18, 20, 22, or 24 pages, printing two papers each cylinder revolution. They were operated at a speed of from 13,000 to 14,000 revolutions per hour. In addition, the equipment included one Hoe linear design, double quadruple press, single deck, with two center folders, similarly provided, with exception of the newspaper conveyor. This press was operated occasionally as a quadruple press on special 16-page issues and as a sextuple on Sunday mornings, but at slightly less speed than the other presses.

The crew for a sextuple press consisted of one pressmen in charge, six other journeymen, and two flyboys, but when operated as a quadruple press one journeyman less was used. When both folder deliveries were used, an extra flyboy was added. The linear press, which was not provided with a newspaper conveyor, required the

additional flyboy at all times. The mailing-room employees removed the papers from the delivery ends of the conveyors. However, considerable trouble was experienced as the conveyors were not perfected at that period, and during the Sunday morning run an extra flyboy was also stationed at each delivery end. Each crew stripped and handled the paper for its own press. The average clock-hour production, equal to the man-hour production for pressmen in charge, was 54,506.5 copies of a 4-page paper per press.

Men in charge of presses received 86.7 cents per hour for week nights and 80 cents per hour for Saturday nights. Other journeymen were paid 70 cents per hour for week nights and 66.7 cents per hour for Saturday nights. The rates for flyboys were 33.3 and 36.2 cents for week nights and 26.7 and 28.9 cents for Saturday nights. The man-hour labor costs exceeded these figures, as a little more than 3 per cent of the total time was overtime. The group termed "laborers" consisted of extra flyboys, who took care of the waste paper, wiped presses on nights when such presses were not operated, and performed other general work. The supervisory group was composed of one superintendent, one foreman, and two assistant foremen, each of whom worked only six nights per week. The man-hour production, on basis of total hours for all employees, was 5,575.6 copies of a 4-page paper, with an average man-hour labor cost of 66.5 cents.

MAN-HOUR PRODUCTION ON SEXTUPLE PRESSES, OPERATED AT QUADRUPLE CAPACITY

Since each of the presses was operated part of the time as a quadruple press and part of the time as a sextuple press, and as the equipment consisted of two distinct types, the two-deck sextuple presses and the single-deck double quadruple press, a table has been prepared for each of these four groups, showing the productive man-hours for each group of productive labor, compared with the total hours, and production per productive hour of 4-page papers and of complete papers. The productive hours were based on the actual running time of each press. The production during this time was subject to slowing down of the speed of the presses for stops between editions, and the slow starting afterward, which naturally retarded it. No record was kept of delays due to breakage of webs or to chokes, but these were declared to have been practically nonexistent. Table 88 contains the data mentioned for the sextuple presses, operated as quadruple presses.

TABLE 88.—*Production on sextuple presses operated at quadruple capacity in newspaper pressroom No. 7 in 1916 (based on productive man-hours for productive labor)*

Occupation	Man-hours			Copies produced			
	Total	Productive		Complete papers		4-page papers	
		Number	Per cent of total	Total	Per productive hour	Total	Per productive hour
Pressmen in charge	135.4	95.3	70.3	2,283,490	23,966.1	8,985,925	94,310.7
Other journeymen	677.2	476.3	70.3	2,283,490	4,794.7	8,985,925	18,868.1
Flyboys	382.6	262.5	68.6	2,283,490	8,699.0	8,985,925	34,232.1
Total	1,195.3	834.0	69.8	2,283,490	2,737.9	8,985,925	10,774.1

The production on these presses was for the Sunday issues. As only 7 stops were made during the 11 runs, outside of the regular stops for shutting down the presses, they were operated at practically continuous high speed, except when partially slowing down for changes of rolls. The average number of complete papers produced per clock hour, as shown by man-hour production for pressmen in charge, was 23,966.1 copies, two papers per cylinder revolution. The actual running time was approximately 70 per cent of the total time, comparatively high because part of the runs occurred on Saturday nights, when the machines were used nearly continuously and very little time devoted to preparation. The output, on the basis of productive man-hours for the total productive labor, was 2,737.9 copies of a complete paper, or 10,774.1 copies of a 4-page paper. The number of copies of 4-page papers was reduced somewhat because part of the issues contained only 14 pages instead of 16 pages, an important factor.

MAN-HOUR PRODUCTION ON LINEAR PRESS, OPERATED AT QUADRUPLE CAPACITY

Table 89 contains data for production on the linear press, when operated as a quadruple press:

TABLE 89.—*Production on linear press operated at quadruple capacity in newspaper pressroom No. 7 in 1916 (based on productive man-hours for productive labor)*

Occupation	Man-hours			Copies produced			
	Total	Productive		Complete papers		4-page papers	
		Number	Per cent of total	Total	Per productive hour	Total	Per productive hour
Pressmen in charge	57.0	29.5	51.7	473,930	16,076.3	1,935,700	65,661.5
Other journeymen	285.0	147.4	51.7	473,930	3,214.8	1,935,700	13,130.5
Flyboys	119.3	64.2	53.9	473,930	7,379.8	1,935,700	30,141.7
Total	461.3	241.1	52.3	473,930	1,965.5	1,935,700	8,028.0

Most of the production on this press was likewise for the Sunday issues, and there were only two stops during the 13 runs it was operated. The average number of complete papers produced per clock-hour was 16,076.3 copies, two papers per cylinder revolution, only two-thirds of the production attained on the other presses. As part of the runs were for special small issues, the actual running time was only a little over half of the total time. The output, on the basis of productive man-hours for total productive labor, was 1,965.5 copies of a complete paper, or 8,028 copies of a 4-page paper, also practically two-thirds of the number produced on the other quadruple presses as shown by Table 88. Part of the production on this press was also 14-page issues.

MAN-HOUR PRODUCTION ON SEXTUPLE PRESSES, OPERATED AT SEXTUPLE CAPACITY

Table 90 contains data in similar form for the sextuple presses, operated as sextuples with sextuple crews, but not always at full plating capacity.

TABLE 90.—*Production on sextuple presses operated at sextuple capacity, in newspaper pressroom No. 7 in 1916 (based on productive man-hours for productive labor)*

Occupation	Man-hours			Copies produced			
	Total	Productive		Complete papers		4-page papers	
		Number	Per cent of total	Total	Per productive hour	Total	Per productive hour
Pressmen in charge	1,244	606.8	48.8	12,223,962	20,146.0	65,758,531	108,374.7
Other journeymen	7,176	3,640.6	50.7	12,223,962	3,357.7	65,758,531	18,062.6
Flyboys	2,488	1,213.5	48.8	12,223,962	10,073.1	65,758,531	54,187.8
Total	10,908	5,460.9	50.1	12,223,962	2,238.5	65,758,531	12,041.7

The usual number of pages in the paper issued daily was 20, 22, or 24 pages, in a few instances dropping to 18 pages. The last sections printed for the Sunday issues were of similar sizes. Any of these could be produced on sextuple presses at the rate of two copies per cylinder revolution. On account of the several editions of each issue there were 555 stops during the 176 runs, outside of the actual shutdowns of presses, involving considerable running at less than full speed. Slowing down for roll changes also took more time for sextuple presses than for quadruple presses, as three rolls were used instead of two. This reduced the clock-hour production to 20,146 copies of complete papers, as shown by the man-hour production for pressmen in charge, or about five-sixths of the production for quadruple capacity. The actual running time was approximately 50 per cent of the total working time. The output, on the basis of productive man-hours for the total productive labor, was 2,238.5 copies of a complete paper, or 12,041.7 copies of a 4-page paper, over 80 per cent as far as complete papers were concerned of the production on the quadruple presses, but an increase of over 10 per cent in 4-page papers, because the issues contained a larger number of pages.

MAN-HOUR PRODUCTION ON LINEAR PRESS, OPERATED AT SEXTUPLE CAPACITY

Table 91 contains data in similar form for the linear press, operated as a sextuple press:

TABLE 91.—*Production on linear press operated at sextuple capacity, in newspaper pressroom No. 7 in 1916 (based on productive man-hours for productive labor)*

Occupation	Man-hours			Copies produced			
	Total	Productive		Complete papers		4-page papers	
		Number	Per cent of total	Total	Per productive hour	Total	Per productive hour
Pressmen in charge	34.0	18.5	54.5	262,920	14,196.5	1,482,220	80,033.5
Other journeymen	204.0	111.1	54.5	262,920	2,366.5	1,482,220	13,341.3
Flyboys	76.5	37.0	48.4	262,920	7,100.2	1,482,220	40,027.6
Total	314.5	166.6	53.0	262,920	1,577.7	1,482,220	8,894.2

The press was used only in sextuple capacity on Saturday nights for the Sunday morning issues, and there were 11 stops, outside of the regular shutdowns, during the eight runs. The clock-hour production was only 14,196.5 copies of complete papers, about the same relation to quadruple production on this press as between sextuple and quadruple production on the other presses, but only a little over 70 per cent of the production reached on the other sextuple machines. The actual running time was over 50 per cent of the total time. The output, on the basis of productive man-hours for productive labor, was 1,577.7 copies of a complete paper, or 8,894.2 copies of a 4-page paper, retaining the same relation to quadruple production of this press and to sextuple production on the other presses, as for pressmen in charge.

PRESSROOM NO. 7 IN 1926

PRODUCTIVITY AND LABOR COST FOR PRESSWORK

SEVERAL changes took place in pressrooms between 1916 and 1926, especially installation of larger and faster equipment. Table 92 contains data for printing and folding of newspapers in the same pressroom in 1926, on sextuple and octuple presses, based on total man-hours for all employees.

TABLE 92.—*Man-hour production and labor cost in printing and folding 21,470,634 copies of 18, 20, 22, 24, 26, 28, 30, 32, 36, 40, 44, 48, and 52 page newspapers, in newspaper pressroom No. 7 in 1926*

Occupation	Man-hours worked in producing 195,093,120 copies of 4-page papers	Average production per man-hour	Labor cost per man-hour	Cost of man-hour production	
				Time cost	Labor cost
		Copies		*Minutes*	
Pressmen in charge	2,851.8	68,410.5	$1.491	5.3	$0.131
Other journeymen	18,221.5		1.340	33.7	.752
Flyboys	6,906.0		.827	12.8	.176
Total, productive labor	27,979.3	6,972.8	1.228	51.7	1.059
Laborers	3,301.7		.955	6.1	.097
Supervisory employees	1,171.1		2.249	2.2	.081
Total, nonproductive labor	4,472.8		1.293	8.3	.178
All employees	32,452.1	6,011.7	1.237	60.0	1.237

An early edition was printed, which usually contained four or eight pages less than the regular edition, and necessitated complete changes of plates and adjustments on the presses used for it. The number of editions in a single issue had increased, so that there frequently were four or five stops for changes of plates, and as many as seven in one run. The regular working shift was 6.5 hours per night, except on Saturday night, when it was 7.5 hours, but an extra weekly working shift of 7.5 hours had been added, worked during daytime, for production of additional Sunday sections. The equipment still included the Hoe sextuple presses from the former period, designated as group A, but additions had been made of—

Group B. Goss octuple presses, Unit-Type, with three units on the floor and one unit on the deck above, with Cutler–Hammer system of press control, and with magnetic brake for quick stoppage;

Group C. Hoe octuple presses, Superspeed style, also with three units on floor and one unit on the deck above, with automatic ink pump system and Cutler-Hammer system of press control; and

Group D. Hoe sextuple presses, Superspeed Unit-Type, arranged in parallel duo-sextuple batteries, all units on floor, with automatic ink-pump system and Cline system of press control.

All presses were equipped with Stone magazine reels for paper rolls and newspaper conveyors to the mailing room on the floor above. All of the newer presses were operated at a speed of 15,000 cylinder revolutions per hour, while the older ones remained at the speed used in 1916—13,000 to 14,000 revolutions per hour. The presses were operated as individual sextuples on runs up to and including 48 pages, and for the smaller advance sections of the Sunday issues. They were operated as octuple presses when the run exceeded 48 pages, or consisted of 32 pages, and on Sunday mornings. Octuple combinations were made from the sextuple presses by running one of these in conjunction with a single unit from one of the other sextuples, allowing production of one paper up to 64 pages, on each press per cylinder revolution, or two 32-page papers per revolution.

The crew for a sextuple press consisted of one pressman in charge, five other journeymen, and two flyboys on a single delivery. For an octuple press three journeymen were added. As only one delivery on each press was provided with a conveyor, it was necessary, when the second delivery was also used, to add one or two extra flyboys to each press, according to the distance for carrying the papers. The mailing room employees removed all papers from the delivery ends of the conveyors. Regular paper strippers were employed, who delivered the rolls to the pressroom ready for insertion in the press, relieving the press crews of getting the rolls ready. Paper strippers were classed as nonproductive labor. The average clock-hour production per press, equal to man-hour production for pressmen in charge, was 7,528 copies of complete papers, only 70 per cent of the production in 1916. On basis of 4-page papers the figures showed an increase of 25 per cent, as the issues contained a larger number of pages during the 1926 period. The reduction in clock-hour production was partly due to the requirement of a comparatively large number of presses, in order to produce a sufficient number of papers as soon as possible after receipt of the plates, as the editorial and advertising departments held the pages open for copy as long as possible. The main cause for the reduction, however, was the size of the daily issues, which prevented printing two copies at each cylinder revolution in 70 per cent of the runs, and consequently produced the papers at the rate of 1.3 copies per cylinder revolution instead of 2 copies.

Wages had advanced in the 10-year period, in accord with the general advance in wages for all trades throughout the country. Pressmen in charge received $1.46 per hour and other journeymen $1.318 per hour. The rates for flyboys varied from 66 cents to $1.185 per hour, according to length of service. As during the former period, the man-hour labor costs were slightly higher than the actual wage rates, due to the overtime, but this had been reduced to less than 1 per cent of the total time. The group termed "laborers" consisted of extra flyboys, picking up waste paper and doing other general work, and the paper strippers. The supervisory force consisted of a

superintendent and a foreman, each working only six nights per week, and an assistant foreman. The man-hour production, on the basis of total hours for all employees, was 661.6 copies of complete papers, or 65 per cent of the 1916 production, due to reasons stated previously. Figured in 4-page papers, there was an increase of approximately 8 per cent. The actual hourly labor cost, for either total productive labor or for all employees, had practically doubled.

MAN-HOUR PRODUCTION ON SEXTUPLE PRESSES, GROUP A

As the presses were operated both as sextuples and octuples, and as the equipment consisted of four different styles, eight tables were compiled to present the output per man-hour for productive labor on each style and size, in similar manner as for the 1916 period. Table 93 contains the compilation for Group A, operated as sextuple presses. As the same presses were covered for 1916 by Table 90, a comparison is afforded of the identical machines for both periods.

TABLE 93.—*Production on sextuple presses, Group A, in newspaper pressroom No. 7 in 1926 (based on productive man-hours for productive labor)*

Occupation	Man-hours			Copies produced			
	Total	Productive		Complete papers		4-page papers	
		Number	Per cent of total	Total	Per productive hour	Total	Per productive hour
Pressmen in charge	299.0	137.1	45.9	1,722,812	12,563.4	13,771,740	100,428.4
Other journeymen	1,495.0	685.7	45.9	1,722,812	2,512.6	13,771,740	20,085.1
Flyboys	812.5	274.3	33.8	1,722,812	6,281.5	13,771,740	50,212.4
Total	2,606.5	1,907.1	42.1	1,722,812	1,570.4	13,771,740	12,553.2

The number of pages printed at one time varied from 18 to 48. Because no more than 24 pages could be produced on a sextuple press at the rate of two papers per revolution, and nearly 75 per cent of the runs consisted of a larger number of pages, only approximately 1.25 papers were produced per cylinder revolution. The productive time in this and the following tables was based on the actual running time for each press, all stops deducted, whether at the end of each edition or for delays due to other causes. There was an average of four stops for each of the 50 runs made by the presses in the group, besides 14 stops caused by delays, which naturally reduced clock-hour production, through slowing down and starting up to speed. The clock-hour production was only 12,563.4 complete papers per hour, or approximately 60 per cent of the 1916 production. Figured on the basis of 4-page papers, the output was a little over 90 per cent of the 4-page papers turned out per clock-hour on these same presses in 1916. The actual running time was approximately 45 per cent of the total time. The output, on the basis of productive man-hours for total productive labor, was 1,570.4 copies of complete papers per hour, or a little over 70 per cent of the 1916 figures, while on the basis of 4-page papers the production was slightly higher than in the former period. A record was kept of delays and time consumed thereby, which showed what might delay production in even a well-

regulated establishment. The causes were replating or chiseling out errors on plates; trouble with the newspaper conveyors, which required 15 to 23 minutes for adjustment each time; with the folder, where adjustments ranged from 10 to 25 minutes; with the blankets, with the rollers, with the press controls, and with cylinder adjustments.

MAN-HOUR PRODUCTION ON SEXTUPLE PRESSES, GROUP B

Table 94 contains similar data for Group B, operated at sextuple capacity:

TABLE 94.—*Production on sextuple presses, Group B, in newspaper pressroom No. 7 in 1926 (based on productive man-hours for productive labor)*

Occupation	Man-hours			Copies produced			
	Total	Productive		Complete papers		4-page papers	
		Number	Per cent of total	Total	Per productive hour	Total	Per productive hour
Pressmen in charge	114.5	71.6	62.6	948,146	13,236.7	7,953,733	111,039.1
Other journeymen	572.5	358.2	62.6	948,146	2,647.2	7,953,733	22,206.6
Flyboys	243.9	143.3	58.7	948,146	6,617.9	7,953,733	55,515.7
Total	930.9	573.1	61.6	948,146	1,654.5	7,953,733	13,879.2

The number of pages printed in the different runs ranged from 18 to 48. Nearly 80 per cent of the runs consisted of more than 24 pages each, so the production was approximately 1.22 complete papers per cylinder revolution. There were four stops for each of the 18 runs made on the press, including a total of four caused by delays. The clock-hour production was 13,236.7 complete papers, nearly 700 papers more than for the previous group. Reduced to 4-page papers, it was 111,039.1 copies, over 10,000 copies more per hour than for Group A. The actual running time was over 60 per cent of the total time. The output, on the basis of productive man-hours for productive labor, was less than 100 complete copies, but more than 1,300 four-page papers per hour over the production for Group A. The cause for one delay was a hot bearing, for another it was cylinder adjustment; for the third, roller trouble; and for the fourth, which consumed 20 minutes, conveyor trouble.

MAN-HOUR PRODUCTION ON SEXTUPLE PRESSES, GROUP C

Table 95 contains similar data for Group C, operated at sextuple capacity.

TABLE 95.—*Production on sextuple presses, Group C, in newspaper pressroom No. 7 in 1926 (based on productive man-hours for productive labor)*

Occupation	Man-hours			Copies produced			
	Total	Productive		Complete papers		4-page papers	
		Number	Per cent of total	Total	Per productive hour	Total	Per productive hour
Pressmen in charge	369.5	212.5	57.5	2,663,738	12,533.5	24,091,550	113,356.0
Other journeymen	1,847.5	1,062.7	57.5	2,663,738	2,506.7	24,091,550	22,670.8
Flyboys	855.2	425.1	49.6	2,663,738	6,266.6	24,091,550	56,676.7
Total	3,073.2	1,700.3	55.3	2,663,738	1,566.7	24,091,550	14,169.3

The number of pages ranged from 18 to 48 for this group also. As only 12 per cent of the runs consisted of 24 pages or less, the average production per cylinder revolution was 1.12 complete papers. There was an average of nearly 4 stops for each of the 59 runs, with an additional total of 29 stops for delays. The clock-hour production was 12,533.5 complete papers, slightly less than in Group A, but reduced to 4-page papers it exceeded the Group A production nearly 13 per cent. The actual running time was approximately 60 per cent of the total time. The output, on the basis of productive man-hours for total productive labor, was practically the same number of complete papers per hour as for Group A, but reduced to 4-page papers it was also nearly 13 per cent more. Two-thirds of the delays were due to replating or chiseling on the plates. Three were caused by conveyor trouble, ranging from 10 to 14 minutes for adjustment, and three others by folder trouble, ranging from 12 to 60 minutes for correction. The rest were due to trouble with the rollers and the reels.

MAN-HOUR PRODUCTION ON SEXTUPLE PRESSES, GROUP D

Table 96 contains similar data for Group D, operated at sextuple capacity:

TABLE 96.—*Production on sextuple presses, Group D, in newspaper pressroom No. 7 in 1926 (based on productive man-hours for productive labor)*

Occupation	Man-hours			Copies produced			
	Total	Productive		Complete papers		4-page papers	
		Number	Per cent of total	Total	Per productive hour	Total	Per productive hour
Pressmen in charge	748.0	399.0	53.3	4,630,807	11,605.5	48,543,166	121,656.0
Other journeymen	3,740.0	1,995.1	53.3	4,630,807	2,321.1	48,543,166	24,331.4
Flyboys	1,607.5	798.0	49.6	4,630,807	5,802.8	48,543,166	60,828.8
Total	6,095.5	3,192.1	52.4	4,630,807	1,450.7	48,543,166	15,207.1

The number of pages for this group did not go below 32, but went as high as 48, making the entire production one complete paper per cylinder revolution. There was an average of 4 stops for each of the 133 runs, besides 34 stops due to delays, which naturally reduced the clock-hour production. This was only 11,605.5 complete papers, 8 per cent less than for Group A, but constituted 21 per cent more copies of 4-page papers than was turned out by that group per hour. The actual running time was a little over 50 per cent of the total time. The output, on the basis of productive hours for total productive labor, was 1,450.7 complete papers, like the clock-hour production 8 per cent less than for Group A or 21 per cent more of 4-page papers. One-fourth of the delays were due to replating or to chiseling on the plates. Over one-third were caused by trouble on the conveyors, ranging from 7 to 18 minutes for adjustments. One break of the web caused a delay of 12 minutes. Others were due to trouble with the folders, blankets, rollers, inking system, cylinder register, or driving clutch.

MAN-HOUR PRODUCTION ON OCTUPLE PRESSES, GROUP A

Table 97 contains data for Group A, operated as octuple presses. As an octuple press has practically the same capacity as two quadruple presses, the table is comparable with Table 88 for 1916 quadruple production on these same presses.

TABLE 97.—*Production on octuple presses, Group A, in newspaper pressroom No. 7, in 1926 (based on productive man-hours for productive labor)*

Occupation	Man-hours			Copies produced			
	Total	Productive		Complete papers		4-page papers	
		Number	Per cent of total	Total	Per productive hour	Total	Per productive hour
Pressmen in charge	344.7	183.7	53.3	2,507,279	13,648.8	21,615,282	117,666.2
Other journeymen	2,757.3	1,469.6	53.3	2,507,279	1,706.1	21,615,282	14,708.3
Flyboys	945.5	367.4	38.9	2,507,279	6,824.4	21,615,282	58,833.1
Total	4,047.5	2,020.7	49.9	2,507,279	1,240.8	21,615,282	10,696.9

Presses from all four groups were used, except in two instances, when octuple runs were made, and the range for the number of pages printed at one time was the same for all groups, 20 to 52. For this group 40 runs were made of issues containing 32 or fewer pages and 25 runs of larger size issues, giving an average of 1.62 complete papers per cylinder revolution. A little over 3.5 stops were made per run, including 19 caused by delays. The clock-hour production was 13,648.8 complete copies, less than 60 per cent of the production by these presses as quadruples in 1916, but at that time they were producing two papers per revolution and were subject to comparatively few stops. Reduced to 4-page papers, the clock-hour production was 117,666.2 copies, a little more than 60 per cent of the number turned out by two quadruples in 1916, due to the smaller

proportion of plating capacity used during the latter period. The actual running time was a little over 50 per cent of the total time. The output, on basis of productive hours for total productive labor, was 1,240.8 copies of complete papers, less than half of the 1916 figures. On the basis of 4-page papers the man-hour production was even smaller than for one quadruple press in 1916. One-fourth of the delays were due to trouble with the reels, consuming from 2 to 22 minutes each. One break of the web caused a delay of 28 minutes and an overflow of an ink fountain caused a delay of 50 minutes. Other delays were due to replating and to trouble with conveyors, blankets, rollers, folders, cylinder register, ink pumps, and a gear guard. The time of adjustments ranged from 10 to 20 minutes.

