Labour Shifts in Continuous Industries in the United States

by

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Long hours of work in the United States are found chiefly in continuous processes. Particulars are given of the arrangement of shifts and hours in various industries which are wholly or partly on continuous processes. The methods of effecting the change from two to three shifts and its results on wages, efficiency, and costs are considered and the opinions of members of the industry are quoted. The iron and steel industry is one of the most important continuous-process industries in the United States. The two-shift system is still general, but the United States Steel Corporation is considering the question of changing to three shifts. In the other metal industries three shifts are the rule. Industries included in the ceramic group are at various stages of transition from 12-hour to 8-hour shifts. In the chemical industries shifts are usually 8 hours in length, except in sugar refining. The heavy equipment group, including paper, flour, rubber, breakfast foods, etc., and automobiles, work largely on three shifts, but practice is not uniform. The service industries, such as gas, water, transport, etc., are steadily moving in the direction of an 8-hour shift. The adoption of 8-hour shifts in the United States will not be uniform or simultaneous, but will come about as the members of each industry, supported by public opinion, become convinced of its desirability.

HOURS of labour in American industries are far from uniform. The organised labour movement has long stood for a day of 8 hours or less; and in the organised crafts, as well as among the unorganised workers in certain centres, a day of approximately 8 hours has been established. The Census of Manufactures for 1919 showed that 48.6 per cent. of the more than nine million wage earners in American manufacturing

industries were in plants where the prevailing hours of labour were 48 hours per week or less. In 1914 the proportion was only 11.8 per cent. Even when allowance is made for the fact that the year 1919 preceded a severe industrial depression, during which there was a marked reaction from the war-time shortening of hours, the general trend would appear to be in the direction of a substantial shortening of the work-day.

There still exists, however, a very important section of American industry where opposition to an 8-hour day is strong. In the industries where labour is unorganised, which include steel and many of the more highly integrated industries, numbers of the manufacturers hold that 10 hours is a proper day's work. Some, indeed, believe that 9 hours is as satisfactory, or more satisfactory, than 10 hours; but there are comparatively few who favour a day of 8 hours. In 1919 25.5 per cent. of the wage earners were in plants where the prevailing hours were more than 48 but not over 54 hours per week, while 25.8 per cent. were in plants where the prevailing hours were more than 54 per week.

There are exceedingly few manufacturers or others who, in principle, favour a day of more than 10 hours. Almost the only instances of day work regularly carried on for more than 10 hours are cases where it is decided to work beyond 10 hours through the week so as to provide for a half-holiday on Saturday; or, in the case of night work, to work 12 hours for five nights and then have the sixth and seventh nights off. These arrangements, however, are not common, and even where they are applied the day does not average more than 10 hours.

It is chiefly, and almost exclusively, on shift work that a day genuinely in excess of 10 hours is found — a day which, in fact, averages 12 hours over six and sometimes over seven days. The difficulty is that continuous work is properly a task for either two or three sets of men. By careful overlapping or interlocking of shifts it is possible to carry on continuous work with 9 or 10-hour shifts, but such systems have not been very widely adopted. Where an industry regards 10 hours as constituting a day's work, the tendency has been to retain men employed on continuous jobs an extra two hours; so that the day shift and the night shift will together make up the twenty-four hours. A common, perhaps the most common, practice where there is two-shift operation is to make the day shift 11 or possibly 10 hours long and the night shift 13 or possibly 14 hours long. An important contributing factor in the continuation in many places of the two-shift system has been the fact that the typical continuous-process operation is one requiring attendance on the operation of equipment rather than constant physical work; there is enough intermittency of work to make a 12-hour shift possible. Another important factor has been the fact that in some of the industries the 12-hour day has carried with it exceptionally large earnings, which a certain element among the men have been reluctant to see reduced.

CLASSIFICATION OF CONTINUOUS INDUSTRIES

The steel industry has been the most prominent two-shift industry in the United States (1). The United States Steel Corporation, which produces slightly in excess of 40 per cent. of the country's iron and steel products, stated in 1919 that it had more than 69,000 workers on a 12-hour day. A few of the "independent" steel companies were at that time on three shifts; but most of the large "independents" were on two shifts. It may be estimated that the steel industry in 1919 employed in all about 150,000 men on 12-hour shifts.