MAN-HOUR PRODUCTION ON OCTUPLE PRESSES, GROUP B

Table 98 contains similar data for Group B, operated at octuple capacity:

TABLE 98.—*Production on octuple presses, Group B, in newspaper pressroom No. 7, in 1926 (based on productive man-hours for productive labor)*

Occupation	Man-hours			Copies produced			
	Total	Productive		Complete papers		4-page papers	
		Number	Per cent of total	Total	Per productive hour	Total	Per productive hour
Pressmen in charge	89.8	51.4	57.3	797,670	15,512.8	7,159,586	139,237.4
Other journeymen	718.6	411.3	57.2	797,670	1,939.3	7,159,586	17,405.9
Flyboys	216.5	102.8	47.5	797,670	7,757.2	7,159,586	69,625.5
Total	1,024.9	565.6	55.2	797,670	1,410.4	7,159,586	12,658.4

During one-half of the runs the issues consisted of 52 pages each, one paper per revolution, while during the other half they contained 20, 22, 28, or 30 pages each, two papers per revolution, making an average production of 1.5 complete papers per cylinder revolution. There were 3.5 stops for each of the 16 runs, including 2 caused by delays. The clock-hour production was 15,512.8 complete papers, over 1,850 more than for Group A. Reduced to 4-page papers, the increase was over 21,500 copies. The actual running time was less than 60 per cent of the total time. The output, on basis of productive man-hours for total productive labor, was 1,410.4 complete papers, 170 more than for Group A, but also 1,960 copies more of 4-page papers. One delay was due to folder trouble, requiring 71 minutes for adjustment, while the other was due to the mailing room.

MAN-HOUR PRODUCTION ON OCTUPLE PRESSES, GROUP C

Table 99 contains similar data for Group C, operated at octuple capacity.

TABLE 99.—*Production on octuple presses, Group C, in newspaper pressroom No. 7, in 1926 (based on productive man-hours for productive labor)*

Occupation	Man-hours			Copies produced			
	Total	Productive		Complete papers		4-page papers	
		Number	Per cent of total	Total	Per productive hour	Total	Per productive hour
Pressmen in charge	249.7	140.2	56.2	2,255,839	16,089.0	19,527,941	139,276.4
Other journeymen	1,997.9	1,121.7	56.1	2,255,839	2,011.0	19,527,941	17,408.8
Flyboys	661.7	280.4	42.4	2,255,839	8,044.2	19,527,941	69,635.7
Total	2,909.3	1,542.4	53.0	2,255,839	1,462.6	19,527,941	12,660.9

During 25 of the runs the number of pages were 32 or less, permitting two papers per revolution, while during the other 20 only one paper per revolution was printed, making the average production 1.56 complete papers per cylinder revolution. There was an average of 4 stops per run, including 22 caused by delays. The clock-hour production was 16,089 complete papers, 2,440 more than for Group A, or a little more than 21,600 copies of 4-page papers additional. The actual running time was a little more than 55 per cent of the total time. The output, on the basis of productive man-hours for total productive labor, was 1,462.6 complete papers, 220 more than for Group A, or over 1,950 copies more of 4-page papers. The majority of delays were caused by replating or by chiseling on the plates. Four were due to folder trouble, ranging from 7 to 26 minutes, two to conveyor trouble, two to roller trouble, and one to cylinder register.

MAN-HOUR PRODUCTION ON OCTUPLE PRESSES, GROUP D

Table 100 contains similar data for Group D, operated at octuple capacity:

TABLE 100.—*Production on octuple presses, Group D, in newspaper pressroom No. 7, in 1926 (based on productive man-hours for productive labor)*

Occupation	Man-hours			Copies produced			
	Total	Productive		Complete papers		4-page papers	
		Number	Per cent of total	Total	Per productive hour	Total	Per productive hour
Pressmen in charge	636.6	336.1	52.8	5,894,352	17,540.1	51,244,472	152,490.6
Other journeymen	5,092.6	2,688.4	52.8	5,894,352	2,192.5	51,244,472	19,061.3
Flyboys	1,562.2	672.1	43.0	5,894,352	8,770.1	51,244,472	76,245.3
Total	7,291.4	3,696.6	50.7	5,894,352	1,594.6	51,244,472	13,862.8

Two papers per revolution were printed during 46 of the runs, but only one paper per revolution during the other 62 runs, giving an average of 1.43 complete papers per cylinder revolution. There was an average of a little over 4 stops per run, including 37 for delays. The clock-hour production was 17,540.1 complete papers, or 3,891

more than for Group A. Reduced to 4-page papers, the increase was 34,824.4 copies. The actual running time was a little over 50 per cent of the total time. The output, on the basis of productive hours for total productive labor, was 1,594.6 complete papers, 350 more than for Group A, or a little over 3,150 copies more of 4-page papers. A number of the delays were due to replating or to chiseling. Trouble with the folders was responsible in 8 cases, ranging from 6 to 40 minutes. Difficulty with ink distribution accounted for 7 more, ranging from 5 to 28 minutes. Five were caused by conveyor trouble, and the rest were due to rollers and to cylinder register.

PRESSROOM NO. 8 IN 1926

PRODUCTIVITY AND LABOR COST FOR PRESSWORK

IN smaller pressrooms, where the equipment consists of only one or two presses, it is often necessary during the same shift to make runs containing different numbers of pages. An example of this kind was found in pressroom No. 8, covered by Table 101, which contains data for printing and folding of newspapers, in 1926, on presses of octuple capacity but used at times as quadruples or sextuples, based on total man-hours for all employees.

TABLE 101.—*Man-hour production and labor cost in printing and folding 3,249,355 copies of 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30, and 32 page newspapers in newspaper pressroom No. 8, in 1926*

Occupation	Man-hours worked in producing 16,947,140 copies of 4-page papers	Average production per man-hour	Labor cost per man-hour	Cost of man-hour production	
				Time cost	Labor cost
		Copies		*Minutes*	
Pressmen in charge	418.3	40,519.2	$1.292	6.2	$0.134
Other journeymen	1,817.5		1.156	27.1	.522
Flyboys	707.0		.492	10.5	.086
Total, productive labor	2,942.8	5,759.0	1.016	43.9	.743
Laborers	692.0		.505	10.3	.087
Supervisory employees	390.0		1.590	5.8	.154
Total, nonproductive labor	1,082.0		.896	16.1	.241
All employees	4,024.8	4,210.7	.984	60.0	.984

The newspaper was published mornings, Sundays included. The number of pages in the different press runs ranged from 10 to 32 and any issue for either week day or Sunday which contained more than 32 pages was printed in several sections, each of which has been treated as a separate issue of its respective size. The daily issue on week mornings and the last section on Sunday mornings were published in three, or occasionally four, editions, requiring changes of several plates for each one, and customarily changes in the number of pages also. One press was usually held a short time for the final O. K. from the mailing room. The regular working shift was 7 hours each night for all except 2 laborers, who worked 58 hours per week, 6 shifts of 8 hours and 1 shift of 10 hours, handling paper. The equipment consisted of Hoe octuple presses, converted deck

type sextuple presses by addition of extra unit on floor by folder. They were provided with Kohler system of press control and had hydraulic elevators back of presses for hoisting paper rolls. During four nights the productive labor consisted of 2 men in charge, 8 journeymen, and 3 flyboys, for each two presses. On two other nights, when part of the Sunday sections were printed, one extra flyboy was added, and on Saturday nights two more journeymen were also added, making each crew for that shift 1 man in charge, 6 journeymen, and 2 flyboys. The average clock-hour production per press, equal to man-hour production for men in charge, was 40,519.2 copies of 4-page papers, or approximately 60 per cent of the number produced in pressroom No. 7.

Men in charge of presses received $1.262 per hour and other journeymen were paid $1.119 per hour. Various rates were paid to flyboys—42.9, 50.0, and 57.1 cents per hour. The average man-hour labor costs for men in charge and for journeymen were slightly higher than the regular hour rate, on account of overtime, which was 1.26 per cent of the total time for men in charge, and 1.78 per cent for journeymen. The nonproductive group of laborers consisted of regular paper handlers, at 41.4 cents and 55.2 cents per hour, and extra paper handlers on the last night of each week, at 50 cents per hour. The supervisory group consisted of a foreman, who worked only six nights per week, and an assistant foreman. The man-hour production, on the basis of total hours for all employees, was 4,210.7 copies of a 4-page paper per hour, or a little over 70 per cent of the production for pressroom No. 7.

MAN-HOUR PRODUCTION ON PRESSES

On account of the varied number of pages produced on a single night, requiring perhaps both quadruple and sextuple capacity for the same issue, no separation could be made of the production on press capacity basis. Consequently only a single table (Table 102) was compiled for production based on productive hours for the productive labor:

TABLE 102.—*Production on all presses in newspaper pressroom No. 8, in 1926 (based on productive man-hours for productive labor)*

Occupation	Man-hours			Copies produced			
	Total	Productive		Complete papers		Four-page papers	
		Number	Per cent of total	Total	Per productive hour	Total	Per productive hour
Pressmen in charge	418.3	214.4	51.2	3,249,355	15,159.1	16,947,140	79,062.9
Other journeymen	1,817.5	953.8	52.5	3,249,355	3,406.9	16,947,140	17,768.6
Flyboys	707.0	396.4	56.1	3,249,355	8,196.8	16,947,140	44,876.0
Total	2,942.8	1,564.5	53.2	3,249,355	2,076.9	16,947,140	10,832.7

Three main editions were printed each night, with stops of considerable duration between them. The records contained the starting and stopping time for each of these, but failed to show the number and duration of stops inside of such running time. Consequently the productive time in this table was based on the time for printing

these three editions, including the time consumed in changing of rolls, in changing of plates for other news, or in possible delays for adjustments, all of which would have reduced the actual running time materially. The known stops totaled 147, which were deducted from the running time and would affect it only through reduced speed in stopping and starting, but the number of roll changes necessary for the production would require approximately 1,000 stops, each of which also affected the production through reduction of speed, and additionally consumed from 30 seconds to 2 minutes actual stoppage for each. The production, on basis of productive man-hours for men in charge, was only 15,159.1 complete papers per man-hour, also representing the clock-hour production. It was decidedly low, at two papers per cylinder revolution, when compared with the production for the previous establishment, but may be accounted for by the inclusion of the stops. Reduced to 4-page papers it was 79,062.9 copies, a far smaller multiple of the complete papers than in room No. 7, caused by the decidedly smaller number of pages in the issues. The actual running time was a little over 50 per cent of the total time. The output, on the basis of productive man-hours for total productive labor, was 2,076.9 complete papers per hour, relatively higher, when compared with production for men in charge, than the similar proportion in room No. 7. The corresponding number of 4-page papers was, like that for men in charge, comparatively much smaller than in the foregoing establishment.

PRESSROOM NO. 6 IN 1926

PRODUCTIVITY AND LABOR COST FOR PRESSWORK

IN another establishment both morning and evening papers were published, creating somewhat varying conditions. They were conducted as two separate newspapers, though using the same equipment, but with a different personnel. The data for the morning issue is presented in Table 103, which covers printing and folding of newspapers in 1926, on quadruple, sextuple, octuple, and decuple presses, based on total man-hours for all employees.

TABLE 103.—*Man-hour production and labor cost in printing and folding 13,585,894 copies of 14, 16, 18, 20, 22, 24, 26, 28, 32, and 36 page newspapers in newspaper pressroom No. 6, in 1926*

Occupation	Man-hours worked in producing 92,677,462 copies of 4-page papers	Average production per man-hour	Labor cost per man-hour	Cost of man-hour production	
				Time cost	Labor cost
		Copies		*Minutes*	
Pressmen in charge	1,996.3	46,425.8	$1.489	4.8	$0.119
Other journeymen	11,540.2		1.340	27.8	.621
Flyboys	3,919.8		.893	9.5	.141
Total, productive labor	17,456.2	5,309.2	1.256	42.1	.881
Laborers	5,797.5		.939	14.0	.219
Supervisory employees	1,632.5		1.836	3.9	.119
Total, nonproductive labor	7,430.0		1.136	17.9	.339
All employees	24,886.2	3,724.1	1.220	60.0	1.220

The publication was issued mornings, Sundays included. The complete Sunday issue contained a larger number of pages than the regular week-day issue, which ordinarily consisted of 28 to 36 pages, but it was printed in several sections, each of which has been treated as a separate issue. The daily issue on week mornings and the last section on Sunday mornings consisted of five editions. As neither the first nor the last edition of the regular daily issue required the operation of all the presses used during the night, part of them were started early and some of the others kept late in the morning. The total number in use was operated only during three of the editions and on the Sunday sections. The regular working shift was 6.5 hours, net, per night, except Friday and Saturday nights, each of which consisted of 7.5 net working hours. The equipment contained several different makes and styles, which were accordingly separated into five groups, consisting of:

Group 1. Hoe sextuple presses, right-angle quadruples with decks, with old-style folders and Kohler system of press control;

Group 2. Hoe sextuple presses, X pattern, with old-style folders and Kohler system of press control;

Group 3. Hoe double sextuple presses, straight-line, three-deck, with old-style folders and Kohler system of press control;

Group 4. Duplex decuple, double sextuple, and double octuple presses, Metropolitan Super Duty type, with Cutler-Hammer newspaper conveyors and General Electric system of press control;

Group 5. Scott octuple presses, Straight Unit, mezzanine type, with automatic tension control, Cutler-Hammer newspaper conveyors and system of press control. One of them was provided with Stone magazine reels for paper rolls.

All presses were provided with air-pressure system on the ink, which was piped from a storage tank to the fountains. Electric roll hoists on ceiling track beams were used for transporting and hoisting paper rolls. The maximum operating speed for presses in Groups 1, 2, and 3 was 12,000 cylinder revolutions per hour, for presses in Group 5 it was 13,200 revolutions, and for presses in Group 4 it was 18,000 revolutions per hour.

The crew for a quadruple press consisted of one pressman in charge, four other journeymen, and two flyboys. A sextuple crew contained one additional journeyman, and an octuple crew three more, or eight men in all. A decuple crew consisted of two pressmen in charge, nine other journeymen, and three flyboys. At times, where the work required it, an additional journeyman or flyboy was added to a crew. Papers were carried by flyboys from deliveries not provided with conveyors to electric lifts, for delivery to the mailing room above. Plates were sent to and from the stereotyping room, on floor above, in electric plate elevators. New plates were removed from the elevators and brought to the presses by extra help, classed as "laborers" under nonproductive labor, but the used plates were returned to the plate elevators by the press crews. Regular paper strippers, not included in the press crews, were employed, and prepared the paper rolls for delivery to the presses. The average clock-hour production per press, equal to the man-hour production for pressmen in charge, was 46,425.8 copies of 4-page papers, about 68 per cent of the production reached in room No. 7. The difference was presumably caused by the smaller number of pages in the daily issues for this establishment.

Men in charge of presses received $1.46 per hour, and other journeymen $1.3175 cents per hour. Flyboys were paid according to length of service in trade, ranging from 66 cents to $1.185 per hour. The actual man-hour labor costs were slightly higher on account of the overtime, which was approximately 3 per cent of the total time for the productive labor. The nonproductive group, termed "laborers," consisted of extra flyboys, not assigned to specific presses, who worked in a general capacity, carried plates, cleaned up, etc., and the paper strippers. The data for the supervisory group consisted of part time for a superintendent, and full time for a foreman and several assistant foremen, who worked only 6 nights per week each. The man-hour production, on the basis of total working hours for all employees, was 3,724.1 copies of 4-page papers, only 88 per cent of the amount turned out in establishment No. 8, practically the relation between the number of pages in the daily issues for the two pressrooms.

MAN-HOUR PRODUCTION ON QUADRUPLE PRESSES, GROUP 1

As the presses in the different groups were operated part time at quadruple, sextuple, octuple, and decuple capacities, data were compiled of the output per productive man-hour for the productive labor, for comparison with previous similar tables. The data for this pressroom also afford a comparison with the same pressroom in 1896 shown in Table 85, but not accompanied by any information on equipment or working conditions. Table 104 contains data of output per man-hour on quadruple presses in Group 1 for the different groups of productive labor, based on the productive hours therefor:

TABLE 104.—*Production on quadruple presses, Group 1, in newspaper pressroom No. 6, in 1926 (based on productive man-hours for productive labor)*

Occupation	Man-hours			Copies produced			
	Total	Productive		Complete papers		4-page papers	
		Number	Per cent of total	Total	Per productive hour	Total	Per productive hour
Pressmen in charge	35.3	19.3	54.8	270,528	13,995.2	1,058,822	54,776.1
Other journeymen	141.1	77.3	54.8	270,528	3,498.4	1,058,822	13,692.3
Flyboys	70.5	38.7	54.9	270,528	6,995.8	1,058,822	27,381.0
Total	246.9	135.3	54.8	270,528	1,999.0	1,058,822	7,824.6

Quadruple capacity was used only for the Sunday advance sections, as the daily issues and the Sunday main sections contained too many pages to justify printing them on anything smaller than sextuple presses. The number of pages printed at one time on a press in Group 1 was either 14 or 16, produced at the rate of two papers per cylinder revolution. The runs for the Sunday advance sections were practically continuous, except for changes of rolls or for delays. No stops were recorded for either, nor was any time deducted for them, so the productive time included any that might have occurred. Approximately 60 stops were made during the six runs for roll changes alone, which would have reduced the productive time materially, if

deducted. The clock-hour production, or output per man-hour for men in charge, was 13,995.2 complete papers. The same item for the 1896 period in this pressroom, shown in Table 85, converted to two 16-page papers per cylinder revolution, was 15,228.4 papers, so the 1926 production appeared to be only 92 per cent of the former output. This was partly through the use of different sizes of presses during the former period, including one sextuple press. The output was, however, also less than 60 per cent of the production reached during 1916 in room No. 7 on practically similar presses but equipped with magazine reels, as shown in Table 88. The running time was approximately 55 per cent of the total time. The output, on the basis of productive hours for all productive labor, was 1,999 complete papers per man-hour, 30 papers less than in the 1896 period for the same room, but only 73 per cent of the production on quadruple presses in room No. 7 during 1916. On the basis of 4-page papers, the production was 7,824 copies per man-hour, equal to 96 per cent of the 1896 output for the pressroom, or 73 per cent of the production during 1916 on quadruple presses in pressroom No. 7.

MAN-HOUR PRODUCTION ON QUADRUPLE PRESSES, GROUP 2

Table 105 contains similar data for Group 2, operated at quadruple capacity:

TABLE 105.—*Production on quadruple presses, Group 2, in newspaper pressroom No. 6, in 1926 (based on productive man-hours for productive labor)*

Occupation	Man-hours			Copies produced			
	Total	Productive		Complete papers		4-page papers	
		Number	Per cent of total	Total	Per productive hour	Total	Per productive hour
Pressmen in charge	26.9	13.3	49.5	145,824	10,947.8	541,416	40,646.9
Other journeymen	107.7	53.3	49.5	145,824	2,737.5	541,416	10,163.6
Flyboys	53.9	26.6	49.4	145,824	5,475.9	541,416	20,331.1
Total	188.5	93.2	49.5	145,824	1,564.3	541,416	5,807.9

This group was also operated for the Sunday advance sections, consisting of 14 and 16 pages, at the rate of two papers per cylinder revolution. Approximately 30 rolls were changed during the four runs but, as with the previous group, no time was deducted for these stops nor for any delays. The clock-hour production, or output per man-hour for men in charge, was 10,947.8 complete papers, less than 80 per cent of the production for Group 1, or about 72 per cent of the 1896 production for this pressroom. The running time was approximately 50 per cent of the total time. The output, on the basis of productive hours for the total productive labor, was 1,564.3 complete papers per man-hour, amounting to only 77 per cent of the production in the 1916 period for this room, or less than 80 per cent of the production for Group 1. Reduced to 4-page papers, it was 5,807.9 copies, per man-hour, equal to 74 per cent of the production for Group 1, or 73 per cent of the 1896 output.

MAN-HOUR PRODUCTION ON QUADRUPLE PRESSES, GROUP 3

Table 106 contains similar data for Group 3, operated at quadruple capacity:

TABLE 106.—*Production on quadruple presses, Group 3, in newspaper pressroom No. 6, in 1926 (based on productive man-hours for productive labor)*

Occupation	Man-hours			Copies produced			
	Total	Productive		Complete papers		4-page papers	
		Number	Per cent of total	Total	Per productive hour	Total	Per productive hour
Pressmen in charge	57.7	38.2	66.2	567,836	14,857.0	2,170,461	56,788.6
Other journeymen	230.7	152.9	66.3	567,836	3,714.5	2,170,461	14,198.1
Flyboys	145.4	76.4	52.6	567,836	7,429.5	2,170,461	28,398.0
Total	433.8	267.5	61.7	567,836	2,122.6	2,170,461	8,113.3

All runs on presses in this group were also for 14 or 16 page advance sections for the Sunday issues, at the rate of two papers per revolution. About 110 rolls were changed during the 12 runs, for which no time deductions were made, and no allowance was made for delays. The output per clock-hour, or man-hour production for men in charge, was 14,857 complete papers, over 6 per cent more than production for Group 1, or almost 98 per cent of the output in this pressroom during 1896. The running time was approximately two-thirds of the total time. On the basis of productive hours for total productive labor, the output was 2,122.6 complete papers per man-hour, nearly one hundred 16-page papers more than the average for this room in 1896, and a little over 6 per cent more than the production for Group 1. Reduced to 4-page papers it was 8,113.3 copies per man-hour, 4 per cent more than for Group 1, but only 7 copies less than the 1896 production.

MAN-HOUR PRODUCTION ON QUADRUPLE PRESSES, GROUP 4

Table 107 contains similar data for Group 4, operated at quadruple capacity:

TABLE 107.—*Production on quadruple presses, Group 4, in newspaper pressroom No. 6, in 1926 (based on productive man-hours for productive labor)*

Occupation	Man-hours			Copies produced			
	Total	Productive		Complete papers		4-page papers	
		Number	Per cent of total	Total	Per productive hour	Total	Per productive hour
Pressmen in charge	102.0	64.7	63.5	1,057,007	16,332.0	4,271,699	66,002.8
Other journeymen	413.6	258.9	62.6	1,057,007	4,083.2	4,271,699	16,501.3
Flyboys	205.4	129.4	63.0	1,057,007	8,166.6	4,271,699	32,803.9
Total	721.0	453.0	62.8	1,057,007	2,333.3	4,271,699	9,429.4

Sixteen of the runs made by presses in Group 4 were for the Sunday advance sections of 14 or 16 pages, at two papers per revolution, but one run was made of 28-page sections, which could be printed only on a quadruple press at the rate of one paper per revolution, giving an average of 1.94 papers per cylinder revolution. As with the previous groups, no time was deducted for stops due to the 209 roll changes nor for delays. The clock-hour production, or man-hour production for men in charge, was 16,332 complete papers, an increase of nearly 17 per cent over the production for Group 1, or a little more than 8 per cent over the 1896 production for this pressroom. The running time was a little over 60 per cent of the total time. The output, on the basis of productive hours for total productive labor, was 2,333.3 complete papers per man-hour, nearly 15 per cent more than the 1896 production or 17 per cent more than that for quadruple presses in Group 1. Reduced to 4-page papers, it was 9,429.4 copies per man-hour, 21 per cent more than the output for Group 1, or 16 per cent more than that produced in the 1896 period.

MAN-HOUR PRODUCTION ON SEXTUPLE PRESSES, GROUP 1

Table 108 contains similar data for Group 1, operated at sextuple capacity:

TABLE 108.—*Production on sextuple presses, Group 1, in newspaper pressroom No. 6, in 1926 (based on productive man-hours for productive labor)*

Occupation	Man-hours			Copies produced			
	Total	Productive		Complete papers		4-page papers	
		Number	Per cent of total	Total	Per productive hour	Total	Per productive hour
Pressmen in charge	59.2	33.4	56.4	395,817	11,850.8	2,005,812	60,054.3
Other journeymen	295.8	167.0	56.5	395,817	2,370.2	2,005,812	12,010.9
Flyboys	118.3	66.8	56.5	395,817	5,925.4	2,005,812	30,027.1
Total	473.3	267.2	56.5	395,817	1,481.4	2,005,812	7,506.8

Presses in Group 1 were used in sextuple capacity for Sunday sections containing 18, 20, or 22 pages, resulting in six runs at the rate of two papers per revolution, or containing 28 or 32 pages, resulting in three runs at the rate of one paper per revolution, giving an average of 1.67 papers per cylinder revolution. No deductions had been made in running time for stops, due either to the 118 changes of rolls or to delays, and none had been recorded. The 1896 production for the same pressroom did not present a fair comparison, as only one sextuple press was operated at that time, and production from it was combined with production from nine smaller presses. Sextuples were operated in room No. 7 during 1916 and 1926, but, although part of these were of somewhat similar type, all were equipped with magazine reels for paper rolls, and all time lost through stops was deducted from the running time. Comparison may be made with Table 93, which relates to pressroom No. 7 during 1926, since the presses were very nearly like those treated of in Table 108. The clock-hour production, or man-hour production, for men in charge was 11,850.8

complete papers, as against 12,563.4 in room No. 7, more than 94 per cent of the latter. Figured as 4-page papers the production was only a little over 60 per cent, on account of the smaller number of pages per issue. The running time was over 55 per cent of the total time. The output, on the basis of productive hours for productive labor, was 1,481.4 complete papers per man-hour, as against 1,570.4 in room No. 7, over 94 per cent of the latter. Figured as 4-page papers it was a little less than 60 per cent of the production in pressroom No. 7.