But the problem of labour shifts is by no means confined to the steel industry. Continuous operation is to be found to a greater or less extent in more that forty important industries. They may be classified as follows:

Group I. Heat-Process Industries

Iron and steel
Coke used in making steel
Non-ferrous metals
  Copper
  Zinc
  Lead
  Nickel
  Aluminium
Glass
  Flint glass
  Bottles
  Window glass
  Plate glass
Portland cement
Lime
Brick
Pottery (2)

Group II. Chemical Industries

Heavy chemicals
Fertilisers
Explosives
Dyes
Industrial alcohol
Wood distillation
Refined corn products
Soap (3)
Glue
Drugs, perfumes, fine chemicals
Electro-chemical industries
Sugar
  Louisiana cane sugar
  Refining of imported sugar
  Beet sugar
Table salt
Petroleum
Cottonseed oil
Linseed and other oils

Group III. Heavy Equipment Industries

Paper
Flour
Rubber
Breakfast foods
Bakeries (4)
Automobiles (5)
Textiles (6)
Mines

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(1) Cf. *International Labour Review*, Vol. VI, No. 4, Oct. 1922, pp. 547-558; *The Three-Shift System in the Iron and Steel Industry*. Also *Application of the Three-Shift System to the Iron and Steel Industry*; Studies and Reports, Series D (Wages and Hours), No. 3. Geneva, 1922. 156 pp. 2s. 6d., 50 cents.

(2) Usually only two or three per cent. of the employees are shift workers.

(3) Only a few soap plants operate continuously.

(4) Operated as continuous industry only in certain localities.

(5) The Ford plant and some other plants are operated continuously most of the twenty-four hours.

(6) Not usually continuous.

Group IV. Service Industries

Electricity, power of all kinds	Street railways
Gas	Telegraph and telephone
Water supply	Mails and express
Ice	Policemen, firemen
Shipping	Watchmen
Railroads	

The lines of division between the four groups just given are far from rigid. The heat-process industries are many of them also chemical. Heavy equipment, as a factor, runs through all the groups. Yet the arrangement of the industries in this fashion should be of assistance in bringing out the four forces in modern industry which make for continuous operation.

Unfortunately, there are no statistics which give the number of shift workers as opposed to the number of day workers in American industry. Nor are the statistics of the Census of Manufactures for hours so collected as to show the number of 12-hour workers, these usually being in a minority in any one plant, and the system of reporting being such that a minority does not figure in the report on hours for a plant. So far as can be judged from all available evidence, there must in 1919 and 1920 have been between 500,000 and 1,000,000 wage earners in American manufacturing industries on shift work. Of these probably not far from 300,000 were on 12-hour shifts. Since 1920 so many of the industries have been running below normal (a condition which has of late been improving) that there is no good basis for making an estimate.

Heat-Process Industries

The industries which have been classed as heat-process industries fall into two major subdivisions : first, the metallurgical industries ; and, second, industries which burn or melt stone, sand, or clay to make glass, cement, lime, brick, tile, pottery, etc., which may be referred to as the ceramic group.

Iron and Steel

Among the metallurgical industries, the importance of shift work in the iron and steel industry has already been referred to. Blast furnaces, coke ovens, open-hearth and Bessemer works, and rolling mills are all operated continuously, with certain exceptions as regards Bessemer works and rolling mills. The typical steel plant has 50 per cent. of its workers on shift work, and the proportion may be nearer two-thirds. At the beginning of the war there was scarcely a steel plant in the country that was not on 12-hour shifts. During the war or in the period immediately following it a number of the "independent" steel companies went to three shifts. In 1920 there were about twenty on that basis. Most of these companies were small, but there were two or three of larger size, including Mr. Rockefeller's Colorado Fuel and Iron Company.

The general feeling in the American steel industry has been that, if there is to be a mass movement towards three shifts in the steel industry, the United States Steel Corporation should take the lead. The officers of the Corporation realise their responsibility in this matter. They know that the public at large is opposed to a 12-hour day, and that this same practice was an important issue in the costly 1919 steel strike. Furthermore, a majority of the superintendents and other officials of the Steel Corporation (and probably of other steel companies) are themselves in sympathy with the idea of abolishing the 12-hour day, provided a practicable way can be found.

By 1920 the United States Steel Corporation had in active operation a committee which was empowered to consider and report on the practicability of abolishing the 12-hour day. In the spring of 1921 Mr. Gary, chairman of the board of directors of the Steel Corporation, issued a statement to the effect that the Corporation hoped to be able to eliminate the 12-hour day, as the difficulties of doing so were overcome. In April 1922 Mr. Gary further announced that between October 1920 and March 1922 the Corporation had reduced the number of 12-hour men from 32 per cent. to 14 per cent. of the workmen.

In measuring the significance of this 14 per cent. figure, two things must be considered. First, a considerable proportion of the workers employed by the Steel Corporation are in coal mines, on railways, or at other points outside the steel plants, so that the percentage of Corporation employees who work 12 hours is not the full measure of the proportion of those actually in steel plants who work 12 hours. In a particular plant the proportion of 12-hour men may be twice or more than twice as great as for the Corporation taken in all its branches. Second, the reduction in the number of 12-hour men was due primarily to the abandonment of strictly continuous operation in rolling mills and wherever else men could be put on two 10-hour shifts, and not to any change in the two-shift system in such continuous-process departments as the blast furnaces, nor to any great extent, probably, on the open-hearth furnaces. This change to 10-hour shifts in rolling mills and elsewhere was associated with a period of extreme stagnation in the industry. While part of the reduction in the number of 12-hour man may be thought of as permanent, much of it has been of a makeshift and experimental character.

As a preparation for the permanent introduction of three shifts, however, the reduction in the actual number of 12-hour workers on the part of the Steel Corporation may have considerable value. So also may various tentative arrangements, sometimes in the nature of three shifts, by which the "independents" sought to distribute employment over as many of their men as practicable. Now that the steel industry is more active, the question of adopting a permanent three-shift policy is being carefully considered. In May 1922 President Harding entertained forty or fifty of the country's leading steel men at a White House

dinner, and on that occasion suggested to them the importance of the steel industry's giving attention to the problem of eliminating 12-hour work. Following the dinner, Mr. Gary, as President of the American Iron and Steel Institute, appointed a committee to investigate the practicability of abolishing the 12-hour day in the steel industry as a whole. This committee began its work, but has not yet reported.

Much interest has centred in the question as to what would be the effect on the cost of making steel of changing to three shifts, and how such a change would be regarded by labour, especially if the earnings for 8 hours' work were not as great as for 12 hours' work. In 1920 the writer visited practically all of the twenty steel plants which were then on three shifts. In 1922 Mr. Bradley Stoughton, formerly secretary of the American Institute of Mining and Metallurgical Engineers, made a further technical study of the shift problem in the steel industry on behalf of the Federated American Engineering Societies.

These studies have shown that the results of changing from two to three shifts depend very much on the methods pursued. The mere fact that hours are reduced from 12 to 8 does not of itself guarantee a great increase in efficiency. On the other hand, very substantial increases in efficiency have been obtained where management and labour have co-operated in an effort to secure increased efficiency. Whether the introduction of three shifts has been carefully done or not, the possible increased costs of putting on a third shift have been found to be smaller than many had assumed. Labour costs are only a part of total costs; men on shift labour constitute only a part of total labour ; furthermore, a compromise is often made by which the men take something less than 12 hours' pay for 8 hours' work. The difference between the cost of two-shift and three-shift operation, even under the less favourable circumstances, is no greater than differences in cost due to location, management, etc. which commonly occur between competing plants.

A compromise by which men going from 12 to 8 hours receive 10 hours' pay is generally regarded as fair, though there have been many departures from this basis of adjustment in both directions. In all but a few cases the workers have found the 8-hour shift much more satisfactory than the 12-hour shift, even though it has meant some reduction in pay. This has been shown both by the general attitude of the men and by the fact that labour turnover and absenteeism are both much less under the three-shift than under the two-shift system.

In many of the plants which the writer visited in 1920 there had not been much obvious increase in efficiency. As many men were employed on an 8-hour as on a 12-hour shift. Output was unchanged ; and there was little if any improvement in the quality of product or general carefulness. The managers felt that much of this was due to general labour conditions. There was a great shortage of labour, and men were not doing as well as they could. There were several plants, however, which had

coupled the change from two to three shifts with much planning and a strong effort to increase efficiency. Some of these had made surprising reductions in the number of men required. In some departments output had been increased, and the managements of two of the companies found that costs in some or in all of their departments were not higher under the three-shift system, in spite of liberal wage adjustments.

Notwithstanding the rather negative results obtained by some of the companies, all but a very few felt satisfied with three-shift operation ; and, with one or two exceptions, all the companies, so far as can be learned, have continued on three shifts through the depression until the present time.

Mr. Stoughton in his recent study has pointed out in detail the conditions which favour the successful introduction of three shifts in the steel industry. As summarised by the Committee of the Federated American Engineering Societies, they are as follows:

(1) The equipment must be in satisfactory condition to respond to increased intensity of operation.

(2) The co-operation of the workmen must be secured.

(3) Necessary labour must be available.

(4) The technical staff must be prepared to furnish full information regarding available labour-saving applicances.

(5) Existing "bottle necks" must be eliminated and probable ones avoided.

(6) Peak loads must be studied with special reference to the installation of mechanical appliances.

(7) The change must not be made during a period of labour unrest (*a*) after strife ; (*b*) when bitterness exists ; (*c*) when mutual confidence is lacking ; (*d*) when labour is arrogant or elated by the defeat of the management.