MAN-HOUR PRODUCTION ON SEXTUPLE PRESSES, GROUP 3

Table 109 contains similar data for Group 3, operated at sextuple capacity:

TABLE 109.—*Production on sextuple presses, Group 3, in newspaper pressroom No. 6, in 1926 (based on productive man-hours for productive labor)*

Occupation	Man-hours			Copies produced			
	Total	Productive		Complete papers		4-page papers	
		Number	Per cent of total	Total	Per productive hour	Total	Per productive hour
Pressman in charge	143.4	47.8	33.3	563,435	11,794.8	3,083,945	64,558.2
Other journeymen	715.9	238.8	33.4	563,435	2,359.2	3,083,945	12,912.7
Flyboys	366.9	95.5	26.0	563,435	5,898.0	3,083,945	32,282.5
Total	1,226.2	382.1	31.2	563,435	1,474.5	3,083,945	8,070.4

Presses in Group 3 were used in a manner similar to those in Group 1, with ten runs at the rate of two papers per revolution, and one run at the rate of one paper per revolution. In addition two runs were also made on the week-day morning papers at the rate of one paper per revolution. This gave a production of 1.71 papers per cylinder revolution. There was no record of stops for the presses operated on the Sunday editions, outside of the 163 roll changes, and no time was deducted therefor. For the week-day runs no record was obtained of the number of rolls changed, but 11 other stops were given, 5 for ends of editions and 6 for delays. Time was deducted for delays from the combined time for the editions, but at the rate of 5 minutes per delay instead of the actual time consumed. The time consumed in the changing of rolls for the week-day issues and in delays on the Sunday editions would have made a considerable decrease in the running time and consequent increase of production. The clock-hour production, or output per man-hour for men in charge, was 11,794.8 complete papers, about 50 copies less than for Group 1, and therefore bearing practically the same relation to Group A of room No. 7 for 1926 as Group 1. Figured as 4-page papers it was, however, 4,500 copies more than for Group 1, or nearly 65 per cent of the production for room No. 7. The running time was a little over 33 per cent of the total time. The output, on the basis of productive hours for total productive labor, was 1,474.5 complete papers per man-hour, practically the same as that for Group 1, and approxi-

mately 94 per cent of similar production for Group A in room No. 7 for 1926. Reduced to 4-page papers, the output was 8,070.4 copies per man-hour, equal to 8 per cent more than the production for Group 1, but only 64 per cent of the output for Group A in room No. 7 during 1926.

MAN-HOUR PRODUCTION ON SEXTUPLE PRESSES, GROUP 4

Table 110 contains similar data for Group 4, more modern style presses, operated at sextuple capacity:

TABLE 110.—*Production on sextuple presses, Group 4, in newspaper pressroom No. 6, in 1926 (based on productive man-hours for productive labor)*

Occupation	Man-hours			Copies produced			
	Total	Productive		Complete papers		4-page papers	
		Number	Per cent of total	Total	Per productive hour	Total	Per productive hour
Pressmen in charge	519.3	269.6	51.9	3,388,689	12,568.4	24,062,057	89,244.3
Other journeymen	2,736.3	1,348.1	49.3	3,388,689	2,513.7	24,062,057	17,849.1
Flyboys	1,046.0	539.2	51.6	3,388,689	6,284.3	24,062,057	44,623.0
Total	4,301.7	2,156.9	50.1	3,388,689	1,571.1	24,062,057	11,155.7

Presses in Group 4 were used in 28 runs for the Sunday sections, ranging from 18 to 24 pages, at the rate of 2 papers per revolution, and in 50 runs for the regular morning issues of 36 pages, at the rate of 1 paper per revolution, making an average of 1.36 papers per cylinder revolution. As for the previous groups, no time had been deducted for stops on the Sunday-morning runs, in which approximately 512 rolls were changed. In similar manner, no record was obtained of roll changes for the regular morning issues, in which there were 179 stops on editions and 319 stops, figured at 5 minutes each, for delays. Time was deducted for the 498 stops, as listed, but this still left the productive time higher than it should have been. The clock-hour production, or output per man-hour for men in charge, was 12,568.4 complete papers, 6 per cent more than in Group 1, or approximately the same as the average production on presses in Group C of room No. 7 for 1926, shown in Table 95. Reduced to the basis of 4-page papers, it was 89,244.3 copies, or 49 per cent more than in Group 1, but less than 80 per cent of the number produced by Group C of room No. 7, which printed larger papers. The running time was a little over 50 per cent of the total time. The output, on the basis of productive hours for total productive labor, was 1,571.1 complete papers per man-hour, 90 copies more than for Group 1, but practically the same as for Group C in room No. 7 for 1926. Reduced to 4-page papers it was 11,155.7 copies, 49 per cent more than for Group 1, but less than 80 per cent of the number of copies produced in room No. 7 by Group C.

MAN-HOUR PRODUCTION ON SEXTUPLE PRESSES, GROUP 5

Table 111 contains similar data for Group 5, also more modern styles than in Groups 1 to 3, operated at sextuple capacity:

TABLE 111.—*Production on sextuple presses, Group 5, in newspaper pressroom No. 6, in 1926 (based on productive man-hours for productive labor)*

Occupation	Man-hours			Copies produced			
	Total	Productive		Complete papers		4-page papers	
		Number	Per cent of total	Total	Per productive hour	Total	Per productive hour
Pressmen in charge	104.8	55.5	55.3	620,661	11,193.2	4,425,933	79,818.6
Other journeymen	516.6	277.3	53.7	620,661	2,238.6	4,425,933	15,963.7
Flyboys	206.3	110.9	53.8	620,661	5,596.6	4,425,933	39,909.2
Total	827.7	443.6	53.6	620,661	1,399.2	4,425,933	9,977.3

Presses in Group 5 were used for four runs on 22 and 24 page Sunday sections, at the rate of 2 papers per revolution, and on 10 runs of 36-page regular morning issues, at the rate of 1 paper per revolution, giving an average of 1.29 complete papers per cylinder revolution. No deduction was made for stops on Sunday sections, on which 104 rolls were changed, and no record was obtained of roll changes on the regular morning issues, where 36 stops occurred for editions and 62 for delays, figured at 5 minutes each. Time for the edition stops and for delays were deducted, as listed, but the productive time was still excessive. The clock-hour production, or output per man-hour for men in charge, was 11,193.2 complete papers, approximately 94 per cent of the production for Group 1, and less than any group in room No. 7 during 1926. Reduced to 4-page papers it was 79,818.6 copies, which was about 33 per cent more than for Group 1, but only about 70 per cent of the production for Group C in room No. 7 for 1926. The running time was approximately 55 per cent of the total time. The output, on the basis of productive hours for total productive labor, was 1,399.2 complete papers per man-hour, approximately 94 per cent of the production for Group 1, but less than 90 per cent of the production for Group C in room No. 7 during 1926. Reduced to 4-page papers it was 9,977.3 copies, 33 per cent more than for Group 1, but only 70 per cent of the number of copies produced by Group C of room No. 7.

MAN-HOUR PRODUCTION ON OCTUPLE PRESSES, GROUP 3

Table 112 contains similar data for Group 3, operated at octuple capacity:

TABLE 112.—*Production on octuple presses, Group 3, in newspaper pressroom No. 6, in 1926 (based on productive man-hours for productive labor)*

Occupation	Man-hours			Copies produced			
	Total	Productive		Complete papers		4-page papers	
		Number	Per cent of total	Total	Per productive hour	Total	Per productive hour
Pressmen in charge	117.7	44.0	37.4	722,839	16,417.0	5,466,026	124,143.2
Other journeymen	941.6	352.3	37.4	722,839	2,052.0	5,466,026	15,516.6
Flyboys	347.4	88.1	25.4	722,839	8,207.6	5,466,026	62,064.6
Total	1,406.7	484.4	34.4	722,839	1,492.3	5,466,026	11,284.8

Presses in Group 3 were used in octuple capacity on 15 runs of 26, 28, or 32 pages for the regular morning issues, produced at the rate of two papers per revolution. Stops on editions totaled 53, and delays, listed at 5 minutes each, totaled 60. The nonproductive time was deducted, but the remaining productive hours still included time lost in changing of rolls. The clock-hour production, or output per man-hour for men in charge, was 16,417 complete papers, over 10 per cent more than the average production for this group when operated as quadruple presses at the same rate of two papers per revolution. It was also 20 per cent more than the average production for octuple presses of Group A in pressroom No. 7 during 1926, as shown in Table 97, but the latter produced only 1.6 papers per revolution. Reduced to 4-page papers it was over 9 per cent more than was turned out on the same presses when operated as two quadruples, or 5.5 per cent more than the number produced by Group A in room No. 7, at 1.6 copies per revolution. The actual running time was less than 40 per cent of the total time. The output, on the basis of productive hours for total productive labor, was 1,492.3 complete papers per man-hour, only 70 per cent of the number produced at quadruple capacity for the group but 20 per cent more than that turned out on octuple presses of Group A in room No. 7, which printed only 1.6 papers per revolution. Reduced to a 4-page basis it was 11,284.8 copies, still 70 per cent of the output of two quadruples in same group, but only 5.5 per cent more than the number produced on octuple presses of Group A in room No. 7.

MAN-HOUR PRODUCTION ON OCTUPLE PRESSES, GROUP 4

Table 113 contains similar data for Group 4, more modern presses, operated at octuple capacity:

TABLE 113.—*Production on octuple presses, Group 4, in newspaper pressroom No. 6, in 1926 (based on productive man-hours for productive labor)*

Occupation	Man-hours			Copies produced			
	Total	Productive		Complete papers		4-page papers	
		Number	Per cent of total	Total	Per productive hour	Total	Per productive hour
Pressmen in charge	463.7	165.4	35.7	3,119,614	18,861.0	22,725,836	137,399.3
Other journeymen	3,704.5	1,323.2	35.7	3,119,614	2,357.6	22,725,836	17,174.9
Flyboys	928.9	330.8	35.6	3,119,614	9,430.1	22,725,836	68,699.6
Total	5,097.1	1,819.4	35.7	3,119,164	1,714.6	22,725,836	12,490.8

Presses in Group 4 were used in octuple capacity on 14 runs of 28, and 32 page Sunday sections, and on 24 runs of 26, 28, and 32 pages for the regular morning issues, making a production of 1.37 complete papers per cylinder revolution. No stops were recorded for the Sunday sections, on which 348 rolls were changed, and no roll changes were recorded for the regular morning issues, on which occurred 106 stops on editions and 113 stops on delays, listed at 5 minutes each. Time for the stops on editions and for delays were deducted, leaving the rest included in the running time. The clock-hour production, or output per man-hour for men in charge was 18,861 complete papers, or over 15 per cent more than the production of presses of the same group when operated at quadruple capacity and at the rate of 1.94 papers per revolution, shown in Table 107. Compared with Group C of pressroom No. 7 during 1926, operated at octuple capacity at the rate of 1.56 papers per revolution, shown in Table 99, it was 17 per cent higher. Reduced to 4-page papers, it was 4 per cent more than the average production when operated as two quadruples at the rate of 1.94 complete papers per revolution, but 1.3 per cent less than the production by Group C of pressroom No. 7 at the rate of 1.56 complete papers per revolution. The actual running time was approximately 35 per cent of the total time. The output, on the basis of productive hours for total productive labor, was 1,714.6 complete papers per man-hour, not quite three-fourths of the quadruple production for same group, but 9 per cent more than the average output for Group C in room No. 7 during 1926. Reduced to 4-page papers it was 12,490.8 copies, only 66 per cent of the production for two quadruple presses of the same group, and practically the same number of copies as turned out by Group C of room No. 7.

MAN-HOUR PRODUCTION ON OCTUPLE PRESSES, GROUP 5

Table 114 contains similar data for Group 5, also more modern presses, operated at octuple capacity:

TABLE 114.—*Production on octuple presses, Group 5, in newspaper pressroom No. 6 in 1926 (based on productive man-hours for productive labor)*

Occupation	Man-hours			Copies produced			
	Total	Productive		Complete papers		4-page papers	
		Number	Per cent of total	Total	Per productive hour	Total	Per productive hour
Pressmen in charge	129.0	50.6	39.2	886,434	17,508.1	6,392,172	126,252.7
Other journeymen	977.3	405.1	41.4	886,434	2,188.4	6,392,172	15,780.4
Flyboys	257.3	101.3	39.4	886,434	8,753.2	6,392,172	63,120.1
Total	1,363.6	557.0	40.8	886,434	1,591.5	6,392,172	11,476.7

Presses in Group 5 were used in octuple capacity on 5 runs of 28 or 32 page Sunday sections, and on 26 runs of 26, 28, or 32 pages for the regular morning issues, all produced at the rate of two papers per revolution. The roll changes for the Sunday sections amounted to 152, but as with the previous groups, none were recorded for the morning issues. Deduction had been made of the time consumed in the latter for 65 delays, also figured at 5 minutes each, and for 47 edition stops, but time for stops on Sunday sections and for roll changes on the morning issues were still included in the productive time. As none of these presses were operated at quadruple capacity, comparison has been made for this group with Group 3, presented in Table 112, where complete papers were also produced on octuple presses at the rate of two papers per revolution, as well as with Group C of pressroom No. 7, where production was only 1.6 papers per revolution. The clock-hour production, or output per man-hour for men in charge, was 17,508.1 complete papers. This was over 6 per cent more than the average production attained by Group 3, or nearly 9 per cent more than for Group C of room No. 7. Reduced to 4-page papers, it was 126,252.7 copies, almost 2 per cent more than for Group 3, but only 90 per cent of the number produced by Group C. The running time was about 40 per cent of the total time. The output, based on productive man-hours for total productive labor, was 1,591.5 complete papers per man-hour, over 6 per cent more than for Group 3, or almost 9 per cent more than for Group C. Reduced to 4-page papers it was 11,476.7 copies, nearly 2 per cent more than for Group 3, or 90 per cent of the number produced by Group C.

MAN-HOUR PRODUCTION ON DECUPLE PRESSES, GROUP 3

Decuple presses were also used in this establishment, as many of the issues contained 36 pages, which could be produced on sextuple or octuple presses only at the rate of one paper per revolution, but at double that rate on decuple presses. Table 115 contains similar data for Group 3, operated at decuple capacity.

TABLE 115.—*Production on decuple presses, Group 3, in newspaper pressroom No. 6 in 1926 (based on productive man-hours for productive labor)*

Occupation	Man-hours			Copies produced			
	Total	Productive		Complete papers		4-page papers	
		Number	Per cent of total	Total	Per productive hour	Total	Per productive hour
Pressmen in charge	320.5	148.7	46.4	1,106,084	7,438.4	9,954,756	66,945.2
Other journeymen	1,442.8	669.2	46.4	1,106,084	1,653.0	9,954,756	14,876.7
Flyboys	480.8	223.1	46.4	1,106,084	4,958.9	9,954,756	44,630.2
Total	2,244.1	1,040.9	46.4	1,106,084	1,062.6	9,954,756	9,563.6

Presses in Group 3 were operated at decuple capacity on 25 runs of 36 pages for the regular morning issues, at the rate of two papers per cylinder revolution. Stops on editions totaled 92, while other delays, figured at five minutes each, totaled 131. Time for these items, as listed, was deducted, but the time lost in changing rolls was still included in the productive hours, increasing them and reducing the production. As there were two men in charge of each press, the clock-hour production was double the output per man-hour for men in charge, or 14,876.7 complete papers, equal to 133,890.5 copies of 4-page papers. The running time was a little over 45 per cent of the total time. The output based on productive hours for total productive labor was 1,062.6 complete papers per man-hour, or 57 per cent increase over the number of copies produced in the same room on a mixed assortment of presses in 1896, as shown in Table 85. Reduced to 4-page papers, it was 9,563.6 copies, or nearly 18 per cent more than the number of 4-page papers produced per man-hour for productive labor in the 1896 period.

MAN-HOUR PRODUCTION ON DECUPLE PRESSES, GROUP 4

Table 116 contains similar data for Group 4, operated at decuple capacity:

TABLE 116.—*Production on decuple presses, Group 4, in newspaper pressroom No. 6 in 1926 (based on productive man-hours for productive labor)*

Occupation	Man-hours			Copies produced			
	Total	Productive		Complete papers		4-page papers	
		Number	Per cent of total	Total	Per productive hour	Total	Per productive hour
Pressmen in charge	156.0	71.9	46.1	703,225	9,780.6	6,329,025	88,025.4
Other journeymen	702.0	323.6	46.1	703,225	2,173.5	6,329,025	19,561.2
Flyboys	156.0	107.9	69.1	703,225	6,520.4	6,329,025	58,683.6
Total	1,014.0	503.3	49.6	703,225	1,397.2	6,329,025	12,575.1

Presses in Group 4 were used on 11 runs of 36 pages for the regular morning issues, at the rate of two papers per revolution. Stops on editions totaled 35, and other delays, which were figured at 5 minutes each, reached 52. The clock-hour production, as for the preceding group, was double the amount for men in charge, or 19,561.2 complete papers, amounting to 31 per cent more than that for Group 3. Reduced to 4-page papers it was 176,050.8 copies, or 31 per cent more than for Group 3. The running time was a little over 45 per cent of the total time. The output, on the basis of productive hours for total productive labor, was 1,397.2 complete papers per man-hour, 31 per cent more than that for Group 3, or an increase for complete copies of 106 per cent over the productive man-hour output for the same room in 1896. Reduced to 4-page papers, the production was 12,575.1 copies per man-hour, 31 per cent more than that for Group 3, but 55 per cent above the 1896 production.

PRESSROOM NO. 9 IN 1926

PRODUCTIVITY AND LABOR COST FOR PRESSWORK

Compilations for evening newspapers differed somewhat from those for morning newspapers, the former usually having longer working shifts, resulting in smaller production per man-hour. As a rule they also issued more editions of each issue, causing more starts and stops for a similar quantity of production. Tables 117 and 118 cover conditions in establishments publishing evening newspapers. Table 117 contains data covering printing and folding of newspapers in 1926 on double, quadruple, sextuple, and octuple presses, based on total man-hours for all employees.

TABLE 117.—*Man-hour production and labor cost in printing and folding 6,730,796 copies of 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30, and 32 page newspapers in newspaper pressroom No. 9 in 1926*

Occupation	Man-hours worked in producing 39,367,490 copies of 4-page papers	Average production per man-hour	Labor cost per man-hour	Cost of man-hour production	
				Time cost	Labor cost
		Copies		*Minutes*	
Pressmen in charge	857.5	45,909.6	$1.052	5.6	$0.098
Other journeymen	5,020.8		.974	32.6	.529
Flyboys	920.0		.493	6.0	.049
Total productive labor	6,798.3	5,790.8	.919	44.1	.676
Laborers	2,016.8		.472	13.1	.103
Supervisory employees	426.0		1.457	2.8	.067
Total nonproductive labor	2,442.8		.644	15.9	.170
All employees	9,241.0	4,260.1	.846	60.0	.846

The newspaper was published evenings for 6 days a week, involving daywork, but also Sunday mornings, involving night work. The regular working shift was eight hours in either case. The equipment consisted of Hoe octuple presses, three-fourths being of the 4-deck straight-line type, with Kohler system of press control, Cutler-Hammer newspaper conveyors to the mailing room on the floor above,

and air-pressure system on the ink, which was piped from a storage tank to the fountains. Electric roll hoists on ceiling track beams were used for hoisting the paper rolls. One-fourth of the presses were of low construction, unit-type design, provided with automatic ink-pump system, Kohler system of press control, and Cutler-Hammer newspaper conveyors. The regular daily issue was printed in two sections, so that the last section would not exceed 32 pages, which could be produced on octuple presses at the rate of two papers per cylinder revolution. The different sections were collated, or stuffed, by workers in the mailing room. The Sunday-morning issue, which was considerably larger than the evening issues, was printed in several sections for the same reason, and manipulated in same manner. As the presses were used in octuple capacity for the last section of each issue, they were manned by full octuple crews, though only quadruple or sextuple portions of the machines might be used for the other sections, sometimes even double presses being sufficient. On week days an octuple crew consisted of 1 man in charge, 6 other journeymen, and 1 flyboy, but on Saturday nights 1 extra journeyman was added. A total of 167 runs required octuple capacity of the presses. Sextuple capacity was sufficient for 52 runs, quadruple capacity for 35 runs, and double capacity for 15 runs. The man-hour production was reduced materially through the employment of full-size octuple crews for the many runs on small-page contents. It was still further reduced, in comparison with previous establishments, by the proportionately larger number of hours per shift. The average clock-hour production, based on total working time for men in charge, was 45,909.6 copies of 4-page papers per press or a little over 67 per cent of the production in pressroom No. 7 during 1926, as shown in Table 92.

Men in charge of presses received $1.042 per hour for week days, and $1.146, or $1.198, per hour for Saturday nights. Journeymen were paid 91.7 cents per hour for week days and $1.008 or $1.054 for Saturday nights. The average man-hour labor cost for these two groups was slightly higher, due to the inclusion of approximately 4 per cent of overtime. Flyboys received varied rates, according to length of service—31.1 to 45.8 cents per hour for week days and 34.2 to 50.4 cents per hour for Saturday nights. The nonproductive labor consisted of the usual groups, laborers, and supervisory help. Laborers handled the paper rolls and stripped them for delivery to the press crews, but during the operation of presses they also watched the delivery stations of the newspaper conveyors in the mailing room. They received 40 to 50 cents per hour. The supervisory force consisted of a foreman, who worked only six shifts per week, and an assistant foreman. The man-hour production on the basis of total man-hours for all employees was 4,260.1 copies of 4-page papers, not quite 71 per cent of the production for pressroom No. 7.

MAN-HOUR PRODUCTION ON PRESSES

As full octuple crews were constantly employed, regardless of the portion of each press actually used, there was no way of telling how many man-hours for the different groups of workers belonged to production on quadruple portions or sextuple portions of the octuple presses. Consequently separate tables for production, according to press capacity, could not be compiled in the same manner as for the

other establishments. Only one table was prepared, Table 118, which covers the combined production on the basis of productive hours for productive labor:

TABLE 118.—*Production on all presses in newspaper pressroom No. 9 in 1926 (based on productive man-hours for productive labor)*

Occupation	Man-hours			Copies produced			
	Total	Productive		Complete papers		4-page papers	
		Number	Per cent of total	Total	Per productive hour	Total	Per productive hour
Pressmen in charge	857.5	291.4	34.0	6,730,796	23,098.1	39,367,490	135,097.8
Other journeymen	5,020.8	1,748.4	34.8	6,730,796	3,849.7	39,367,490	22,516.3
Flyboys	920.0	291.4	31.7	6,730,796	23,098.1	39,367,490	135,097.8
Total	6,798.3	2,331.2	34.3	6,730,796	2,887.3	39,367,490	16,887.2

The productive time was based on the actual running time for the presses. All time consumed by stops was deducted, whether due to waiting time between editions, to breakage of the webs, to folder chokes, or other delays. This method was the same as that used for pressroom No. 7, but the production was at the rate of two papers per cylinder revolution, making it more comparable with the production during the 1916 period in that establishment, when papers were produced there at a similar rate. The number of hands used for the operation of the presses was also the same as that required for the quadruple presses during that period in room No. 7, as shown in Table 88. The clock-hour production, or output per man-hour for men in charge, was 23,098.1 complete papers, 96 per cent of the 1916 production in pressroom No. 7. On the basis of 4-page papers it was 135,097.8 copies, or over 43 per cent more than the number produced in pressroom No. 7, where only 14 or 16 page papers were printed, while the sections printed in pressroom No. 9 ranged from 8 to 32 pages. The actual running time was 34 per cent of the total time, differing from the other establishment in the working shifts being one-third longer, and consequently having a larger number of total man-hours per day. The output on the basis of productive man-hours for total productive labor was 2,887.3 complete papers, or over 5 per cent more than that for the quadruple presses in room No. 7 during 1916. Reduced to 4-page papers it was 16,887.2 copies, or nearly 57 per cent more than in pressroom No. 7 in 1916, again due to the difference in the number of pages for the publications.

PRODUCTION OF 32-PAGE NEWSPAPERS ON OCTUPLE PRESSES

An interesting comparison of the difference between total running time, consisting of the combined time between starts and stops for the different editions, and actual running time, in which time lost for changes of rolls or caused by delays had been deducted, is shown in Table 119, compiled from selected items for issues of 32 pages.

TABLE 119.—*Average production of 32-page papers in total and actual running time on three octuple presses* [1] *in newspaper pressroom No. 9 in 1926*

Type of press	Average production in—			
	Total time		Actual time	
	Per minute	Per hour	Per minute	Per hour
	Copies	*Copies*	*Copies*	*Copies*
Deck-type press No. 1	299.2	17,951.8	385.1	23,107.2
Deck-type press No. 2	321.3	19,280.3	422.7	25,363.1
Unit-type press	328.4	19,701.0	351.2	21,070.0

[1] Two of deck type, provided with ordinary roll brackets, and one unit type, equipped with magazine reels.

The 32-page size was selected because it required the full capacity of an octuple press at two papers per cylinder revolution, and also because the majority of the runs were on 32-page sections. Figures were tabulated for two presses of the deck type, to show variations on machines presumably exactly alike. These were provided with ordinary brackets on each of the four decks for the paper rolls, and required complete stops for roll changes, approximately four stops for every 25 minutes of continuous running. The total running time consisted of the time from starting to stopping on each edition, combined for each issue. For the actual running time deductions were made of the time the machine was stopped to change paper rolls, through breakage of webs, through chokes in the folders, or other delays. On press No. 1 the actual running time was 77.7 per cent of the total running time. An average of 299.2 complete papers were produced per minute, based on total running time, but figured on the basis of actual running time the production was 385.1 complete papers per minute. The recorded output per minute of actual running time on all size products of the machine ranged from 308.1 to 518.6 complete papers. On press No. 2 the actual running time was 76 per cent of the total running time. An average of 321.3 complete papers were produced on the basis of total running time, but figured on basis of actual running time the output was 422.7 complete papers per minute. The recorded production per minute of actual running time on products of all sizes of the machine ranged from 305.8 to 496.7 complete papers. No stops were necessary on the unit-type press for changing of rolls, as it was equipped with Stone magazine reels, and therefore, the actual running time was 93.4 per cent of the total running time. It was, however, operated at slower speed than the other presses, so while the average number of complete papers produced per minute of total running time was 328.4, only 351.2 papers were turned out per minute of actual running time. The recorded output of products of all sizes on the machine ranged from 289.5 to 390.2 complete papers per minute of actual running time.

PRESSROOM NO. 10 IN 1926

PRODUCTIVITY AND LABOR COST FOR PRESSWORK

A SOMEWHAT different proposition was encountered on another evening newspaper, which was printed on the same equipment as the morning issues in pressroom No. 6, but was operated as a

separate newspaper. As conditions differed essentially from those existing in publication of the morning issues and in order to avoid confusion in comparison, the pressroom was designated No. 10 in connection with the evening issues. Table 120 contains data for this publication covering the printing and folding of newspapers, in 1926, on quadruple, sextuple, octuple, and decuple presses, based on total man-hours for all employees. This table is especially comparable with Table 103, for the morning issues printed on the same equipment, as showing the differences in production of morning and evening newspapers:

TABLE 120.—*Man-hour production and labor cost in printing and folding 10,628,336 copies of 10, 14, 16, 18, 20, 22, 24, 26, 28, 30, 32, 36, and 40 page newspapers in newspaper pressroom No. 10 in 1926*

Occupation	Man-hours worked in producing 71,486,433 copies of 4-page papers	Average production per man-hour	Labor cost per man-hour	Cost of man-hour production	
				Time cost	Labor cost
		Copies		*Minutes*	
Pressmen in charge	1,918.3	37,265.5	$1.338	4.4	$0.098
Other journeymen	11,923.5		1.192	27.2	.540
Flyboys	4,002.5		.779	9.1	.118
Total productive labor	17,844.3	4,006.1	1.115	40.7	.756
Laborers	6,388.8		1.042	14.6	.253
Supervisory employees	2,092.7		1.506	4.8	.120
Total nonproductive labor	8,481.5		1.156	19.3	.373
All employees	26,325.8	2,715.5	1.129	60.0	1.129

The publication was issued daily for 6 days each week. The daily issue ordinarily consisted of 30, 32, or 36 pages but sometimes dropped as low as 18 pages, and special sections of 10, 14, or 16 pages were also printed. As a rule nine different editions were published of each daily issue, involving the changing of two or more plates and sometimes also changing the number of pages in the issue. Only a section of the force came to work early and operated two octuple or four sextuple presses on the first edition. Another section came in later and operated additional presses on the second edition. The rest of the force arrived still later, to operate the rest of the presses necessary for the day's output. Toward the latter part of the day the number of presses was reduced in a similar manner, leaving, customarily, four of them to finish the daily issue. The regular working shift was 7.5 hours per day net. The equipment was the same as that used for the morning newspaper printed in pressroom No. 6, and consisted of different groups, described in the text following Table 103 (p. 190). The presses were manned by the same number of hands as for the morning issues, according to the sizes of machines used. The average man-hour production for pressmen in charge was 37,265.5 copies of 4-page papers, or only a little over 80 per cent of the amount produced for the morning issues.

All work was performed in the daytime, and the hourly rates of regular pay varied from those for night work, both on account of lower daily wages and on account of longer regular shifts. Men in

charge of presses received $1.267 per hour, other journeymen $1.133 per hour, and flyboys 56.7 or 71.1 cents per hour. The actual man-hour labor costs exceeded these amounts, due to overtime, which was over 13 per cent of the total working time, though the cost was still less than for the morning issues. The nonproductive group of laborers whose functions were similar to those for the corresponding group at night, showed a comparatively higher man-hour cost, on account of a smaller percentage of lower-priced extra flyboys. The supervisory group included, as with the morning issues, part time for a superintendent, who directed both morning and evening pressrooms and whose hours and earnings were allotted on the basis of total man-hours for each pressroom, and a foreman and several assistant foremen. The man-hour production on the basis of total working hours for all employees was 2,715.5 copies of 4-page papers, or less than 73 per cent of the number produced in the same pressroom for the morning edition. The reduction in output for all employees, as well as for men in charge and for productive labor, was due mainly to the variance in clock-hours in the regular working shifts—47.5 per week for 7 morning issues, and 45 per week for 6 evening issues.

MAN-HOUR PRODUCTION ON QUADRUPLE PRESSES, GROUP 1

Tabulations were prepared, on the basis of productive hours for productive labor, for the different groups of machines and for the various capacities at which they were operated, in the same way as Tables 104 to 116 for pressroom No. 6. Computation of productive time was by the same method, combining the total time for the various runs by presses in each group, according to size of presses used, and deducting the time recorded for delays. These, like those for room No. 6, were all figured at 5 minutes each regardless of actual time involved. The running time, however, included time lost in the changing of rolls, and would have been shortened considerably if it had been possible to deduct the time lost. Table 121 contains data for output per productive man-hour for the different groups of productive labor on presses in Group 1, operated at quadruple capacity, and is comparable with Table 104 for room No. 6:

TABLE 121.—*Production on quadruple presses, Group 1, in newspaper pressroom No. 10 in 1926 (based on productive man-hours for productive labor)*

Occupation	Man-hours			Copies produced			
	Total	Productive		Complete papers		4-page papers	
		Number	Per cent of total	Total	Per productive hour	Total	Per productive hour
Pressmen in charge	22.1	4.0	18.0	33,500	8,438.3	268,000	67,506.3
Other journeymen	88.4	15.9	18.0	33,500	2,110.9	268,000	16,887.2
Flyboys	44.2	7.9	18.0	33,500	4,224.5	268,000	33,795.7
Total	154.7	27.8	18.0	33,500	1,206.3	268,000	9,650.7

Presses in Group 1 were used only at quadruple capacity in three short runs of 32 pages each, produced at the rate of one paper per cylinder revolution. The stops on editions totaled 11, and 7 addi-

tional stops were due to delays. Approximately 12 rolls were changed. The clock-hour production, or output per man-hour for men in charge, was 8,438.3 complete 32-page papers, equal to 16,876.6 copies of 16-page papers, and was an increase over production in pressroom No. 6 of more than 20 per cent. Reduced to 4-page papers the output was 67,506.3 copies per hour, or more than 23 per cent above the production in room No. 6. The added increase was due to the product of room No. 10 being the full plating capacity of the presses, while in room No. 6 part of it consisted of 14-page papers, only seven-eighths capacity. The actual running time was 18 per cent of the total time. The output on the basis of total productive labor was 1,206.3 complete 32-page papers, or 9,650.7 copies of 4-page papers, the same relation to room No. 6 as that for men in charge.

MAN-HOUR PRODUCTION ON QUADRUPLE PRESSES, GROUP 2

Table 122 contains similar data for Group 2, operated at quadruple capacity, comparable with Table 105 for room No. 6:

TABLE 122.—*Production on quadruple presses, Group 2, in newspaper pressroom No. 10 in 1926 (based on productive man-hours for productive labor)*

Occupation	Man-hours			Copies produced			
	Total	Productive		Complete papers		4-page papers	
		Number	Per cent of total	Total	Per productive hour	Total	Per productive hour
Pressmen in charge	8.0	2.3	28.4	31,060	13,682.8	248,480	109,462.6
Journeymen	32.0	9.1	28.3	31,060	3,424.5	248,480	27,395.8
Flyboys	16.0	4.5	28.3	31,060	6,856.5	248,480	54,852.1
Total	56.0	15.9	28.3	31,060	1,957.2	248,480	15,657.2

Presses in Group No. 2 were used partly for 16-page papers, at the rate of two papers per revolution, and partly for 32-page papers, at the rate of one paper per revolution, giving an average production of 1.25 papers per cylinder revolution. Seven stops were made on editions, and two other stops occurred through delays. Approximately 10 roll changes were made. The clock-hour production, or output per man-hour for men in charge, was 13,682.8 complete papers, or nearly 25 per cent more than in room No. 6. Reduced to 4-page papers it was 109,462.6 copies per hour, nearly 170 per cent above the production for the morning issue, due to the difference in size of the complete papers. The running time was less than 30 per cent of the total time. On the basis of productive hours for total productive workers, the output was 1,957.2 complete papers, or 15,657.2 copies of 4-page papers, practically the same relation to that of room No. 6 as that for men in charge. The presses were evidently operated at considerably faster speed than ordinarily, as the production showed it to be over 200 revolutions per minute, including roll changes.

MAN-HOUR PRODUCTION ON QUADRUPLE PRESSES, GROUP 3

Table 123 contains similar data for Group 3, operated at quadruple capacity, and is comparable with Table 106 for room No. 6.

TABLE 123.—*Production on quadruple presses, Group 3, in newspaper pressroom No. 10 in 1926 (based on productive man-hours for productive labor)*

Occupation	Man-hours			Copies produced			
	Total	Productive		Complete papers		4-page papers	
		Number	Per cent of total	Total	Per productive-hour	Total	Per productive-hour
Pressmen in charge	15.0	4.5	30.2	104,203	23,002.9	416,920	92,035.3
Other journeymen	60.0	18.1	30.2	104,203	5,747.6	416,920	22,996.1
Flyboys	45.0	9.1	20.2	104,203	11,488.8	416,920	45,966.9
Total	120.0	31.7	26.4	104,203	3,284.1	416,920	13,139.6

Presses in Group 3 were operated for 16-page papers, produced at the rate of two papers per revolution. Only two stops were made on editions and no delays existed. Approximately 20 rolls were changed. The clock-hour production, or output per man-hour for men in charge, was 23,002.9 complete papers, nearly 55 per cent more than in room No. 6. Reduced to 4-page papers it was 92,035.3 copies per hour, or 62 per cent more. The added increase for the 4-page copies was due to the use of full plating capacity in room No. 10, and only seven-eighths capacity part of the time in room No. 6. The running time was approximately 30 per cent of the total time. The output on the basis of productive hours for total productive labor was 3,284.1 complete papers, or 13,139.6 copies of 4-page papers, practically the same relation to the production in room No. 6 as that for men in charge.

MAN-HOUR PRODUCTION ON QUADRUPLE PRESSES, GROUP 5

Table 124 contains similar data for Group 5, operated at quadruple capacity, and is comparable with Table 107 for room No. 6.

TABLE 124.—*Production on quadruple presses, Group 5, in newspaper pressroom No. 10 in 1926 (based on productive man-hours for productive labor)*

Occupation	Man-hours			Copies produced			
	Total	Productive		Complete papers		4-page papers	
		Number	Per cent of total	Total	Per productive hour	Total	Per productive hour
Pressmen in charge	8.0	2.3	28.1	27,052	12,023.1	216,416	96,184.9
Other journeymen	32.0	9.0	28.1	27,052	3,005.8	216,416	24,046.2
Flyboys	16.0	4.5	28.1	27,052	6,011.6	216,416	48,092.4
Total	56.0	15.8	28.1	27,052	1,717.6	216,416	13,740.7

Presses in Group 5 were operated at a higher rate of speed than any others, but as none of the group were operated at quadruple capacity in pressroom No. 6, while some from Group No. 4 were operated there and not in room No. 6, comparison was made of the two individual groups. They were operated at full plating capacity, 32 pages, produced at the rate of one paper per revolution. Seven stops were made on editions, and two additional stops involved delays. Approximately 11 rolls of paper were changed. The clock-hour production, or output per man-hour for men in charge, was 12,023.1 complete 32-page papers, equal to 24,046.2 copies of 16-page papers, an increase over the production in room No. 6, on Group 4 presses, of over 47 per cent. Reduced to 4-page papers it was 96,184.9 copies per hour, practically the same relation as that for the 16-page papers. The increase over the other group shown is comparatively larger than is actually correct, as only 1.94 papers were produced per cylinder revolution by it. The running time was approximately 28 per cent of the total time. The output on the basis of productive hours for total productive labor was 1,717.6 complete 32-page papers, or 13,740.7 copies of four-page papers, relatively the same proportion to the output in room No. 6 as that for men in charge.

All of the tables for quadruple production showed a decidedly higher hourly output than similar tables for room No. 6. This may have been due to operation of the presses in room No. 10 on the regular daily issue, while the presses in room No. 6 were operated practically on Sunday advance sections, that did not require publication inside of a limited number of minutes. The production was, however, also influenced by the time for delays not having been deducted for the Sunday advance sections in room No. 6, as indicated by the different proportion of running time to total time.

MAN-HOUR PRODUCTION ON SEXTUPLE PRESSES, GROUP 1

Table 125 contains similar data for Group 1, operated at sextuple capacity, and is comparable with Table 108 for room No. 6:

TABLE 125.—*Production on sextuple presses, Group 1, in newspaper pressroom No. 10 in 1926 (based on productive man-hours for productive labor)*

Occupation	Man-hours			Copies produced			
	Total	Productive		Complete papers		4-page papers	
		Number	Per cent of total	Total	Per productive hour	Total	Per productive hour
Pressmen in charge	161.7	51.0	31.5	559,745	10,975.4	4,011,900	78,664.7
Other journeymen	826.8	255.0	30.8	559,745	2,195.1	4,011,900	15,732.9
Flyboys	331.8	102.0	30.7	559,745	5,487.7	4,011,900	39,332.4
Total	1,320.3	408.0	30.9	559,745	1,371.9	4,011,900	9,833.1

Presses in Group 1 were used in sextuple capacity for 12 runs of 18 or 22 page papers, at the rate of two papers per revolution, and for 7 runs of 36 or 40 page papers, at the rate of one paper per revolution, giving an average of 1.37 complete papers per cylinder revolution. There was a total of 136 stops for editions, and 122 stops involving delays. These did not include changing of rolls, which were not recorded. The clock-hour production, or output per man-hour for men in charge, was 10,975.4 complete papers, or 13 per cent increase over the production on the same presses in room No. 6, on the same basis. Reduced to 4-page papers it was 78,664.7 copies, an increase of nearly 70 per cent. The actual running time was a little over 30 per cent of the total time. The output on the basis of productive hours for total productive labor was 1,371.9 complete papers per hour, or 9,833.1 copies of 4-page papers, also respectively 13 and 70 per cent over room No. 6.

MAN-HOUR PRODUCTION ON SEXTUPLE PRESSES, GROUP 2

Table 126 contains similar data for Group 2, operated at sextuple capacity, and is comparable with Table 109 for room No. 6:

TABLE 126.—*Production on sextuple presses, Group 2, in newspaper pressroom No. 10 in 1926 (based on productive man-hours for productive labor)*

Occupation	Man-hours			Copies produced			
	Total	Productive		Complete papers		4-page papers	
		Number	Per cent of total	Total	Per productive hour	Total	Per productive hour
Pressmen in charge	120.0	31.3	26.1	421,881	13,478.6	2,728,254	87,164.7
Other journeymen	617.5	156.5	25.3	421,881	2,695.7	2,728,254	17,432.9
Flyboys	255.0	62.6	24.5	421,881	6,739.3	2,728,254	43,582.3
Total	992.5	250.4	25.2	421,881	1,684.8	2,728,254	10,895.6

Presses in Group 2 were operated at sextuple capacity for seven runs of 18 or 22 page papers, at the rate of two papers per revolution, and for seven runs of 36 or 40 page papers, at the rate of one paper per revolution, giving an average of 1.5 complete papers per cylinder revolution. Stops on editions totaled 85, and 30 other stops involved delays. Stops for changing of rolls were not included. As none of the presses in this group were operated as sextuples for the morning issues, comparison was made with production for Group 3 of room No. 6, which was the nearest in type. The clock-hour production, or output per man-hour for men in charge, was 13,478.6 complete papers. Compared with production of Group 3 for room No. 6, on the same basis, it was an increase of nearly 35 per cent. Reduced to four-page papers, the production was 87,164.7 copies, or an increase of almost 60 per cent. The actual running time was 26 per cent of the total time. The output on the basis of productive hours for total productive labor was 1,684.8 complete papers per hour, or 10,895.6 copies of four-page papers, the same relative increase as that for men in charge.

MAN-HOUR PRODUCTION ON SEXTUPLE PRESSES, GROUP 3

Table 127 contains similar data for Group 3, operated at sextuple capacity, and is comparable with Table 109 for room No. 6.

TABLE 127.—*Production on sextuple presses, group 3, in newspaper pressroom No. 10 in 1926 (based on productive man-hours for productive labor)*

Occupation	Man-hours			Copies produced			
	Total	Productive		Complete papers		4-page papers	
		Number	Per cent of total	Total	Per productive hour	Total	Per productive hour
Pressmen in charge	104.5	17.0	16.3	263,314	15,489.1	1,941,541	114,208.3
Other journeymen	558.5	85.0	15.2	263,314	3,097.8	1,941,541	22,841.7
Flyboys	258.0	34.0	13.2	263,314	7,744.5	1,941,541	57,104.2
Total	921.0	136.0	14.8	263,314	1,936.1	1,941,541	14,276.0

Presses in Group 3 were operated at sextuple capacity for four runs of 20 or 24 pages, at the rate of two papers per revolution, and for eight runs of 36 or 40 pages, at the rate of one paper per revolution, giving an average of 1.33 complete papers per cylinder revolution. Stops on editions totaled 67, and 43 other stops involved delays. Stops for changing of rolls were not included. The clock-hour production, or output per man-hour for men in charge, was 15,489.1 complete papers, an increase over production for the same group in room No. 6 of nearly 75 per cent. Reduced to 4-page papers it was 114,208.3 copies, an increase of 135 per cent, due to the difference in the number of pages printed. The running time was about 16 per cent of the total time. The output on the basis of man-hours for total productive labor was 1,936.2 complete papers per hour, or 14,276 copies of 4-page papers, bearing the same relation to production in room No. 6 as that for men in charge.

MAN-HOUR PRODUCTION ON SEXTUPLE PRESSES, GROUP 4

Table 128 contains similar data for Group 4, operated at sextuple capacity, and is comparable with Table 110 for room No. 6:

TABLE 128.—*Production on sextuple presses, Group 4, in newspaper pressroom No. 10 in 1926 (based on productive man-hours for productive labor)*

Occupation	Man-hours			Copies produced			
	Total	Productive		Complete papers		4-page papers	
		Number	Per cent of total	Total	Per productive hour	Total	Per productive hour
Pressmen in charge	362.7	115.2	31.7	1,362,420	11,831.7	9,878,196	85,785.5
Other journeymen	1,843.7	575.8	31.2	1,362,420	2,366.3	9,878,196	17,157.1
Flyboys	718.7	230.3	32.0	1,362,420	5,915.9	9,878,196	42,892.7
Total	2,925.1	921.3	31.5	1,362,420	1,478.9	9,878,196	10,722.5

Presses in Group 4 were operated at sextuple capacity for 14 runs of 18, 20, 22, or 24 pages, at the rate of 2 papers per revolution, and for 29 runs of 36 or 40 pages, at the rate of 1 paper per revolution, giving an average of 1.33 complete papers per cylinder revolution. Stops on editions totaled 314, and 160 other stops involved delays. Roll changes were not included. The clock-hour production, or output per man-hour for men in charge, was 11,831.7 complete papers, nearly 4 per cent less than for the same group in room No. 6. Reduced to 4-page papers it was 85,785.5 copies, or about 2 per cent decrease. The running time was a little more than 30 per cent of the total time. The output on the basis of productive hours for total productive labor was 1,478.9 complete papers per hour, or 10,722.5 copies of 4-page papers, a similar decrease when compared with room No. 6 as that for men in charge.

MAN-HOUR PRODUCTION ON SEXTUPLE PRESSES, GROUP 5

Table 129 contains similar data for Group 5, operated at sextuple capacity, and is comparable with Table 111 for room No. 6:

TABLE 129.—*Production on sextuple presses, Group 5, in newspaper pressroom No. 10 in 1926 (based on productive man-hours for productive labor)*

Occupation	Man-hours			Copies produced			
	Total	Productive		Complete papers		4-page papers	
		Number	Per cent of total	Total	Per productive hour	Total	Per productive hour
Pressmen in charge	219.1	86.6	39.5	1,018,649	11,769.5	7,340,986	84,817.9
Other journeymen	1,094.3	432.8	39.5	1,018,649	2,353.9	7,340,986	16,963.6
Flyboys	436.3	173.1	39.7	1,018,649	5,884.7	7,340,986	42,408.9
Total	1,749.7	692.4	39.6	1,018,649	1,471.2	7,340,986	10,602.2

Presses in Group 5 were operated at sextuple capacity for 8 runs of 18, 20, or 22 pages, at the rate of 2 papers per revolution, and for 14 runs of 36 or 40 page papers, giving an average of 1.36 complete papers per cylinder revolution. A total of 177 stops was made on editions, and 202 other stops included delays, but stops for changing of rolls were not included. The clock-hour production, or output per man-hour for men in charge, was 11,769.5 complete papers, a decrease of about one-fourth of 1 per cent from the production of same group in room No. 6. Reduced to 4-page papers it was 84,817.9 copies, or nearly 8 per cent more than that produced in room No. 6. The running time was approximately 40 per cent of the total time. The output on the basis of productive man-hours for total productive labor was 1,471.2 complete papers, or 10,602.2 copies of 4-page papers, the same relation to production in room No. 6 as that for men in charge. Comparison of production for sextuple presses in room No. 10 with that for room No. 6 was also affected by the printing of the Sunday newspapers for the morning issue, and the inclusion of lost time for delays in the productive time for these.

MAN-HOUR PRODUCTION ON OCTUPLE PRESSES, GROUP 3

Table 130 contains similar data for Group 3, operated at octuple capacity, and is comparable with Table 112 for room No. 6:

TABLE 130.—*Production on octuple presses, Group 3, in newspaper pressroom No. 10 in 1926 (based on productive man-hours for productive labor)*

Occupation	Man-hours			Copies produced			
	Total	Productive		Complete papers		4-page papers	
		Number	Per cent of total	Total	Per productive hour	Total	Per productive hour
Pressmen in charge	54.8	13.0	23.7	280,733	21,594.9	1,675,786	128,906.6
Other journeymen	438.7	104.0	23.7	280,733	2,699.4	1,675,786	16,113.3
Flyboys	151.0	26.0	17.2	280,733	10,747.4	1,675,786	64,453.3
Total	644.5	143.0	22.2	280,733	1,963.2	1,675,786	11,718.8

Presses in Group 3 were operated at octuple capacity for 8 runs of 28, 30, or 32 pages, at the rate of two complete papers per cylinder revolution. A total of 45 stops was made on editions and 25 additional stops involved delays. The remaining productive time included the time lost in changing of rolls. The clock-hour production, or output per man-hour for men in charge, was 21,594.9 complete papers, an increase of more than 30 per cent over the production for the same group in room No. 6. Reduced to 4-page papers it was 128,906.6 copies, an increase of less than 4 per cent. The running time was less than 25 per cent of the total time. The output on the basis of productive hours for total productive labor was 1,963.2 complete papers per hour, or 11,718.8 copies of 4-page papers, bearing the same relation to production for room No. 6 as that for men in charge.

MAN-HOUR PRODUCTION ON OCTUPLE PRESSES, GROUP 4

Table 131 contains similar data for Group 4, operated at octuple capacity, and is comparable with Table 113 for room No. 6:

TABLE 131.—*Production on octuple presses, Group 4, in newspaper pressroom No. 10 in 1926 (based on productive man-hours for productive labor)*

Occupation	Man-hours			Copies produced			
	Total	Productive		Complete papers		4-page papers	
		Number	Per cent of total	Total	Per productive hour	Total	Per productive hour
Pressmen in charge	537.9	139.9	26.0	4,894,288	34,989.2	32,088,069	229,397.1
Other journeymen	4,294.3	1,119.1	26.1	4,894,288	3,479.9	32,088,069	28,673.9
Flyboys	1,159.9	279.8	24.1	4,894,288	17,494.0	32,088,069	114,694.5
Total	5,992.1	1,538.7	25.7	4,894,288	3,180.8	32,088,069	20,853.8

Presses in Group 4 were used in octuple capacity on 53 runs 26, 28, 30, or 32 pages, at the rate of two papers per revolution, on 6 runs of 14 or 16 pages, at the rate of four papers per revolutio giving an average of 2.2 complete papers per cylinder revolution. total of 399 stops were made on editions, and 208 others comprised delays, not including changes of rolls. The clock-hour production, or output per man-hour for men in charge, was 34,989.2 complete papers, an increase of a little more than 15 per cent over the production for same group in room 6. Reduced to 4-page papers it was 229,397.1 copies, or an increase of 4 per cent. The running time was 26 per cent of the total time. The output based on the productive hours for total productive labor was 3,180.8 complete papers per hour, or 20,853.7 copies of 4-page papers, the relation to production for room No. 6 being also 15 and 4 per cent increase, respectively.

MAN-HOUR PRODUCTION ON OCTUPLE PRESSES, GROUP 5

Table 132 contains similar data for Group 5, operated at octuple capacity, and is comparable with Table 114 for room No. 6.

TABLE 132.—*Production on octuple presses, Group 5, in newspaper pressroom No. 10 in 1926 (based on productive man-hours for productive labor)*

Occupation	Man-hours			Copies produced			
	Total	Productive		Complete papers		4-page papers	
		Number	Per cent of total	Total	Per productive hour	Total	Per productive hour
Pressman in charge	190.3	63.3	33.3	979,422	15,477.6	7,432,099	117,447.8
Other journeymen	1,523.6	506.3	33.2	979,422	1,934.6	7,432,099	14,680.1
Flyboys	399.3	126.6	31.7	979,422	7,738.2	7,432,099	58,719.3
Total	2,113.2	696.1	32.9	979,422	1,406.7	7,432,099	10,676.5

Presses in Group 5 were used in octuple capacity on 22 runs of 26, 28, 30, or 32 pages, at the rate of two complete papers per revolution. Stops on editions aggregated 146, and 117 additional stops were made on delays. Time lost in changes of rolls was not deducted from the running time. The clock-hour production, or man-hour production for men in charge, was 15,477.6 complete papers, a decrease of nearly 12 per cent from the production for the same group in room No. 6. Reduced to 4-page papers it was 117,447.8 copies, a decrease of 7 per cent. The running time was 33 per cent of the total time. The output based on the productive time for total productive labor was 1,406.7 complete papers per hour, or 10,676.5 copies of four-page papers, also 12 and 7 per cent decrease from the production for the group in room No. 6.

MAN-HOUR PRODUCTION ON DECUPLE PRESSES, GROUP 4

Table 133 contains similar data for Group 4, operated in decuple capacity, and is comparable with Table 116 for room No. 6.

BLE 133.—*Production on decuple presses, Group 4, in newspaper pressroom No. 10 in 1926 (based on productive man-hours for productive labor)*

Occupation	Man-hours			Copies produced			
	Total	Productive		Complete papers		4-page papers	
		Number	Per cent of total	Total	Per productive hour	Total	Per productive hour
Pressmen in charge	113.8	41.3	36.3	294,673	7,140.1	2,688,482	65,143.7
Other journeymen	512.3	185.7	36.2	294,673	1,586.8	2,688,482	14,477.6
Flyboys	170.5	61.9	36.3	294,673	4,760.5	2,688,482	43,432.7
Total	796.6	288.9	36.3	294,673	1,020.1	2,688,482	9,306.9

Presses in Group 4 were used in decuple capacity for seven runs of 36 or 40 page papers, which could not be produced on smaller presses, at the rate of two complete papers per cylinder revolution. Stops on editions totaled 41, and other delays aggregated 16, not including roll changes. The clock-hour production, which was double the amount produced per man-hour for men in charge, was 14,280.3 complete papers, 27 per cent less than the production on the same presses for room No. 6. Reduced to 4-page papers it was 130,286.3 copies, or a decrease of 26 per cent. The running time was 36 per cent of the total time. The output on the basis of productive hours for total productive labor was 1,020.1 complete papers per hour, or 9,306.9 copies of 4-page papers, also reductions of 27 and 26 per cent, respectively.

COMPARISON OF PRODUCTIVITY AND LABOR COST IN PRESSWORK IN 1916 AND 1926

TO afford easier comparison of the main features, Table 134 is presented containing a comparison of man-hour production and labor cost for the establishments surveyed, on the basis of total man-hours for productive labor and for all employees:

TABLE 134.—*Comparison of man-hour production and labor cost in five newspaper pressrooms in 1916 and 1926*

Year and establishment	Time issued	Average number of 4-page papers produced per man-hour by—		Labor cost per man-hour for—	
		Productive labor	All employees	Productive labor	All employees
1916: No. 7	Mornings [1]	6,217.3	5,575.6	$0.656	$0.665
1926:					
No. 6	do. [1]	5,309.2	3,724.1	1.256	1.220
No. 7	do. [1]	6,972.8	6,011.7	1.228	1.237
No. 8	do. [1]	5,759.0	4,210.7	1.016	.984
Average		6,297.5	4,965.8	1.225	1.214
No. 9	Evenings [1]	5,790.8	4,260.1	.919	.846
No. 10	do	4,006.1	2,715.5	1.115	1.129
Average		4,498.5	3,117.7	1.061	1.056

[1] Includes Sunday mornings.

Man-hour production was influenced by conditions peculiar to each pressroom, as heretofore described, which regulated in each case its relation to the general averages computed. The table contains three divisions—data for pressroom No. 7 in 1916, which are comparable with the same pressroom 10 years later; data for three morning newspapers in 1926, which are comparable with each other and with the weighted average for these publications; data for two evening newspapers, also comparable with each other and with the weighted average therefor. The weighted averages for the morning and evening publications are likewise comparable. In comparing one establishment with another, the individual differences, shown in the detailed text for such establishments, should be consulted for proper analysis.

RELATIVE MAN-HOUR PRODUCTION

Comparison of the man-hour production in establishment No. 7 during 1916 with that of 1926 shows an increase for the latter period of 755.4 copies of 4-page papers per hour for productive labor, or over 12 per cent, and of 436.2 copies per hour for all employees, or nearly 8 per cent. Equipment and working conditions in pressroom No. 7 during the 1916 period were thoroughly modern, and practically the same as or even better than existed in a number of other pressrooms in 1926. As far as production was concerned it could well have been included with the 1926 establishments as representative of present-day pressrooms. Comparison of the production for each of the three morning publications with the weighted average for the group shows considerable fluctuation, caused mainly by variations in length of working shifts, in sizes of press crews, and in number of pages published per issue. In establishment No. 6 production on the basis of total man-hours for productive labor was 84 per cent of the weighted average, and on the basis of total man-hours for all employees was only 75 per cent. In establishment No. 7 production was 11 per cent more than the general average on the basis of productive labor, and 21 per cent more on the basis of all employees. In establishment No. 8 production was 91 per cent of the weighted average on the basis of productive labor, and 85 per cent on the basis of all employees. The two evening publications show a decided difference. In establishment No. 9 production was 29 per cent more than the average for the two plants on the basis of productive labor, and 37 per cent more on the basis of all employees. In establishment No. 10 the production was only 89 per cent of the average on the basis of productive labor, and only 87 per cent on the basis of all employees. Comparison of the averages for the morning and evening publications show that the average man-hour production on the evening newspapers was 71 per cent of the average output on the morning newspapers based on the total man-hours for productive labor, and 63 per cent based on total man-hours for all employees. This was mainly attributable to the longer regular shifts for the evening publications.

RELATIVE LABOR COST

The actual man-hour labor cost differed from the regular hourly wage rate. It was obtained by dividing the total amount of money paid to each group by the net number of hours worked. The net hours were obtained by deducting lunch periods, when paid for by the establishment, from the regular hours worked, and adding overtime.

The labor cost was consequently also subject to individual pressroom conditions, which regulated the relation for each establishment to the weighted average for the respective group. The average labor cost per man-hour for pressroom No. 7, which was 65.6 cents in 1916 for productive labor, and 66.5 cents for all employees, had advanced in 1926 to $1.228 for productive labor, an increase of 87 per cent, and to $1.237 for all employees, an increase of 86 per cent. Comparison of the labor costs on the three morning newspapers with the weighted averages therefor show a variation, partly caused by locality of the establishment. The labor cost per man-hour in establishment No. 6 for productive labor was 2.5 per cent more than the average labor cost for all morning publications, and for all employees was 0.5 per cent more than the average. The labor cost per man-hour for productive labor in establishment No. 7 was 0.2 per cent more than the average, and for all employees was 2 per cent more than the average. The labor cost per man-hour in establishment No. 8 was only 83 per cent of the average cost for productive labor, and only 81 per cent for all employees. The labor cost per man-hour for evening publications was usually lower than that for the morning publications in the same locality, because of longer hours in the regular shifts and a lower regular wage rate. These items varied with the different localities, as did hours and wages for morning publications, and the actual man-hour labor costs were naturally affected by them. The man-hour labor cost for productive labor in establishment No. 9 was only 87 per cent of the average weighted cost for all evening papers, and for all employees was only 80 per cent of the average. The labor cost per man-hour for productive labor in establishment No. 10 was 5 per cent more than the average, and for all employees was 7 per cent more than the average. Comparison of the averages for the morning and evening publications show that the average man-hour labor cost on evening newspapers, for either productive labor or all employees, was only 87 per cent of the average man-hour cost on morning papers.

OUTPUT PER PRODUCTIVE MAN-HOUR

To provide easy comparison of production, based on productive hours for the productive labor, Table 135, containing a compilation of production in all establishments on that basis, is presented. As explained in the detailed text for the individual establishments, productive hours were based on the actual running time of the machines, while productive labor consisted of the workers directly engaged in operation of the presses. Comparisons of production for each group with that of other groups are given in the detailed text for the specific group on preceding pages.

TABLE 135.—*Man-hour production of complete and of 4-page papers in five newspaper pressrooms, in 1916 and 1926 (on basis of productive man-hours for men in charge (machine production) and total productive labor)*

Year and establishment	Presses		Number of hands per press	Per cent productive time is of total time	Complete papers per cylinder revolution	Number of copies produced per productive man-hour for—			
						Men in charge		Total productive labor	
	Group	Capacity operated				Complete papers	4-page papers	Complete papers	4-page papers
1916: No. 7	Sextuple	Quadruple	8 or 9	70.3	2	23,966.1	94,310.7	2,737.9	10,774.1
	Linear	do	9	51.7	2	16,076.3	65,661.5	1,965.5	8,028.0
	Sextuple	Sextuple	9 or 10	48.8	2	20,146.0	108,374.7	2,238.5	12,041.7
	Linear	do	10	54.5	2	14,196.5	80,033.5	1,577.7	8,894.2
1926:									
No. 6	1	Quadruple	7	54.8	2	13,995.2	54,776.1	1,999.0	7,824.0
	2	do	7	49.5	2	10,947.8	40,646.9	1,564.3	5,807.9
	3	do	7	66.2	2	14,857.0	56,788.6	2,122.6	8,113.3
	4	do	7	63.5	1.94	16,332.0	66,002.8	2,333.3	9,429.4
	1	Sextuple	8	56.4	1.67	11,850.8	60,054.3	1,481.4	7,506.8
	3	do	8	33.3	1.71	11,794.8	64,558.2	1,474.5	8,070.4
	4	do	8	51.9	1.36	12,568.4	89,244.3	1,571.1	11,155.7
	5	do	8	55.3	1.29	11,193.2	79,818.6	1,399.2	9,977.3
	3	Octuple	11	37.4	2	16,417.0	124,143.2	1,492.3	11,284.8
	4	do	11	35.7	1.37	18,861.0	137,399.3	1,714.6	12,490.8
	5	do	11	39.2	2	17,508.1	126,252.7	1,591.5	11,476.7
	3	Decuple	[1]14	46.4	2	7,438.4	66,945.2	1,062.6	9,563.6
	4	do	[1]14	46.1	2	9,780.6	88,025.4	1,397.2	12,575.1
No. 7	A	Sextuple	8 to 10	45.9	1.25	12,563.4	100,428.4	1,570.4	12,553.2
	B	do	8 to 10	62.6	1.22	13,236.7	111,039.1	1,654.5	13,879.2
	C	do	8 to 10	57.5	1.12	12,533.5	113,356.0	1,566.7	14,169.3
	D	do	8 to 10	53.3	1	11,605.5	121,656.0	1,450.7	15,207.1
	A	Octuple	11 to 13	53.3	1.62	13,648.8	117,666.2	1,240.8	10,696.9
	B	do	11 to 13	57.3	1.50	15,512.8	139,237.4	1,410.4	12,658.8
	C	do	11 to 13	56.2	1.56	16,089.0	139,276.4	1,462.6	12,660.9
	D	do	11 to 13	52.8	1.43	17,540.1	152,490.6	1,594.6	13,862.8
No. 8		All	6 to 9	51.2	2	15,159.1	79,062.9	2,076.9	10,832.7
No. 9		do	8	34.0	2	23,098.1	135,097.8	2,887.3	16,887.2
No. 10	1	Quadruple	7	18.0	1	8,438.3	67,506.3	1,206.3	9,650.7
	2	do	7	28.4	1.25	13,682.8	109,462.6	1,957.2	15,657.2
	3	do	7	30.2	2	23,002.9	92,035.3	3,284.1	13,139.6
	5	do	7	28.1	1	12,023.1	96,184.9	1,717.6	13,740.7
	1	Sextuple	8	31.5	1.37	10,975.4	78,664.7	1,371.9	9,833.1
	2	do	8	26.1	1.50	13,478.6	87,164.7	1,684.8	10,895.6
	3	do	8	16.3	1.33	15,489.1	114,208.3	1,936.1	14,276.0
	4	do	8	31.7	1.33	11,831.7	85,785.5	1,478.9	10,722.5
	5	do	8	39.5	1.36	11,769.5	84,817.9	1,471.2	10,602.2
	3	Octuple	11	23.7	2	21,594.9	128,906.6	1,963.2	11,718.8
	4	do	11	26.0	2.20	34,989.2	229,397.1	3,180.8	20,853.8
	5	do	11	33.3	2	15,477.6	117,447.8	1,406.7	10,676.5
	4	Decuple	[1]14	36.3	2	7,140.1	65,143.7	1,020.1	9,306.9

[1] Includes 2 men in charge.

CHAPTER 12.—INTRODUCTION AND DEVELOPMENT OF PRINTING

INVENTION OF MOVABLE TYPE

PRINTING from wooden blocks and clay tablets was practiced in Asia at an early period, and in the thirteenth century in Europe, books were printed from hand-cut blocks. The possibility of separating the characters on such blocks was discovered, and movable single type was introduced about 1450 by Johan Gaensfleish, commonly known as Gutenberg, at Mentz, Germany, or by Lourens Janzoon Coster at Haarlem, Holland. The individual type characters could be placed side by side to form words, which could be combined into sentences and paragraphs, and finally arranged together in pages. After printing they could be taken apart and used again in other combinations. This was the first of the important steps in the mechanical development of printing, which eventually led to the production of the modern newspaper. Combined with the invention of the crude printing press of that age it made multiple production a commercial possibility.

MECHANICAL PRODUCTION FROM 1800 TO 1850

AT THE beginning of the nineteenth century, though at least 350 years had passed since the introduction of movable type, frequently referred to as the invention of printing, there had been very little change in the mechanical production involved. A fifteenth-century printer would, in fact, have been perfectly at home in a printing office in 1800. The type used was virtually the same and the methods of composition had not changed. Paper, which was produced in the same manner as during the earlier period, was probably not of as good a quality. The same type of wooden presses, with a few minor improvements, were in use, and the ink, made by each printer for his own use, was applied to the type by means of hair-stuffed leather balls.

Up to the second half of the nineteenth century the mechanical production of a newspaper consisted of two operations—composition and presswork. The methods employed for composition remained practically the same up to 1850 (see ch. 4, p. 33), but some changes were effected in presswork during that period.

HAND PRESSES

THE earliest form of printing press, such as that used by Gutenberg, was built on the same principle as the ordinary cheese or linen presses of that period, and was practically modeled after the old wine presses of ancient Greece. It consisted of a framework of two heavy upright timbers, held together by several crossbeams. One of the crossbeams supported a flat table of wood or stone, called the bed, while a higher beam was pierced by a wooden screw, resting on a horizontal block called the platen. The type form was placed on the bed, and daubed with ink. A sheet of dampened paper was laid

on top of the inked type and covered with a piece of blanket to soften the impression, and the platen was screwed down on top of it. After the impression was taken the platen was screwed up again, so the paper could be removed and hung up to dry. About 1620 Willem Janszoon Blaeu, a printer of Amsterdam, Holland, constructed nine presses for his printing house, which embodied several improvements, such as suspension of the platen from a block which was guided in the upright timbers, an iron hand lever for turning the screw, a device for rolling the bed in and out of the frame, and a spring release of the platen. The Blaeu press was introduced in England, where one of them was operated in 1725 by Benjamin Franklin at the Watts Printing House in London, and where as late as 1770 it was termed the "new-fashioned" press to distinguish it from the more common and older style. It was also used extensively on the Continent.

IMPROVEMENTS IN EARLY STYLES

A frame, called the "tympan," was later attached to the bed by hinges. It was covered with fabric, on which the sheet was placed. Another frame, attached by hinges to the tympan and called the "frisket," was folded over the paper to protect it from any ink or impression not desired, and the double frame was folded over the type form before the bed was rolled under the platen. No further improvements were made, except the substitution of iron platens, until 1798, when Charles Mahon, third Earl of Stanhope, patented and built an all-iron press in England. It embodied the screw principle, but a combination of levers was added to provide greater power with less expenditure of energy.

HAND PRESSES IN THE UNITED STATES

The first printing press used in the American Colonies was erected in Cambridge, Mass., in 1638. The early presses used here, as well as the type, were imported from England and often consisted of second-hand outfits. In 1750 Christopher Sower, jr., printer of Germantown, Pa., began to manufacture hand presses, but they were inferior to the imported ones.

In 1816 a new style was devised by George Clymer, of Philadelphia, Pa., in which the screw was entirely eliminated. The press was constructed completely of iron, and the platen was raised or lowered by levers. It was known as the "Columbian," and gained great popularity at once in England, where it was constructed. The first one, completed in 1818, was afterwards sent to Russia. Adam Ramage, who came to Philadelphia about 1790 and for a long time was the chief press builder in this country, was one of the first to construct iron beds and platens, but, like preceding styles, the presses were so small that only one-half of a sheet of respectable dimensions could be printed at once, and four impressions were necessary for printing a small newspaper on both sides.

According to Van Winkle's Printers Guide, New York, there were only four styles of presses worthy of notice in the United States in 1818, all more or less improvements upon the Stanhope press. These were the Columbian, the Ramage screw, the Ruthven, and the Wells. The Ruthven press, which was invented by John Ruthven, a printer of Edinburgh, Scotland, and patented in 1813, was manu-

factured by Adam Ramage of Philadelphia, who patented improvements on it in 1818. It was distinguished by having a stationary bed, and a platen which moved to and fro. The Wells press, which was invented by John J. Wells, of Hartford, Conn., was not patented until 1819, but two of them had been used in that city for some time, with reported good satisfaction. All of these, as well as other makes, were practically supplanted by the Smith hand press, invented in 1822 by Peter Smith of New York, brother-in-law of Robert Hoe, founder of the firm of R. Hoe & Co., printing machinery manufacturers of New York. In this press a toggle joint was substituted for the screw and levers, which was simpler and more efficient.

WASHINGTON HAND PRESS

In 1827 Samuel Rust, a printer of New York, brought out a hand press, embodying all of Smith's ideas, but with improvements in construction and details which created practically a new machine. The frame was cast hollow instead of solid, but reinforced with rods. By turning a crank the bed slid in and out from under the platen on a track. The impression of the platen was given by a curved hand lever, acting on a toggle joint, and the platen was lifted afterwards by springs. With a few improvements by R. Hoe & Co., who secured the patents, the Washington hand press, as it was termed, soon became the most popular machine for the printing of newspapers, and much of the earlier progress of the smaller newspapers in this country was due to the comparative ease, economy, and sureness of its operation. Though this press is no longer employed for actual printing, a number are still used for taking proofs in photo-engraving plants.

PRODUCTIVITY ON HAND PRESSES

IN THE beginning printing on hand presses was probably done by only one man, but the operation was soon divided between two workers. One of these distributed the ink on the ink balls by patting them together until a fine, even film was produced, and then pressed them carefully on the type. The other placed a sheet of damped paper on the tympan, folded the frisket over the paper, and, together with the tympan, down over the form, ran the bed under the platen, took the impression by depressing the platen, raised the platen, ran the bed out, lifted the tympan and frisket, and removed the printed sheet. So much physical strength was required for turning the screw or pulling the lever of the old-fashioned hand press that a man was required for the function. The inking operation could be performed by a boy, but in the larger pressrooms two men were often employed on a press, taking turns at the operations. The duties also included making the ink, and dampening the paper before printing.

Manufacturing the ink was not difficult, consisting mainly of boiling linseed oil, with rosin added, and afterwards mixing it with lampblack and grinding the mass together with muller stones, in the same manner as paint was ground. Boiling the linseed oil was often the occasion of a picnic for the staff of the early printing house, who would set up the kettle in the fields for the purpose. This involved so great a loss of time, and the ink was not always satisfactory, that by the end of the sixteenth century many printing houses bought

their ink from factories which had been gradually established, and thus ink making became an independent branch of the industry. The printing houses in the American Colonies either made their own ink or imported it from Europe, and this practice was continued after independence had been gained and up to the end of the eighteenth century. Dampening of the paper was accomplished by dipping the sheets into a tub of water, a small number at a time, and piling them under weights to squeeze out superfluous moisture and keep them in shape. After printing, the sheets required folding, which was done by hand, by means of a bone or a stick.

Printing on the oldest style of hand press was extremely slow and laborious, as only very small type forms could be used, and even these involved a great deal of physical exertion. According to Ringwalt [1] 300 sheets, or 600 impressions, were considered a good day's work in 1475 by the printers of Mentz, Germany. Early in the sixteenth century this had increased to 2,000 impressions, and later (about 1575) pressmen in Paris, France, were supposed to print 2,650 sheets per day, while at Lyon, France, a good day's work consisted of 3,350 sheets. The hours were long, as at that time pressmen in Lyon had to work from 2 a. m. to 8 or 9 p. m. without leaving the shop. The year contained more recognized holidays than at present, and only 230 or 240 working-days. About 1830 the hourly production on hand presses in London, England, for two men was rated at 75 impressions on wooden presses, 150 to 200 impressions on Stanhope presses, and 200 impressions on Columbian or Albion presses.

The improvements in the hand presses not only increased the number of sheets printed hourly, but also gradually permitted larger type forms to be printed at one impression. The early presses used in the Colonies were so small that only one page of even the miniature newspapers of that day could be printed at one time, necessitating four pulls to produce the complete paper. Even the larger hand presses, introduced later, required two impressions for each copy of a 4-page newspaper.

Theodore L. De Vinne,[2] in discussing conditions in New York for 1870, stated that the ordinary task of a hand press was rated at 1,500 impressions a day on forms of large size, with one man, using an inking machine, and by one pull, giving practically eight times the production in Mentz during 1458, considering the difference in size. In a detailed table on average daily performance of presses, De Vinne gives figures for hand presses, claimed to be examples of actual practice, based on a full 10-hour day, which show an additional difference according to the number of copies in the editions printed. For a hand press in continuous employment, with 1,500 impressions required from the form, one hour was allowed in making ready and nine hours for actual printing to complete the job, an average of 166 impressions per productive machine hour. When only 250 impressions were required from each form, the production for a 10-hour day was reduced to 1,000 impressions. This was caused through an allowance of 1 hour for making ready on each form, leaving but 6 hours for actual presswork and giving an average of 166 impressions per productive machine hour. The work referred to by De Vinne was, of course, mixed in character and slower than where newspaper printing alone

[1] Ringwalt, J. Luther: American Encyclopedia of Printing, Philadelphia, 1871.
[2] De Vinne, Theodore L.: The Printers Price List. New York, 1871.

was involved. Large quantities of newspapers were, however, not produced in those days. Before 1810 the circulation of the most widely read newspaper in the United States did not exceed 900 copies.

LABOR COST IN EARLY PRESSROOMS

NO record was found of the actual wages for pressmen in the early days, but these were stated to have been two or three times more than paid to journeymen in other skilled trades. According to Northumberland Household Book, quoted by Timperley,[3] about 1512 in England "the daily wages of a master carpenter, mason, bricklayer, tyler, or plumber were 6 pence per day, without diet, from Easter to Michaelmass; other laborers 4 pence per day."

The first regular wage rates stipulated were in a scale (quoted by Timperley) agreed to in 1810 by the master printers of London, in which 6 pence per token was paid for printing of folios (4 pages), using small pica (now 11-point) type or larger, if only one token was printed, and 7 pence if smaller type was used or the pages exceeded 8⅔ inches in width. When either two or three tokens were printed, the rate was reduced to 5½ and 6 pence, respectively, according to the type and size of page. When four tokens were printed, the rate was reduced one-half penny more for each item, and in 1816 another one-half penny reduction was made effective for each token above the first four. A token at that time consisted of 10 quires, or one-half ream, of paper, and a quire, as used by newspapers, consisted of 25 sheets, making a total of 250 sheets. In 1838 pressmen in England reckoned their work by the hour, equal to one token. If two men worked on the press, 10 quires constituted an hour, but if one man operated the press alone, 5 quires constituted an hour.

APPLICATION OF MECHANICAL POWER

MANY attempts were made to devise some way of increasing the capacity of the presses. About 1776 Benjamin Dearborn, publisher of the New Hampshire Gazette, devised a wheel press, on which the whole side of a sheet could be printed by one pull of the lever. It was used for a while at Newburyport, N. H., but was not adopted generally. A patent was issued to Dearborn in 1786 by the State of New Hampshire.

Friedrich Koenig, a Saxon inventor, obtained an English patent for applying steam power to a bed and platen press in 1810. He had devised the principle previously in Leipzig, Saxony, but was unable to find backers. After trying other cities, including St. Petersburg (now Leningrad), Russia, he went in 1807 to England, where Thomas Bensley, Richard Taylor, and George Woodfall, London printers, furnished the money to build a model, which took nearly three years. The bed, on which the form was placed, was reciprocated under inking rollers by means of tapes and a pulley. During the backward movement the paper was placed by hand on the tympan. The latter, together with the frisket, was folded mechanically over the form while it traveled toward and under the platen, where the impression was taken, and unfolded during the forward travel toward the inking rollers. Cloth-covered, leather-surfaced cylinders were used for

[3] Timperley, C. H.: Dictionary of Printers and Printing. London, 1839.

applying the ink, which was kept in a box above them and forced by a piston through a slit in the box to fall on them. The new machine was installed and set to work in the office of Bensley, where 2,000 or 3,000 impressions of part of the Annual Register for 1810 was printed on it, the first commercial job executed with the aid of steam power.

TREADWELL PRESS

In the United States power was first applied to bed and platen presses by Daniel Treadwell, of Boston, Mass., in 1822. Two years before he had patented in England a press, with a fixed bed and worked by a treadle, which was constructed by David Napier, a London manufacturer. After his return to this country, several presses provided with reciprocating beds were manufactured for him by Phineas Dow in Boston. As he could not sell them, he established a printing office, where he ran them by horse power. After this office had burned down a second one was established, where the presses were run by water power, and purchasers were finally found about 1825 or 1826, when an American patent was also obtained. Treadwell presses were used in New York as late as 1845.

ADAMS PRESS

In 1827 Isaac Adams, a Boston machinist, was called to repair a Treadwell press for Daniel Fanshaw, of New York, who had 10 of them in his office. He devoted the next three years to experiments, and in 1830 brought out a new style, power-driven bed and platen press, which rapidly became popular. Assisted by his brother, Seth Adams, he made several improvements, placing it in its final form on the market in 1834. The bed was raised and lowered by straightening and bending a toggle joint by means of a cam, giving the impression against a fixed platen above the form. The paper was fed by hand to the frisket, and the printed sheet was delivered automatically by means of tapes and a fly—a frame with long wooden fingers which received the sheet from the press and deposited it on a table. Ink was provided by a roller, turning in a trough or fountain at one end of the press, and applied by a series of rollers traveling over the form. The Adams press was first made with wooden frames like the Treadwell press, but later iron frames were substituted. It was used extensively, and the business of Adams was acquired in 1858 by R. Hoe & Co., who continued to manufacture it for many years. After faster presses had taken its place for newspaper production, it was often found side by side with them, for use on fine printing which for a long while many thought could be produced only by flat pressure. One important feature at the time of its invention was its speed of production, which reached a maximum of 1,000 impressions per hour, 300 being the highest attained on the hand presses. Many patents were later taken out in connection with bed and platen presses, eventually resulting in the modern platen presses, which are adapted for small commercial work and have been eliminated as a factor in newspaper production.

CYLINDER PRESSES

THE next step to satisfy the growing appetite of the public for news was the replacement of the flat platen as an impression medium by a rotating cylinder, which reduced the impression contact.

On the Adams presses the impression was applied at one time to 1,200 or 1,500 square inches, while on cylinder presses the printing contact was 40 or 50 inches in width but only one-fourth inch in length, applied successively as the cylinder revolved. The method of printing by moving a form resting on a flat bed forward and backward under a cylinder had been rudely applied by printers of copperplate engravings in the fifteenth century. The cylinder revolved in stationary bearings. The ink was applied by inking balls, and the paper was covered with a piece of blanket as for the ordinary hand presses.

In 1790 William Nicholson, of London, author, inventor, and patent agent, obtained a patent in England for "a machine or instrument on a new construction for the purpose of printing on paper, linen, cotton, woolen, and other articles in a more neat, cheap, and accurate manner than is effected by the machines now in use." It covered two devices—a flat bed and a rotary. In the first the types were placed on the flat bed of the press and, after application of ink, passed under a cylinder covered with cloth, which produced the impression. In the second plan the types were imposed on a cylinder, placed between two other cylinders, one built up of cloth and covered with leather, to apply the ink, and the other on which the sheet was held by grippers. No practical method of utilizing these principles was added, as Nicholson was not a mechanic and failed to reduce his theory to practice, so the ideas never passed beyond the paper stage.

KOENIG CYLINDER PRESSES

His ingenious plans, however, probably influenced Friedrich Koenig, who had secured the services of Nicholson in connection with his patents, and to whom belongs the credit of introducing the flat-bed cylinder press into actual use, permitting the more rapid production of newspapers. Assisted by his countryman, Andreas F. Bauer, an expert machinist, he had previously designed and built a power-driven bed and platen press for Thomas Bensley. In 1812 he took out a patent covering a power-driven flat-bed press in which the impression was given by a cylinder instead of by a flat platen. The first one, which was completed the same year, was installed in the office of Bensley. The cylinder was located above the bed, or carriage, contained three impression surfaces, each provided with a frisket frame, and printed three sheets each revolution. The paper was placed on a sloping platform, called a "feedboard," near the top of the cylinder. A sheet was laid by hand on the top impression surface of the cylinder while this was stationary. The cylinder revolved 120 degrees, bringing another impression surface to the feeding position at the top. After a sheet had been laid on this, the cylinder revolved as before, making the impression on the first sheet and bringing the third impression surface on top. The third sheet was laid on this, the first sheet being meanwhile removed by hand by another attendant. The cylinder revolved again, carrying the first impression surface to the top, and so on. The reciprocating bed motion employed by Koenig, later improved by Napier and commonly known under his name, was very efficient and is still one of the most practical forms in use. One pressman and two attendants operated the machine, which turned out 800 impressions per hour

A double machine was also described in the patent, and a system of 10, arranged in a circle, with the form continuously running forward from one machine to the other. Other improvements were made by Koenig in a patent of 1813, principally in the gearing and the inking devices. John Walter, proprietor of the London Times, was so impressed with the importance and future possibilities of the machine that he ordered two double cylinder presses for his publication. These were erected during 1814, and the issue of November 29 was printed entirely on them, according to the published statement of the owner, at the rate of 1,100 copies per hour. Circumstances connected with this revolution in newspaper production were described in an English trade journal,[4] as follows:

> The opposition of the printing trade, both employers and employed—particularly the latter—to any new mechanical appliance which bids fair to displace labor, or put the majority of the printers in a disadvantageous position, was such that great secrecy had to be observed. Nothing untoward, however, happened, and most of our readers are no doubt acquainted with the story of how Walter, after the great feat had been successfully carried through, entered his hand-press room at 6 o'clock in the morning with a copy of the Times for November 29, 1814, and announced the doom of the old method by telling the astonished pressmen that the paper had been produced by steam-driven machinery, and that it would be useless for them to try and kick against the pricks, but if they faced the new state of things in a reasonable manner he would see they did not suffer by it.

This machine, which, in order to preserve the secrecy was not patented until later in the same year, was provided with continuously revolving cylinders, each having a single impression surface. As only the impression surface was covered with a blanket, the balance of the cylinder was of small enough diameter to clear the form on the return journey of the bed. The Times at that period was a four-page journal, printed on a sheet measuring 18 by 24 inches. As both cylinders in one press printed from the same form, which passed alternately under them, it was necessary to print one side of the sheets in one press and afterwards to run them through the other press for printing the other side. Two attendants were necessary for each cylinder—one to feed and one to take away. Friskets had been eliminated and tapes substituted to hold the sheet against the cylinder. A feeding attachment was also provided, consisting of an endless web of cloth. Successive improvements, planned by Koenig, increased the production, so that by 1824 the machines printed 2,000 impressions per hour. A machine provided with a single continuous-revolution cylinder was also described in the 1814 patent, while in the 1812 patent plans had been shown for a double cylinder press, designated as a completing press and later as a perfecting press, to print both sides of the sheet at one operation. Such a machine, but provided with continuous-revolution cylinders, was constructed for Bensley. It contained two beds, with connected drive to insure unison, each carrying a form. The sheet was transferred from one cylinder to the other by tapes, presenting opposite sides to the forms. It produced 750 perfected sheets an hour, or 1,500 impressions, but it was too heavy and too high priced, so no more were made. Koenig and Bauer returned in 1818 to their native country, and founded the firm of that name, press builders, at Kloster Oberzell in Bavaria. Double cylinder presses were constructed by the larger German newspapers and single

[4] The British and Colonial Printer and Stationer, London, November 26, 1814.

cylinder presses, printing 1,200 impressions per hour, for the smaller ones. In 1823 Koenig was invited to build a new machine for the London Times, but declined. The firm, which was continued after the death of Koenig and still exists, completed in 1847 the six-hundredth machine, capable of printing 6,000 impressions per hour.

COWPER AND APPLEGATH CYLINDER PRESSES

The success of Koenig was immediately apparent, and other inventors entered the field to devise improvements. Cylinder presses were at first considered fit only for newspaper production, and early improvements were consequently directed toward higher speed, ignoring quality of printing. Edward Cowper, a London machinist, improved Koenig's machine by substituting a better inking apparatus and by removing a number of wheels, protecting his work by patents in 1818. He and his brother-in-law, Augustus Applegath, also an inventor, succeeded Koenig in the machine room of the Times. Cowper's patent introduced for the first time a flat ink-distribution table, while Applegath's patent of the same year covered vibratory motion of ink-distributing rollers. After the refusal of Koenig to construct a new press for the Times, Cowper and Applegath devised a faster and better machine, consisting of four cylinders, which replaced Koenig's machines in 1827. Two alternative cylinders printed one way, and the other two the other way. A description by Savage [5] of this press, states:

> The paper is laid on at four places, one forme of which, consisting of four pages, is printed at the astonishing rate of 4,320 an hour, a fact of which I have seen and ascertained myself, by counting its motions with a second-watch in my hand.

Each machine required 4 attendants to lay on and 4 to take off, or 16 in all for the two presses, beside the pressmen and helpers. They were used until 1848, when the flat-bed principle was abandoned by the Times. Cowper and Applegath also turned their attention to the perfecting press, which they brought to a high degree of efficiency. With but little alteration it was later on developed into the modern flat-bed perfecting press.

NAPIER CYLINDER PRESSES

About 1824 David Napier, the English press manufacturer, perfected a practical style of grippers for holding the sheet on the cylinders during the impression and delivering it afterwards, though he failed to cover it by patents. He constructed presses with large single-impression cylinders, but also introduced in 1830 a press provided with two small impression cylinders, which made two or more revolutions for each sheet printed. The cylinders were raised or lowered alternately by means of toggle joints, so that one cylinder was giving the impression while the other was raised to let the form pass under it. After the sheet was printed on one side, it was released by the grippers on the first cylinder and caught by the grippers on the other cylinder, where it was printed on the other side.

This so-called two-revolution press further increased the capacity, as it permitted printing of larger forms. The power platen press

[5] Savage, William: Dictionary of the Art of Printing, London, 1840

was limited to about 24 by 36 inches, and the single-revolution cylinder press to 36 by 48 inches, while the double-revolution cylinder press was capable of printing on 48 by 72 inch sheets. One of the Napier presses, used by Thomas Curson Hansard, a London printer, during 1825, was declared by him to have an average speed of 2,000 sheets per hour, but capable of printing more. Several cylinder presses were imported into the United States, where the first one was installed in Boston, Mass., in 1826, but supremacy in development of printing presses passed in a few years from England to this country.

HOE CYLINDER PRESSES

The first two cylinder presses manufactured here, which were similar to the Napier presses, were turned out in 1828 by R. Hoe & Co., of New York, for the New York Commercial Advertiser and the Philadelphia Daily Chronicle. They were provided with single large cylinders, having a circumference equal to the entire travel of the bed forward and backward. The cylinder revolved continuously, making one revolution for each impression. The portion of the cylinder not used for the impression surface was turned down to allow the form to pass under it without touching. In 1832 the firm sent Sereno Newton to England to investigate improvements there. On his return in 1833 Newton, who was afterwards taken into the firm, patented a double Napier press, and construction was started on both single and double small cylinder presses, combining the most valuable properties of the Applegath and the Napier presses. The first one, used in the office of the New York Sun, had a capacity of 4,000 impressions per hour.

In 1847 a new style of bed motion was introduced, the so-called direct drive, which became very popular. Perfecting presses with large cylinders were also constructed, as well as others intended especially for fine book and job work, such as the stop-cylinder press, invented in France in 1852. The sheet fly, which was used on the Adams bed and platen press for delivering the sheet, was improved by the firm and placed on all of its cylinder presses. Improvements were continued on machines embodying the flat-bed and cylinder principle, and a number of other manufacturers also introduced their various makes, but about 1850 the cylinder press was replaced in some of the larger offices by a faster machine, and began to be more closely associated with book and job production. It remained popular in the small country newspaper offices, where it had gradually supplanted the platen presses. Some of these are still producing their small weekly editions, together with other printing of large size, on cylinder presses.

Aside from those manufactured by R. Hoe & Co. there were in 1870 several makes, constructed especially for newspaper printing but also adaptable for job work. They were styled country presses and were known individually by the name of their manufacturer. The more popular of these presses were made by Andrew Campbell, New York; Cottrell & Babcock, Westerly, R. I.; and the A. B. Taylor Printing Press & Machine Co., New York.

In 1833 some of the daily newspapers in the larger cities of the United States were printed on cylinder presses, cranked by hand, though others were still turned out on bed and platen presses, as were the country papers of small circulation. The Sun, the first penny

paper in the country, established in New York in 1833, was printed on Napier presses turned by crank men, as were practically all daily newspapers in New York, but, with a sheet 11½ by 17 inches, could be produced only at the rate of 400 copies per hour. Two years later steam was applied to the double-cylinder presses in the Sun office. This relieved the situation for the time being, but the constant growth of the publication made it difficult a year afterward to print the required number of copies each day in the time allotted for a daily paper.

The cylinder presses manufactured by R. Hoe & Co. surpassed the foreign makes in both quantity and quality of work, though the latter was not considered so important for newspapers. Driven by mechanical power, the output of the single-cylinder presses reached a maximum of 2,000 impressions per hour, or as fast as the feeder could lay the sheets down. Twice as much could be produced on the double-cylinder presses, on which two feeders placed the sheets, as both cylinders printed on the same form, but even this production failed to meet the requirements, which eventually resulted in the development of the rotary principle for newspaper printing.

PRODUCTIVITY ON CYLINDER PRESSES AND LABOR COST IN 1870

AN interesting comparison is afforded by a table published by De Vinne[6] on cylinder-press production in 1870, although it covers work in job offices, consisting ordinarily of work of a finer grade than that involved in newspaper work, and consequently would be slower.

He also stated that a double medium cylinder, when running on newspaper work, could be made to give 1,500 or 1,750 impressions per hour, but such speed could not be kept up through 10 consecutive hours, that 10,000 impressions could seldom be secured in 10 hours from one form, and that the average was often below 9,000 impressions.

[6] De Vinne, Theodore L.: The Printers Price List. New York, 1871.

Average daily performance of presses on editions of irregular numbers, with a small allowance of time for making ready

[The estimates of the following table are for miscellaneous work, done in the usual manner, with little making ready and under the favorable conditions of a busy season. It is supposed that the presses are at work full 10 hours; that feeders and pressmen are expert and diligent; that paper, rollers, steam power, ink, etc., are in perfect order, and that there are no detentions or accidents. These estimates are applicable only to a press in full employment]

Make-ready time (hours)	Style of press and number of forms	Time press-work (hours)	Rate per hour when at work	Daily performance (impressions)
	Medium cylinder			
1	1 form of 1,500 impressions	9	833	7,500
5	5 forms of 750 impressions	5	750	3,750
7	8 forms of 250 impressions	3	666	2,000
	Double medium cylinder			
2	1 form of 5,000 impressions	8	666	5,000
5	3 forms of 1,000 impressions	5	600	3,000
7	6 forms of 250 impressions	3	500	1,500
	Mammoth cylinder			
3	1 form of 4,000 impressions	7	570	4,000
5	2 forms of 1,250 impressions	5	500	2,500
7	4 forms of 250 impressions	3	333	1,000

The allotment of impressions to forms is not fanciful. The proportions are those of actual practice. In every job office small editions are always in excess.

Average wages of the period were given by De Vinne for New York as $20 per week for hand, cylinder, and Adams press men, but ranging from $15 to $18 for inexpert workmen to $22 or $24 for superior workmen. Feeders received $6 to $9 per week, according to ability, and fly boys $3 or $4 per week, while foremen were paid $25 to $40 per week.

INKING ROLLERS

AN extremely valuable improvement was the discovery of glue and treacle composition for inking the type. The lack of a suitable method for applying the ink had blocked the progress of development for many years, as no speed could be attained while hair-stuffed leather balls were used. Experiments had been made by Stanhope and others in using cylinders covered with cloth, silk, or skins of animals, but all proved unsatisfactory.

In 1813 F. B. Foster, an English printer, noticed that an elastic compound was used successfully by pottery workers in Staffordshire for transferring designs, receiving and depositing the colors freely and evenly. Learning that it consisted of glue and treacle he introduced such a composition for hand-inking balls. The new material was utilized the same year in roller form by Donkin & Bacon on a new-style press furnished by them to the University of Cambridge, England.

Koenig had been handicapped at first by the lack of suitable material, as the leather-covered cylinders on his new presses did not possess the proper suction and flexibility. While building his cylinder presses for the Times his attention was called to the new composition. He adopted it, constructing cylindrical molds for casting rollers from it around metal cores. These solved the difficulty of applying the ink. The subsequent introduction of distributing rollers by Cowper and by Applegath improved the facilities. Attempts were made at first to keep the process secret, but eventually the contents became known to others, and roller making was added to the duties of the pressman. For a number of years nearly every printing plant made its own rollers, though factories for supplying the trade also appeared.

Daniel Fanshaw, the New York printer, who learned from a Presbyterian minister from England of the innovation, experimented with the composition about 1826, and used it exclusively for a while, also attempting to keep it secret. The formula leaked out here also, and roller factories were established in this country, though some pressmen continued to manufacture rollers for their own use as late as 1900. It was later discovered that glycerin would keep the glue soft and prevent the rollers from drying and hardening too rapidly, an important feature from a financial standpoint, as well as affecting the time of the workmen. Patents were obtained by Lewis Francis of New York in 1864 for this addition. Subsequently treacle or molasses was left out, glue and glycerin alone being used for the main body, but with individual small secret additions by the various manufacturers to obtain the necessary tack and resiliency. At the beginning of the nineteenth century printing houses in the United States were still manufacturing printing ink for individual use or importing it from Europe. Around 1805 two firms, one in Philadelphia and the other in Cambridgeport, began the manufacture of printing ink for the trade, but black ink only. Vermilion ink, which

in recent years has been used to a great extent in newspapers, was also manufactured after about 1822, and was the only colored ink produced on this side of the Atlantic up to 1840. The establishment of ink factories gradually relieved the pressmen of ink making.

PAPER MANUFACTURE

THE tremendous increase in newspaper publishing was also partly due to the changes in the composition and manufacture of paper. Before 1800 all paper was made in single sheets by hand. In the early days it was manufactured from rags, either cotton or linen, the material still used for fine writing paper. Paper mills were established by the Saracens in Spain during their occupation of that country, and paper making gradually spread to other countries. It was not undertaken in the American Colonies until 1690, when a paper mill was erected at Germantown, Pa., by William Rittinghuysen, an expert paper maker from Holland, together with William Bradford, printer, who later established the first newspaper published in New York. Several days were required for finishing a sheet of dry, perfected paper, and a day's work for three men resulted only in 4½ reams of newspaper, 20 by 30 inches in size. One ream equaled 480 to 516 sheets.

The Revolutionary War practically ended importation of printing paper from abroad, and also created an acute shortage. While the number of paper mills had increased until there were more than 40 in the country, several of them were idle on account of the war, and the others could not manufacture a sufficient quantity. In the rush to supply the demand, the paper was often disposed of before it was dry or had been finished by the workers. In these early days, when all paper was made by hand, 5 to 10 reams a day were considered a fair production for one mill. After peace had been established other mills were built, and by 1810 nearly 200 existed in the United States.

In 1798 Louis Roberts, a clerk in Didot's paper mill at Essonnes, France, took out a patent for making paper by an endless-web machine. Unable to secure financial assistance, he sold the patent to Leger Didot, who took it to England, where it was acquired by Henry Fourdrinier, proprietor of a paper mill in Kent. A machine was constructed in 1803 by the Fourdrinier Bros., after whom it was named, which manufactured the paper in one continuous web of any desired length and revolutionized paper making, as hand manufacture required a week to accomplish what the machine would do in a day. In 1817 a couple of paper mills in the United States had installed machines of American origin on nearly similar principles, but these were outclassed by the Fourdrinier machine, imported in 1820 by Thomas Gilpin & Co., of Wilmington, Del., which rapidly became popular.

Newspaper production was still limited by the scant supply of suitable material for paper, and various substitutes for rags were brought out. In 1719 the use of wood had been suggested by René Antoine Réaumur, the French scientist, but ground wood pulp was not introduced until after the invention of a grinding machine in 1844 by Gottfried Keller in Germany. The method was adopted by Heinrich Voelter, a paper manufacturer. It was introduced in this

country by Alberto Pagenstecher, who in 1867 built a grinding mill in Curtisville, Mass., and finally succeeded in getting Wellington Smith, the owner of a near-by paper mill, to use it. The result proved to be good paper for newsprint, and the new fiber was soon adopted generally for that purpose, taking an important part in the development and productivity of newspaper printing.

ROTARY PRESSES

THE cylinder press, originally projected by Nicholson and introduced by Koenig, had been successfully established. Meantime others had attempted different ways of arriving at the same result, in line with the second project of Nicholson, which proposed placing the type on a cylinder, revolving against another cylinder to provide the impression. Cotton cloths had been printed in a similar manner, from engraved cylinders, as early as 1743. In 1796 Dr. Appollos Kinsley, of Connecticut, took out a patent for an improvement on Nicholson's press, placing the cylinders vertical instead of horizontal. It is claimed that a press was constructed, which worked well. While considered too complicated to use and too defective in color distribution, one machine was constructed for the University of Cambridge, England, by Richard M. Bacon, printer of Norwich, and Bryan Donkin, of Bermondsey, under a patent of 1813. It consisted of a revolving, four-sided prism, on which the forms were locked, while the sheets were fastened on another prism. The ink was applied by a composition roller, which rose and fell to meet the irregularities of the prism.

In 1815 Edward Cowper took out an English patent for printing paper for paper hangings and other purposes by means of stereotype plates, cast flat and curved by means of heat, to be locked on a cylinder. Three years later he and his associate, Augustus Applegath, supplied the Bank of England with machines to print in colors, using curved stereotype plates. Such presses were used for 50 years for printing labels in two colors, and for printing 4,000,000 banknotes.

A rotary machine, with the types secured around a cylinder, was used in 1828 for printing the Christian Advocate of New York, which at that time had a circulation of 8,000. One copy was produced each cylinder revolution. Sir Rowland Hill took out an English patent in 1835 for "certain improvements in certain methods of letter-press printing by machinery," consisting of a press intended to print, either with movable type or with stereotype plates, from a continuous roll of paper, made possible by the Fourdrinier paper-making machine. A press was constructed and operated, which printed on both sides of the web, but the difficulty attending the impression of stamps on each copy, required then by English law, interfered with its use, and the project was abandoned like previous ones. In 1836 Dryden & Co., of Lambeth, England, received a patent for tapered types, and in 1839 Jephtha A. Wilkinson, of Brooklyn, N. Y., built a rotary press for the New York Sun, but abandoned the project three years later, as the types would not hold on the cylinders.

HOE TYPE REVOLVING PRESSES

An American firm finally carried forward the evolution of the printing press, and with the assistance of related devices made possible the enormous production of the modern newspaper. A number of patents were granted to Richard M. Hoe, of New York, among them one in 1844 for a rotary combined cylinder press, the Planetarium. It was provided with any number of cylinders, from two to eight or more, each of which received a sheet and carried it to the form for the impression. This principle was applied by substituting a horizontal revolving cylinder to carry the type form in place of the flat bed, resulting in the Hoe type revolving machine, installed in the Philadelphia Ledger in 1846. Four small impression cylinders were grouped around the large type cylinder, on which the type was held by patented removable devices, known as turtles. Ordinary type was used, and locked in the turtles by means of wedge-shaped column rules. Ink was supplied from a fountain under the type cylinder to portions on this cylinder not occupied by type, and taken off by composition inking rollers, that rose and fell alternately to receive a supply of ink and to deposit it on the form. The sheets were fed in by boys, one for each impression cylinder, and delivered by sheet fliers, which laid them in piles on tables. A maximum running speed was obtained of about 2,000 sheets per hour to each feeder, or a total of 8,000 sheets per hour for the press, printed on one side.

Even this production proved too slow. The daily circulation of newspapers had reached 60,000 in 1853, requiring 12 hours for printing the first side on a 4 or 6 cylinder press, and 8 hours for the second side. The New York Sun, for instance, went to press on the second side at midnight and did not finish until 8 a. m. At the demands of the newspapers for more production, the size of the machine was enlarged from time to time by adding more impression cylinders, until finally 10-cylinder machines were in use. The theoretical speed was 3,000 impressions per hour for each cylinder, but accidents and stoppages brought the results down to about 1,500 per hour, giving a production for a 10-cylinder press of 15,000 copies per hour. As they were printed on one side only, it was of course necessary to put them through the press again after the forms had been changed, or through another machine. One of the new presses was erected in the office of La Patrie, in Paris, France, in 1848, where it was seen by the publisher of Lloyd's Weekly Newspaper of London, England. A 6-cylinder machine was installed for that publication in 1856.

COWPER AND APPLEGATH TYPE REVOLVING PRESS

Meantime Cowper and Applegath had constructed a somewhat similar machine for the London Times, where it was installed in 1848. The type was placed on a large cylinder, revolving on a vertical axis, but as no means were devised to lock the type other than in flat columns, the forms presented a polygonal surface. Eight small vertical impression cylinders were placed around the type cylinder, and ink was applied by rollers to the form as it passed from one impression cylinder to the other. The sheets were fed down by hand from flat horizontal feedboards, passed sideways between impression and type cylinders, and delivered in vertical position to boys, one at each cylinder. At the best it could produce only 8,000 impressions per hour on one side of the sheets, with a theoretical speed of 10,000

to 11,000 per hour. The Hoe type-revolving machine in Lloyd's proved so superior that the Applegath press was replaced in 1857 by two Hoe 10-cylinder machines, which lasted for about 11 years. The Hoe type-revolving, or "Lightning," press, which was rapidly adopted both in the United States and Europe by the leading newspapers, and for many years was regarded as one of the wonders of the age, contributed much to the advancement of newspaper printing. Publications, which had been limited through inability to produce sufficient copies, increased their circulations and new publications were started.

STEREOTYPE PLATES ON TYPE REVOLVING PRESSES

In 1859 James Dellagana, a London stereotyper, produced curved printing plates for the London Times by the papier-mâché method. These were, however, cast type-high in separate single-column strips, and were locked in the turtles on the Hoe presses used there. Curved plates had already been produced in 1854 by Charles Craske, a New York stereotyper, for the New York Herald, and beds were later provided on the type revolving presses to receive these plates instead of the type. This proved a temporary relief to the larger newspapers, as the setting of type was so slow and costly that forms could not be set up for more than one press, limiting establishments to the use of one machine for each side of the newspaper sheet. The production of stereotype plates permitted duplication of pages in any desired quantities, and consequent printing on several machines at the same time, as well as operating the presses faster. In several of the leading offices, such as the New York Herald, the London Daily Telegram and the London Standard, as many as five of these machines were in constant operation.

BULLOCK ROTARY WEB PRESSES

In 1865 William Bullock, an American inventor, presented a press that utilized the various advantages properly, and the first one was erected in the office of the Philadelphia Inquirer. In 1853 Bullock had moved a newspaper published by him in Philadelphia, Pa., to Catskill, N. Y., where he constructed for his personal use a wooden press, turned by a hand crank, to which an automatic sheet feeder was attached. Soon afterwards he went to New York, where he perfected an automatic feeding machine for sheets. In 1863 he was granted a patent for a rotary self-feeding and perfecting press to print from stereotype plates, which instead of using sheets was fed from a continuous roll or web by means of a roller, revolving in contact with the paper roll. The web was passed between two cylinders, where a serrated blade severed it into sheets of desired length. This method of cutting the web was probably adopted from a patent issued in 1851 to Jacob Worms, of New York, who obtained it from a French patent of 1849, for the combination with the printing cylinders of cylinders provided with a sharp knife or saw, operated by a cam, for the purpose of severing the paper as it passed through the rollers.

The sheet used by the Philadelphia Inquirer was 25 inches in width and 40 inches in length, presenting pages 20 by 25 inches after folding. The sheet was carried by grippers to the first impression cylinder, where it was printed on one side from a curved stereo-

type plate, clamped on a form or plate cylinder. It was transferred to a second large impression cylinder, where the other side was printed in similar manner, and then carried to a delivery table by automatic nippers, placed on endless leather belts. Each plate cylinder was provided with a separate inking unit, in which the ink was transferred from a roller revolving in a fountain to a cylinder or drum. Composition rollers, in independent adjustable bearings distributed the ink on the drum, which was also given alternative lateral movement, and transferred it to the plate. The impression cylinders were covered with soft, spongy felt blankets, stretched over rubber blankets, to soften the impression and make up for imperfections in the surfaces of the stereotype plates. The second impression cylinder, which was of large diameter to provide additional tympan surface, was in addition covered with a muslin sheet, or offset tympan, to absorb surplus ink offset by the first side printed. In these items the Bullock press contained the principles of the modern newspaper press, but two serious defects existed. It did not deliver neatly and the papers required folding by hand, while severing the web before printing necessitated passing single sheets through the press. The output of the machine, which required three attendants for operation, was 10,000 copies per hour, printed on both sides. Double machines were built later which printed and cut two copies each delivery, producing 30,000 impressions per hour.

Experiments by Bullock were stopped in 1867 by a serious accident while laboring on one of his presses in Philadelphia, which resulted in his death nine days afterward. Attempts were later made to overcome the defects by adding a fly delivery and a folder, as well as a modification, known as Kellberg's arrangement, by which the sheet was cut after printing, patented by John W. Kellberg, of Philadelphia, Pa., in 1870. Another single and a double machine were installed by the Philadelphia Inquirer. Bullock presses were used by many large newspapers, such as the New York Sun, which had seven, the New York Tribune, and the New York Herald, and also by the Daily Telegraph and the Journal in London, England.

PAPER FOR WEB PRESSES

Newsprint, as the particular kind of blank paper was termed, had up to this time been cut into sheets of the standard sizes when it left the paper-making machine. On the introduction of the roll-fed press and as a result thereof it also appeared in a continuous web, wound in roll form on a hollow core, which permitted it to be fastened on a shaft or spindle. Dampening of paper had also passed to the machine stage. In 1854 patents were issued to William and Andrew Overend, of Philadelphia, Pa., for a wetting machine for flat paper, in which the sheets were passed between felt-covered rollers, one of which revolved in a trough of water. A machine on similar lines but adapted to a continuous web was patented by A. Dougherty, of New York, in 1861. The web was rewound after dampening, and the machine was provided with a wooden brake, resting on the dry roll, to provide uniform friction. Other wetting machines distributed a fine spray of water on the web.

WALTER ROTARY WEB PRESS

Experiments conducted by the London Times resulted in the construction of a rotary perfecting press by J. C. MacDonald in 1868. It was named the Walter press, after the publisher of the Times. It was similar in principle to the Bullock press but was provided with impression cylinders of equal diameter, arranged with the plate cylinders in a vertical line, one above the other. The web was severed after printing. The sheets were carried by tapes up an incline and down to a sheet flier, which distributed them alternately to two boys, seated at opposite sides of the flier. It was also provided with dampening cylinders, containing sponges filled with water, later replaced by perforated hollow cylinders, supplied with steam. According to Ringwalt,[1] a circular issued by the manufacturer stated that the press was capable of producing 12,000 copies per hour, printed on both sides, or 10,000 to 11,000 per hour, including stoppages.

> When changing from one reel to another the arrangements are such that the delay scarcely exceeds a minute, and the reels are kept as large as possible for convenient handling. The labor employed when the Walter press is in operation consists of two lads taking off, who suffice to inspect and count each sheet, and a striker to start the machine and look after the reels as they are unwound. One overseer can easily superintend two presses—capable of turning out, with six unskilled hands, perfected sheets at the rate of 20,000 to 22,000 per hour, stoppages included. With four of these presses—12 lads and 2 overseers—the Times is now printed at the rate of 40,000 copies per hour—i. e., in less than half the time and with one-fifth the number of hands required by the fastest and best printing machines previously in use. Moreover, layers-on, who are highly trained workmen, and must be paid accordingly, are entirely dispensed with.

The four Walter presses which were installed in the Times office in 1868, displaced the Hoe type-revolving machines there, which some time previously had been converted to carry stereotype plates. In 1885 folding mechanisms were attached to the Times presses, which were used by that publication until 1895. The Walter press was also used by the London Daily News, among others in England, and by the New York Times in the United States.

MARINONI ROTARY PRESS

In 1868, to cope with the growing circulation of Le Petit Journal in Paris, France, Hippolyte Marinoni, of that city, also utilized the idea of impression and plate cylinders of equal size, placed above each other, in a press. It was provided with separate flyboards for delivery of the sheets and rivaled the fast Bullock and Walter presses in speed but differed essentially from them in being fed by sheets instead of from a roll. It was claimed by the Echo, of London, where a couple of Marinoni presses were installed in 1872, to produce an average of 9,000 sheets of large size per hour, printed on both sides.

HANDICAPS TO PRODUCTION ON ROTARY PRESSES

Even these machines working at top speed, failed to satisfy the demand created by the constant increase in circulation of the newspapers. According to the American Newspaper Directory for 1871, published by George P. Rowell & Co. of New York, there existed at that time in the United States 548 newspapers printing over 5,000 copies per issue, and 11 printing more than 10,000 copies per issue. Supplying the paper to the presses in sheet form had been dispensed

[1] Ringwalt, J. Luther: American Encyclopedia of Printing, Philadelphia, 1871.

with in the Bullock and the Walter presses. Considerable trouble was, however, experienced with the paper, as newsprint was only about 0.003 of an inch in thickness, and was subject to a great deal more strain in web form than in sheet form. Frequent breaks of the web delayed production, and the condition was further aggravated by the lack of suitable ink.

Another factor which greatly retarded the speed of production was the folding of the paper after the actual printing had been done. In many cases this was still performed by hand, though mechanical folding in the larger establishments was accomplished on separate folding machines, but these were fed by hand, which limited the individual capacity. The sheet was carried by tapes under a chopping blade, which forced it between two folding rollers, giving it the first fold, and then carried in similar manner at a right angle under another chopping blade, where the second fold was given. The most common for newspaper work was the Chambers' newspaper folding machine, invented by Cyrus Chambers, jr., who with his brother established the firm of Chambers, Bro. & Co., in Philadelphia, Pa., in 1856, manufacturing folders for book and job work as well, and by 1870 had turned out 38 varieties. Another was the Forsaith newspaper folding machine, patented and manufactured by S. C. Forsaith, of Manchester, N. H., built in different styles and said to be capable of folding 2,500 to 3,500 sheets per hour. The independent folding machines were used to advantage in smaller establishments, in connection with cylinder printing, where the production was large enough to warrant the use of such a machine, and are at the present time still found in places of that kind. Chopping-blade folders were later attached to the rotary presses, but as they could not be worked faster than 8,000 an hour, it was necessary to slow down the presses to accommodate the folders.

These difficulties were finally eliminated by other manufacturers of rotary web presses, as used at the present time. The details of modern presswork on newspapers are described in chapter 9. (See p. 134.)

STEREOTYPING

INVENTION OF PROCESS

FOR MANY years after the introduction of movable type all printing was done directly from them, as is still the practice in much of the commercial printing and in the production of small newspapers. About the beginning of the eighteenth century attempts were made in Holland to produce solid printing plates by soldering the bottoms of type together in a form, but the method was not generally used as it destroyed the availability of the type for further composition. In 1727 William Gedd, a goldsmith of Edinburgh, Scotland, introduced the casting of duplicate printing plates in plaster of Paris molds, taken from the type forms, but through opposition of the printers the idea was abandoned until again brought out, in an improved form, by Andrew Foulis and Alexander Tilloch, printers, who secured English patents in 1784.

A French printer, Gabriel Valleyre, who had also been trying to produce solid plates, invented a similar method of making molds and casting plates in 1730, using a stiff moist clay for the molding medium. The plaster of Paris method was later perfected in England for shop work by Charles, third Earl of Stanhope, assisted by Foulis and Til-

loch, who together with a printer, Andreas Wilson, established the first foundry in 1803. Stereotype foundries were also established in France about the same time, but they used various different methods.

INTRODUCTION INTO THE UNITED STATES

David Bruce, sr., a Scotchman, who with his brother had established the firm of D. & G. Bruce, printers, in New York, realized in 1811 the importance of stereotyping, as the process had been named by a French printer and typefounder, Firmin Didot, from the Greek words "stereos" and "typos", meaning, respectively, firm, hard, or solid, and type or letter. He went to England to study it, but at that time stereotyping, like type founding and many other trades, was essentially a secret trade, and no information could be obtained from Earl Stanhope. He managed, however, to secure some practical ideas from a Scotch workman, and returned home to carry them out. About this time the firm began type founding and gave up the printing business, later abandoning stereotype work, also. Credit for producing the first stereotype plates in America seemingly belongs to John Watts, an Englishman, who established the printing firm of J. Watts & Co. in New York in 1809, as he printed a book from plates in June, 1813, while the first book from plates turned out by the Bruce foundry did not appear until 1814.

PLASTER METHOD

The plaster method was slow, and only one cast could be made from each mold, as this was destroyed in removal. One or more pages were locked in a chase. The surface of the type was oiled and covered with semiliquified plaster of Paris, mixed with a little fine salt. When partly dry, but still soft, the composition was pressed down carefully and rolled smooth on top. After standing about 15 minutes the mold was set sufficiently to permit removal and it was placed in an oven, where it was baked for three or four hours until all moisture had been evaporated.

It was later discovered that by suspending the mold directly over the metal pot, or floating it on the surface of the molten metal, it could be dried in approximately one-half hour. Several of the plaster casts were placed, side by side and face downwards, in a special casting pan, about 2 inches deep, and a lid fastened over the backs of the molds. The pan was put in the kettle of molten metal for about 10 minutes, or until filled, the metal running into the pan at the sides and corners. Casting pans were subsequently replaced by casting boxes, open at one end, in which the molds were placed and the metal was poured with a ladle. These boxes permitted adjustment for the required thickness of the cast. The metal consisted mostly of lead, with various alloys for hardening. The casting pan was placed in the cooling trough for about 20 minutes, after which the mold was removed and the surplus metal cut off. The face of the cast was cleaned and inspected for defective letters or parts. If any existed, they were cut out and replaced by perfect ones, soldered in. The sides of the plate were trimmed and the back cut down to the required thickness. English stereotypers leveled their plates by holding the backs against a revolving disk, provided with knives. A notable improvement was made by David Bruce, sr., by the invention of a plate-shaving machine, which insured a uniform thickness for the entire plate.

The desirability of duplicate printing forms in a single piece created a demand, and by 1850 more than 50 firms in the United States, employing more than 1,000 men, were engaged in the production of stereotypes. In some of these establishments the clay method was used. The plaster method is still employed, in an improved form, for the production of plates consisting of an aluminum alloy, used in commercial printing.

PAPIER-MÂCHÉ METHOD

Many experiments were made to produce curved plates, capable of being clamped on a cylinder. In 1816, English patents for such a process were granted to Edward Cowper, a machinist, who made the first curved printing plates. These were cast flat, by the plaster process, and curved afterwards to fit the printing cylinders, and were used for printing the bank notes of the English Government. The method was not adaptable to newspaper work, as the destruction of the mold in removal from the cast necessitated a new mold for each plate.

A papier-mâché matrix, consisting of several sheets united by a paste and capable of standing a high temperature without burning, was invented and patented by Jean Baptiste Genoux, a printer of Lyon, France, in 1829. The patent rights were sold to several individuals in France and Germany, but the possibilities were neglected for many years. In 1846 Tetin, a master printer, established a stereotype foundry in Paris, using the method, which he improved greatly, and applying it successfully to book work. In 1852 it was adopted by the daily newspaper La Presse, in Paris. It was introduced to the stereotype trade in the United States by Charles Craske, a steel and copperplate engraver of New York, in 1850. He cast the first curved plate for a Hoe rotary press in the plant of the New York Herald in 1854, but the experiment did not prove successful and the process was not adopted permanently at that time. Further experiments solved the problems, and in 1861 Craske made contracts to stereotype the regular editions of the Tribune, Times, Sun, and Herald, which were satisfactorily carried out.

Experiments had also been conducted by James Dellagana, an Italian printer who had learned the method in France, for the London Times, where papier-mâché molding was adopted in 1860. The first plates were cast type high in single-column strips, which were locked in turtles on the type cylinders. In 1859 full pages were cast in curved form for the type-revolving presses then in use, but semicylindrical plates were not perfected there until 1863.

The method was rapidly adopted by all larger newspapers. The flexible paper matrix could be inserted in a curved casting receptacle, and a cast could be produced in semicylindrical form of any diameter desired. The matrix was tough and could be stripped from the cast without injury, to be used over again. Consequently it was possible to obtain several curved replicas of each type form, enabling the newspapers to operate several presses at the same time, as well as at a higher speed than when printing from type.

Manufacturing of stereotype printing plates added a third distinctive operation, stereotyping, to the two already existing for the mechanical production of newspapers. The details of modern stereotyping for newspapers are described in chapter 7. (See p. 90.)

CHAPTER 13.—DEVELOPMENT OF THE NEWSPAPER INDUSTRY

EARLY NEWSPAPERS

ANCIENT NEWS BULLETINS

DISTRIBUTION of news was practiced in ancient Rome as far back as 691 B. C., through bulletins. One of these, Acta Diurna, or Daily Events, contained short announcements of official information on battles, trials, punishments, deaths, and sacrifices. Another, Acta Senatus, containing accounts of various matters brought before the senate, decisions, and opinions, was issued regularly by command of Julius Caesar. Still another, Acta Publica, which contained a register of births and deaths in the city of Rome, financial reports of the treasury, doings of the imperial family, and some details of public affairs, was published daily by authority of the Government during the latter days of the republic and under the empire. These bulletins, however, were all written by scribes, and publication consisted in posting them in the forum or other public places, together with sending some copies to the Provinces.

PRINTED NEWSPAPERS

The first printed newspaper was probably the Peking (China) Gazette, according to some authorities first issued about 1340 A. D. Toward the close of the fifteenth century small sheets in epistolary form were printed in several towns of continental Europe.

In 1566 the Venetian Government issued a newspaper, Notizi Scritte, which might be read on payment of a small coin, gazetta, and from this fact, it is claimed, originated the term "Gazette," later used for the majority of early American newspapers. During the seventeenth century the newspaper, in the modern application of the term, made its appearance in Europe as a regular weekly periodical and not just a paper containing news. Among the earliest were the Frankfurter Journal in Germany, started in 1615, and the Nieuwe Tijdinge of Antwerp, Belgium, known to have been issued in 1616, possibly earlier. The first weekly English newspaper with a definite title was the Weekly Newes, started in 1622. Daily newspapers were not introduced until many years afterwards, the first regular London daily, the Daily Courant, appearing in 1702. A previous venture by the Post Boy to publish daily numbers, in 1680, was abandoned after four issues. All early papers were small, about 7 by 9 inches, and usually of four pages. After 1650 a larger size, 13½ by 17 inches, became common, but the limitations of the presses did not permit printing two pages of that size at one time.

EARLY AMERICAN NEWSPAPERS

According to the autobiography of Benjamin Franklin, the first newspaper published in the United States was the Boston News-Letter, which appeared in Boston, Mass., April 24, 1704. This was followed by others in several of the principal towns during the

colonial period, and m April, 1775, the number published had reached 37. While the News-Letter was the first continued publication, another newspaper had been issued previously in Boston. Publick Occurrences, both Foreign and Domestic, as this was named, was issued on September 25, 1690, but, as with a previous attempt, it was suppressed by the Government after the first issue. It was intended to be issued monthly and was printed on three pages of a folded sheet, each 11½ by 7½ inches, with two columns to the page, leaving the fourth page blank so that personal messages could be written on it. The News-Letter was sometimes printed on a single sheet, foolscap size, but oftener on a half sheet, folio, 7 by 11½ inches, with two columns on each page. It was announced in the first issue as a weekly publication. In 1719 it was changed to a whole sheet as "half a sheet a week would not carry all the news."

The early newspapers varied greatly in size and shape, on account of the scarcity of news and, especially, the scarcity of paper. The slow methods of production naturally prevented expansion, but during the Revolutionary period the editions on some of the papers became so large that the men who pulled the levers on the presses complained of backaches. The growth of the towns created a demand for advertising space, which changed the weekly issues, first to semiweekly, next to triweekly, and finally to regular daily publications, Sundays excepted. In 1729 Benjamin Franklin attempted semiweekly publication of the Pennsylvania Gazette, which was imitated by the Boston Chronicle in 1768 and gradually adopted by others. In 1770 Isaiah Thomas published the Massachusetts Spy triweekly, an example also followed by others later.

The first American daily newspaper, the Pennsylvania Packet and Daily Advertiser, was published in Philadelphia, Pa., September 21, 1784. It was a 4-page sheet, four columns to the page. Other dailies were gradually established in the larger cities. In the beginning these were all evening publications, but in 1796 the New World in Philadelphia, Pa., printed two editions, from two forms on the same sheet. These were divided, and one issued as an evening publication and the other as a morning publication. Separate morning publications appeared subsequently. By the year 1810 the number of newspapers published in the United States had increased to 359. In 1825 the first Sunday newspaper was published, the New York Courier. It was a regular Sunday newspaper, issued on that day of the week only, and not a Sunday edition of a daily publication, such as is common at the present time.

MODERN NEWSPAPER PUBLISHING

CHANGES IN PRODUCTION METHODS

ALL of the radical changes which contributed to the development of printing since the invention of movable type, and made possible the enormous output of the modern newspaper plant, have taken place since the year 1800. These were mostly mechanical. The invention of the paper machine resulted in the manufacture of an abundant supply of cheaper paper. The development of the printing press, first as a cylinder press and later as a rotary press, permitted faster production and more pages per issue. The improvement of

presses was greatly aided by the substitution of pliable rollers for distributing and applying the ink, in place of the inking balls; the change from hand power for operating the machines to steam power, and later to electric power; the application of stereotyping, producing curved printing plates and eliminating direct printing from type, with subsequent automatic production of the plates; and last, but not least, the invention of typesetting and typecasting machines, which increased the productive power of the composing room fivefold and cheapened the cost of composition.

The many improvements in mechanical facilities, combined with the increase in advertising, the public demand for news, and the continued requirement for speed, have evolved the present newspaper. There has been considerable change in the size of pages, which now are customarily about 18 inches in width but vary from 21½ to 24 inches in length. The increase in number of pages contained in a single issue has been tremendous, and it is no longer unusual to see a week-day newspaper consisting of over 50 pages, or a Sunday paper containing more than 100 pages. The Sunday paper had attracted but scant attention before the Civil War, but during that period it commenced to gain importance through the desire for news. It was at first the same size as the regular daily issue, but additional features of partial news value were added to it and it was gradually enlarged from time to time. The somewhat cumbersome size of the ordinary newspaper page was responsible for the introduction of a later innovation, the tabloid size, in which the pages are only half as large. The first of these published in the United States was the Daily News, which appeared in New York on June 26, 1919.

The revolutionary changes in equipment for newspaper printing, which created facilities for expansion of the industry, did not become effective at once in all establishments. New methods were ordinarily adopted first in the larger establishments, gradually spreading to others. Even at the present day some of the changes brought into use many years ago are just being made in some establishments, and plants still exist where newspapers are being turned out in a comparatively primitive fashion. Consequently, the mechanical production of newspapers may be found in a variety of stages throughout the country, depending principally on the period of issue, the bulk of the publication, and its circulation.

In spite of the many time-reducing factors there is still a demand for more speed, and the paramount issue in newspaper production continues to be a question of the shortest possible interval between the time when the latest news is received and the time of its distribution. It is often not only a question of minutes but of seconds, especially in the larger cities, where competition is keen.

PHOTO-ENGRAVING

Aside from the three important mechanical processes—composition, stereotyping, and presswork—which have been studied, there are several others which have contributed greatly to the development of the modern newspaper. Photo-engraving, the process by which the numerous illustrations are reproduced, is now a common division of newspaper manufacturing. Some of the weekly papers in England published illustrations as early as 1832. The first illus-

trated newspaper in this country was Gleason's Pictorial, established in 1853 in Boston, Mass., but moved soon afterwards to New York, where it was published as the Illustrated News of New York for about a year. Several other weekly newspapers in this country had occasionally produced illustrations which were cut in wood and electrotyped by a primitive method which destroyed the wood blocks. The principle upon which photo-engraving is based was discovered in France about 1821, but it was not applied successfully to printing until more than 30 years later, when it was used in connection with lithography. This process, photo-lithography, was introduced into the United States in 1866, but the earliest adaptation to newspaper production was on the New York Daily Graphic, which appeared on March 4, 1873, and was for several years the only illustrated daily newspaper in the world.

The process was again revolutionized when, on March 4, 1880, the Graphic published the first half tone, now the practically universal style of illustration. A method was later developed which permitted printing of half tones on fast presses using stereotype plates. It is claimed this was first accomplished by the New York Tribune on February 12, 1879.

Photo-engraving has been an important factor in development of multicolor work, as used by many Sunday newspapers in their comic or magazine sections. Colored plates were printed in the London Illustrated News as far back as 1855, but they were woodcuts. Considerable advance was made in this field in England, France, and Germany, and as a result an attempt was made to install English color equipment by the Chicago Inter-Ocean in 1891. This was abandoned when it was found that it could not be done without infringing on American patents. Equipment was obtained from American manufacturers, and the first color supplement in the United States was produced in May, 1892. Photo-engraving has also made possible the production of other Sunday sections, manufactured by the offset method or the rotogravure method. Some of the larger newspapers have installed equipment for such features in their plants. Others obtain the finished product from various establishments that specialize in work for the trade.

Offset printing is an adaptation of the methods previously used for lithographic printing (invented in 1800 in Bavaria), combined with photo-engraving and rotary presswork. The printing plate, which carries the design on a chemically prepared surface, does not come in contact with the paper, but deposits the ink on an intervening rubber-covered cylinder, from which it is set off, or transferred, to the paper. The surfaces of the plate surrounding the design are of the same height as the design, but repel the greasy ink when moistened by water. The possibilities of the combination were discovered in the United States during 1903. After some development it was used considerably for illustrations, first by periodicals and later also by newspapers.

Rotogravure printing is a combination of photo-engraved intaglio plates and rotary presswork. The design is etched, or engraved, below the surface of the plate, which consists of a copper-faced cylinder. The cylinder revolves through an ink fountain, filling the depressions with ink, which is deposited on the paper. The fundamental process is old and had been applied as early as 1900 in the United States for the printing of railroad tickets. Improved methods

were discovered in 1903 in Austria, and during 1905 the first practical newspaper gravure outfit was perfected in Germany. An outfit was imported by the National Cash Register Co., Dayton, Ohio, in 1910, but rotogravure printing was first introduced in regular newspaper manufacturing during 1912 by the New York Sun and the Cleveland Leader. In the beginning all products by this method were printed in monotone, but during recent years great progress has been made in 4-color rotogravure work.

ELECTROTYPING

Competition in attractive Sunday magazine sections was responsible for adding electrotyping departments to some of the newspaper plants. Electrotyping is the application of electroplating to the printing process, the possibility of which was discovered in England in 1837. It consists in making one, or more, facsimile printing plates from an original by making an impression of the original in a plastic substance, depositing a thin copper or nickel shell in this mold, backing it with a semihard metal and trimming it to desired sizes. Experiments were also made in this country during 1839, resulting in practical production of electrotypes in 1841. It was, however, not employed successfully until 1846, when the first commercial electrotyping plant in the United States was established in Boston, Mass. It was used extensively for newspaper advertising plates, produced commercially, and for production of printing plates in book or magazine work. Electrotyping departments were installed in newspaper plants to procure plates with better printing surface than ordinarily provided in stereotyping, or which would not be corroded by color ink.

DISTRIBUTION

Preparatory work for the distribution of newspapers, as performed by the mailing department, is a very important item in production. It has also been modernized by development of automatic wrapping and addressing devices, installation of conveyors, and other improvements to facilitate rapid delivery of the finished product.

NUMBER OF NEWSPAPERS PUBLISHED AND COPIES PRINTED

ALL CLASSES, FROM 1720 TO 1925

The newspaper branch of the printing industry has experienced a tremendous growth. According to the seventh census of the United States, in 1850,[1] only seven newspapers existed in the American Colonies in 1720. During the 71 years between 1704, when the first continued newspaper was established, and 1775, when the Revolutionary War commenced, 78 different newspapers had been printed in the British-American Colonies, but only 37 of these were in existence in the latter year. In 1810 the number of newspapers had increased to 366, in 1828 to 863, and in 1850 to 2,302. The returns for the Fourteenth Census show that in 1919 the newspapers published in the United States totaled 15,735 in number, an increase over 1850 of 583.5 per cent. In addition to the numerical increase of individual papers, the growth in the number of issues for these should also be considered. In the

[1] U. S. Bureau of the Census: Statistical View of the United States, being a Compendium of the Seventh Census, Washington, 1854.

early days the newspapers were published weekly, gradually changing to semiweekly, triweekly, and daily, the latter meaning six or seven issues per week.

The expansion in volume was also an important factor in growth. While the newspaper of a hundred years ago consisted of only 4 pages, the number of pages in the present-day newspaper is often 10 or 15 times that on week days and over 25 times that on Sundays. Circulation has also advanced by leaps and bounds. The Boston News-Letter was stated to have had a circulation of 300 copies per issue. Before 1810 the circulation of the most widely read daily newspaper did not exceed 900 copies per issue, and there were few weekly or semiweekly newspapers with a circulation of above 600 copies per issue. In 1920, it was estimated, one copy of a daily newspaper was being published each day for every fourth inhabitant, including children, in the United States.

A compilation was made of figures presented in the Compendium of the Seventh Census for the number of newspapers published during selected years, with their circulation, and later figures from subsequent census reports were added to show the development of newspaper publication; population figures from the same source were also included. The data are presented in Table 137:

TABLE 136.—*Development of newspaper publishing, and population, in the United States, 1720 to 1925*

[From Compendium of Seventh Census and subsequent reports of the Bureau of the Census]

Year	Daily papers						Triweekly		Semiweekly	
	Morning		Evening		Total					
	Number	Aggregate circulation per issue	Number	Aggregate circulation per issue	Number	Aggregate circulation per issue	Number	Aggregate circulation per issue	Number	Aggregate circulation per issue
1720										
1775										
1810					27		15		37	
1828										
1840					138				[1] 125	
1850					254	758, 454	[2] 115	75, 712	31	53, 511
1860					387	1, 478, 435	86	107, 170	79	175, 165
1870					574	2, 601, 547	107	155, 105	115	247, 197
1880	438		533		971	3, 566, 395	73	68, 086	133	264, 910
1889	559		1, 051		[3] 1, 610	8, 387, 188	34	50, 067	194	561, 743
1899	595		1, 631		2, 226	[3] 15, 102, 156	62	228, 610	637	2, 832, 868
1909	760	9, 605, 694	1, 840	14, 606, 283	2, 600	24, 211, 977	73	335, 389	635	2, 312, 919
1919	720	12, 582, 841	1, 721	20, 445, 789	2, 441	33, 028, 630	93	492, 286	452	2, 020, 165
1925	504	14, 284, 198	1, 612	23, 122, 417	2, 116	37, 406, 615			[1] 430	1, 703, 372

[1] Includes triweekly papers.
[2] Includes some semiweekly papers.
[3] Includes Sunday issues of dailies.

TABLE 136.—*Development of newspaper publishing, and population, in the United States, 1720 to 1925*—Continued

Year	Weekly papers		Sunday papers		Grand total		Population
	Number	Aggregate circulation per issue	Number	Aggregate circulation per issue	Number	Aggregate circulation per issue	
1720	7				7		[4] 750,000
1775					37	[4] 23,000	[4] 3,490,740
1810	283				[5] 366	[6] 24,557,400	7,239,881
1828					863	[6] 68,117,798	[7] 12,866,020
1840	1,141				1,404	[6] 195,838,673	17,069,453
1850	1,902	2,944,629			2,302	3,832,306	23,191,876
1860	3,173	7,581,930			3,725	9,342,700	31,443,321
1870	4,295	10,594,643			5,091	13,598,492	38,558,371
1880	8,633	16,266,830	252		9,810	20,166,221	50,155,783
1889	[8] 10,814	28,954,515			12,658	37,953,513	62,947,714
1899	12,979	[1] 39,852,052	567		15,904	58,015,686	75,994,575
1909	13,903	20,946,335	520	13,347,282	17,731	61,153,912	91,972,266
1919	12,145	20,740,551	604	19,368,913	15,735	75,650,545	105,710,620
1925	6,435	15,989,700	597	25,630,056	9,869	80,704,948	[4] 115,378,094

[1] Includes triweekly papers.
[4] Estimated.
[5] Includes 3 publications, the classification of which is unknown.
[6] Aggregate annual circulation.
[7] For 1830.
[8] Includes exclusively Sunday issues.

The first Government census of newspapers was taken in 1850, and previous figures given in the census reports were credited to other sources. Division of the daily newspapers into morning and evening issues was not made until the 1880 census, when the number in each class was given, and circulation figures were not included until the 1909 census. In censuses previous to 1909 the Sunday newspapers were not listed separately in the reports, but were treated as editions of dailies if they were published by the daily newspapers, or as regular weekly newspapers if they were issued by concerns that published no other newspapers. At the census of 1909 all Sunday newspapers were tabulated separately. No account has been taken of biweekly, semimonthly, monthly, or quarterly publications which might possibly be classed as newspapers instead of periodicals. Some of the triweekly, semiweekly, or weekly publications shown in tabulations before 1909 might have belonged in the periodical class, as newspapers and periodicals were not strictly separated before that census. Exact population figures were not available until after the first census of the United States in 1890, so population for earlier periods were based on seemingly conservative estimates.

According to preliminary figures published for the 1925 census of manufactures, 235 years after the issue of the first newspaper in this country, the number of newspapers published in the United States, including the Territories, were: Morning, 504, with daily circulation of 14,284,198; evening, 1,612, with daily circulation of 23,122,417; Sunday, 597, with weekly circulation of 25,630,056; triweekly and semiweekly, 430, with circulation per issue of 1,703,372; weekly, 6,435, with weekly circulation of 15,989,700. The population of the country was estimated for the same year at 115,378,094. This meant that one copy of a daily newspaper was published for every three inhabitants of the country, one copy of a Sunday newspaper for every four inhabitants, and one copy of a weekly newspaper for every seven inhabitants. In 1850 only one copy of a daily newspaper was pub-

lished for every 30 inhabitants, while the weekly newspaper, at that time the most popular form, was published at the same ratio as at present—one copy for every seven inhabitants. During the course of years the number of newspaper copies published has advanced in much the same proportion as the population.

DAILY NEWSPAPERS, 1889 TO 1925

The main progress was due to the development of the daily newspaper, which, as it was published six times per week, turned out the largest portion of the products. While the number of daily newspaper publications was smaller in 1925 than in 1909, it was still considerably above the 1889 figures of 1,610 papers—559 morning newspapers and 1,051 evening newspapers. By 1925 the morning publications totaled 504, a reduction of 10 per cent, but the evening publications had risen to 1,612, an increase of over 50 per cent, making a total increase for the daily newspapers of over 30 per cent. The aggregate circulation per issue had advanced over 330 per cent, to more than 37,000,000 copies, or one daily newspaper for each three inhabitants of the country, children included. In addition, the average number of pages per issue had increased approximately 200 per cent, while the average page size had been enlarged about 10 per cent. Therefore, around 1,250 per cent more pages of daily newspapers were printed in 1925 than in 1889, and each page contained about 10 per cent more type than in the early period.

WEEKLY NEWSPAPERS, 1889 TO 1925

In 1889 the weekly newspapers consisted of about 10,000 publications. These had increased to nearly 14,000 by 1909, but had been reduced to less than 6,500 by 1925. The aggregate circulation per issue had dropped from 29,000,000 copies to 16,000,000 copies. Figures for the weekly newspapers in 1889, however, included Sunday newspapers published independent of the dailies, just as the figures for the daily newspapers of that year included Sunday issues connected with them. The Sunday newspaper had become a very important factor by 1925, and was listed separately. While it consisted of less than 600 publications, the aggregate circulation per issue was over 25,600,000 copies—practically one for each family in the United States—and the estimated average number of pages per issue was about 60. These items, if included, would increase the figures for the weekly newspapers considerably.

EFFECT OF IMPROVED METHODS ON EMPLOYMENT

EXPANSION OF INDUSTRY

IN most industries the result of the evolution from hand methods to machine methods and subsequent improvements in the machines or methods, has been the permanent displacement of workers. One of the notable exceptions is newspaper manufacturing, where the facilities afforded through such changes not only increased the man-hour output but also expanded the industry and stimulated the mechanical processes, so that the number of workers were increased instead of diminished. The old hand methods were entirely inadequate, and without the labor-saving and time-saving machines used in modern newspaper plants it would have been physically impossible to produce the mammoth newspapers of the present day.

Introduction of some machines or changes in methods did result in temporary elimination of part of the workers, but the growth of the industry soon balanced the reduction. New publications appeared and the existing ones experienced a rapid increase both in circulation and in bulk of the newspapers published. Idle workers were absorbed and a demand was created for labor in new channels, often at higher wage rates. Consequently the wage earners were, on the whole, benefited by the improvements in manufacturing methods, both in employment and in higher wages.

SUSPENSIONS AND CONSOLIDATIONS

Some temporary setbacks occurred later, such as conditions during and after the World War, which made it difficult for small publications to continue in business and caused a drop in the number of newspapers, especially among the country weeklies. It did not, however, affect the number of workers in the industry greatly, nor lessen the value of the total products. These were influenced more by the suspension of several large daily newspapers or consolidations of some of these with their stronger competitors, a rather common occurrence during recent years. According to the figures of the United States census, approximately 500 daily newspapers had been suspended or consolidated with others between 1919 and 1925.

INCREASES IN CIRCULATION AND BULK

The increases in circulation and bulk, only possible through the improvements in manufacturing methods, affected mainly the daily newspapers, especially in the larger cities. They were principally the result of changes in general business methods of the country, which have made practically the entire commercial life of the Nation dependent on the information spread by the daily press. The rising circulation and the increased number of pages both called for additional labor, almost equalizing the number displaced through suspensions and consolidations. This was illustrated by a statement from one establishment, that 26,000 copies of 4-page 6-column newspapers were turned out by it daily in 1852, with 40 compositors and a handful of pressmen, flyboys, and other labor. In 1926, the average daily production had reached over 390,000 newspapers, and the average bulk of a single issue had grown to more than 62 eight-column pages, including in both items the Sunday issues. This had necessitated a mechanical working force of about 1,700 hands, including 325 compositors.

EMPLOYMENT IN NEWSPAPER AND PERIODICAL PUBLISHING, 1889 TO 1925

NUMBER OF WORKERS AND THEIR EARNINGS

INFORMATION published by the United States Bureau of the Census does not show separate figures for the number of workers engaged in the mechanical production of newspapers alone, but combines them with those for similar workers on periodicals. Periodicals are produced in somewhat similar manner, but the majority of them are issued weekly, while the majority of the newspaper copies printed are dailies. Figures from census reports, covering production of newspapers and periodicals in specified years from 1889 to 1925, are presented in Table 137, which include the number of publications, the aggregate circulation per issue, the value of the products, the number of workers employed, and the earnings of the workers.

TABLE 137.—*Development of newspaper and periodical publishing in the United States, 1889 to 1925, by specified years*

Year or period	Number of publications	Aggregate circulation per issue	Value of products	Number of workers		Earnings of—	
				All workers	Wage earners	All workers	Wage earners
1889	14,901	68,147,619	$179,859,750	106,095	85,975	$68,601,532	$50,824,359
1914	22,754	205,594,907	495,905,948	212,000	114,375	179,580,971	88,561,248
1919	20,489	222,481,983	924,152,878	228,630	120,381	288,198,701	144,348,173
1923 [1]	13,077	231,642,614	1,268,501,566	238,548	115,646	414,151,142	196,804,325
1925	14,065	259,986,457	1,447,661,177	247,758	117,001	463,239,727	217,540,967
	Per cent of increase						
1889 to 1914	52.7	201.7	175.7	99.8	33.0	161.8	72.4
1914 to 1919	[2] 10.0	8.2	86.4	7.8	5.3	60.5	63.0
1919 to 1923	[2] 36.2	4.1	37.3	4.3	[2] 3.9	43.7	36.5
1923 to 1925	7.6	12.2	14.1	3.9	1.2	11.9	10.5
1899 to 1925	[2] 5.6	281.3	704.9	133.5	36.0	575.3	328.0

[1] Establishments with yearly production under $5,000 not included.
[2] Decrease.

PRODUCTION AND WORKERS IN 1889

Enormous changes have taken place in newspaper and periodical publishing since the establishment of the United States. At that time only 37 newspapers existed, mostly weekly publications, with an estimated aggregate circulation of 23,000 copies per issue, and they required only a few workers. By 1889, production had emerged from the infant stage. It had become an important factory process, turning out nearly 15,000 different newspapers and periodicals, with an aggregate circulation of more than 68,000,000 copies per issue. Among these were 559 morning and 1,051 evening newspapers, including Sunday editions of dailies, with an aggregate circulation of almost 8,400,000 copies per issue, and also nearly 11,000 weekly newspapers, with an aggregate circulation of close to 29,000,000 copies per issue. As a result more than 23,000 issues were published weekly, or about six hundred and twenty-five times the number published in 1775. A greater number of copies were also produced per issue, so that the aggregate circulation per issue had increased three thousand times. In addition, the issues contained more, as well as larger, pages. The early newspapers consisted of four pages, each smaller than 8 by 10 inches in size, while the average newspaper of 1889 was about 12 pages, each four times as large as the page of 1775. The few workers required in the early period had risen to more than 100,000, over 80 per cent of whom were engaged in the mechanical production.

PRODUCTION AND WORKERS IN 1914

Continuous growth was experienced in all phases between 1889, when the influence of the linotype became felt, up to 1914. During these 25 years the number of newspapers and periodicals had increased more than 50 per cent, bringing the total number of publications up to nearly 23,000, and the value of the products over 175 per cent, while the aggregate circulation per issue had advanced over 200 per cent and passed the 200,000,000 mark. As a result the total number of workers engaged in the industry had increased nearly 100 per cent, but on account of improvements in machinery and methods the

number of wage earners, or workers in the mechanical production, increased only 33 per cent, though aggregating nearly 115,000 in 1914 and constituting about 54 per cent of the total personnel. The earnings of all the workers increased over 160 per cent, though those of the workers in the mechanical production advanced less than 75 per cent.

PRODUCTION AND WORKERS IN 1919

During the following five years the effect of the war caused a 10 per cent reduction in the number of publications, but this was balanced by an increase in average circulation per issue for the remaining ones. Value of the products advanced over 85 per cent during the five years, and the total number of workers increased nearly 8 per cent. The increase for the workers in the mechanical production was 2½ per cent less, but still continuing. Earnings of both total workers and mechanical-production workers rose more than 60 per cent.

PRODUCTION AND WORKERS IN 1923

By 1923 a larger reduction had taken place in the number of publications, and a small decrease had been made in the mechanical-production workers, though there was still employed a larger number than in 1914. Both circulation per issue and the total number of workers had risen about 4 per cent over the 1919 figures. Earnings had also increased, over 40 per cent for all workers and less than 40 per cent for the mechanical-production workers.

Suspensions, especially of weekly editions of the daily newspapers and of small country weeklies, together with consolidations, caused a drop of over 9,500 publications since 1914, a decrease of over 40 per cent. The aggregate circulation per issue had meantime advanced nearly 13 per cent and the total number of workers in the industry had increased a similar amount. The wage earners, who had passed the 120,000 mark in 1919 but subsequently experienced a reduction, increased only a little over 1 per cent during the period, though still advancing. Earnings had increased 130 per cent for the total workers and over 120 per cent for mechanical-production workers.

PRODUCTION AND WORKERS IN 1925

Between 1923 and 1925 a steady rise took place for all of the items. The number of publications increased over 7 per cent, and the aggregate circulation per issue advanced more than 12 per cent. The total number of workers engaged in the industry increased nearly 4 per cent and the number of wage earners over 1 per cent. Consequently, in spite of the reduction in the number of publications since 1914, and the improvements in equipment or methods, the number of workers in the mechanical production of newspapers and periodicals advanced 2.3 per cent during the interval. The combined daily and Sunday newspapers, on which the majority of the workers are employed, have decreased constantly in number since 1909, but the growth in circulation and the increase in the number of pages have more than balanced the reduction.

Comparison of figures for 1925 with those for 1889 shows that, while the number of publications dropped more than 5 per cent during the interval, the aggregate circulation per issue increased over 280 per cent in the same period, the value of the products more than 700 per cent, the number of the total workers over 130 per cent, and the workers in the mechanical production 36 per cent. Earnings

of all workers in the industry advanced over 575 per cent, and earnings of wage earners, who were engaged in the mechanical production, increased more than 325 per cent.

RELATIVE VALUE OF PRODUCTS FOR NEWSPAPERS AND FOR PERIODICALS, 1889 TO 1925

WHILE separation can not be made of workers in newspaper publishing and workers in periodical publishing, approximate estimates thereof can be obtained by several methods, such as one based on the number of publications, on the aggregate circulation per issue, or on the value of the products. The latter seems the nearest accurate method, and to assist in possible estimates on such a basis Table 138 is given, showing the relative value of products for newspapers alone to products for the group of newspapers and periodicals, as reported by the United States Bureau of the Census. The table contains comparisons of subscriptions and sales, of advertising, and of total products, which include other minor items:

TABLE 138.—*Value of newspaper products compared with newspaper and periodical products, 1889 to 1925, by specified years*

Products	Value (000 omitted)						
	1889	1899	1909	1914	1919	1923	1925
Subscriptions and sales:							
Newspapers	(1)	(1)	$84,439	$99,542	$192,820	$222,560	$230,581
Periodicals	(1)	(1)	50,624	64,035	85,187	138,333	167,757
Total	$72,343	$79,928	135,063	163,577	278,006	360,893	398,338
Advertising:							
Newspapers	(1)	(1)	148,554	184,047	373,502	580,938	661,513
Periodicals	(1)	(1)	53,979	71,585	154,797	212,956	261,759
Total	95,861	145,518	202,533	255,633	528,299	793,893	923,273
Total products:							
Newspapers	143,586	175,790	232,993	283,589	566,321	803,497	892,094
Periodicals	36,273	47,194	74,097	212,317	357,831	465,004	555,567
Total	179,859	222,984	406,090	495,906	924,153	1,268,502	1,447,661
Per cent newspapers are of total:							
Subscriptions and sales			62.5	60.9	69.4	62.5	57.9
Advertising			73.3	72.0	70.7	73.2	71.6
Total products	79.8	78.8	57.4	57.2	61.3	63.3	61.6

[1] Not reported separately.

While the value of the total products for newspapers had dropped from 80 per cent of the value for combined newspapers and periodicals in 1889 to less than 60 per cent in 1909, it rose again to over 60 per cent and continued at that level. The value of subscriptions and sales for newspapers also hovered around the 60 per cent mark, though showing a wider fluctuation, in spite of the smaller value for the single copies of an issue than for single periodicals. Part of the increases in values of the products from one period to another was, of course, due to the general advance in prices for all commodities. The purchasing power of the dollar was reduced practically one-half between 1889 and 1925, measured in terms of wholesale prices of commodities, but this reduction affected only the totals and not the relations between the groups.