(8) The change must not be made too suddenly.

(9) Management must be able to exert a strong influence against (*a*) tardiness and absence ; (*b*) deliberate shirking ; (*c*) misuse of extra hours of free time.

(10) Where possible time studies of the work should be made to determine how much more the 12-hour crew could produce per hour if it worked with greater efficiency. The same hourly rate for 8 hours as for 12 should be paid, but a bonus should be added which will enable the men by becoming more efficient to maintain their daily income.

Not all of these conditions are, of course, apt to be realised in any one plant. Mr. Stoughton concludes, however, that :

> As a matter of actual experience, it is known that some plants, or departments of plants, have changed from the 12-hour to the 8-hour shift and reduced their labour costs. Others are operating on the 8-hour shift with satisfaction to their management and stockholders. Others have changed and reduced their total manufacturing cost. Finally, there are other plants wich have had experience with the 8-hour shift, the exact economic result of which is not known, but as to which there seems to be reason to believe that the total manufacturing cost is, at most, not much greater with the 8-hour than with the 12-hour shift.

Non-Ferrous Metals

American metallurgical industries other than iron and steel are now on three shifts. In the western part of the country the change took place twenty or more years ago. Some of the

eastern and southern plants were on 12-hour shifts until the last few years, but during or since the war have changed to three shifts.

The Tennessee Copper Company changed to three shifts in February 1919. At the time no increase in wage rates was entailed; but later, when prices dropped, the company kept wages somewhat higher than they would probably have been had the men still been paid for a 12-hour day. All the department heads are convinced that the 8-hour shift has been of benefit to the company. In 1921 28.8 per cent. more ore was being smelted per man per day than before the war — this in spite of a reduction in the hours of smelting workers from 12 to 8, and of miners from 9½ to 8. Other factors than the change in shifts entered into these gains, but the change in hours is regarded by the management as an important element. The management noticed an increase in efficiency immediately after changing to three shifts, and this situation kept on improving. There has been a great reduction in friction and misunderstanding between the company and the workers.

The Palmerton, Pennsylvania, works of the New-Jersey Zinc Company were put on three shifts about 1915. The management is of the opinion that their costs are lower under the 8-hour shift system than they would be under the two-shift system. In some of the departments the men accomplished more in 8 than in 12 hours. Taking the plant as a whole, the management did not quite reach, but it approached, the ideal of going to three shifts without increasing the number of men.

The International Nickel Company put its Bayonne plant on three shifts in October 1915. There was a saving in the number of men required per shift and an increase in output. There were also very important intangible gains, as, for instance, the willingness of the men to continue to operate the plant during the summer months instead of shutting down as previously. The management estimate the increased efficiency of the men at 20 per cent.

The aluminium industry has been on three shifts for more than twenty years, except that a small proportion of the workers, including engineers, stokers (where the work is automatic), and watchmen, are on a 12-hour shift. Lead smelting has been on three shifts for many years. There are a few 12-hour shift men engaged in lead oxidising.

Ceramic Industries

In what has been called the ceramic group, the glass industry has a limited number of 12-hour workers. Originally this industry did not operate continuously except for the men employed about the furnaces, who were on 12-hour shifts until quite recently. Of late some of the furnace men have been put on three shifts, though others are still on 12-hour shifts. The proportion of furnace men to the total is often very small. The

hours of glass workers other than furnace men, in the several branches of the glass industry, have passed through certain stages.

(1) The glass is made in pots and turned by hand into finished products by men working on one shift, or, more likely, on two shifts of from 8 to 8½ hours each.

(2) The introduction in some (but not all) of the plants of continuous tanks and automatic or semi-automatic machinery has caused that portion of the industry to run through the twenty-four hours, most probably on 12-hour shifts.

(3) To meet the competition of the machine plants, the hand workers agree to work on three 8-hour shifts, thus enabling their employers to get a larger output from their equipment, to save in fuel, etc.

(4) In the last few years the machine plants have been changing from two 12-hour to three 8-hour shifts.

The manufacture of small glass articles of various kinds, which may be called the "flint glass" industry, is still largely in the first of these four stages of development, though in some places it is in the second or fourth stages. The manufacture of bottles is in the third and fourth stages. The manufacture of window glass is on continuous operation, with most of the continuous workers on 8-hour shifts; in certain occupations, however, a considerable number of men are still on 12-hour shifts. The plate glass industry, except for a few plants, went to three shifts several years ago.

Where men in charge of glass furnaces have been put on three shifts there has been some difference of opinion with regard to the satisfactoriness of having three instead of two sets of men responsible for the melting. Some managers think two shifts better, though they are able to get along on three. Others hold that the results are quite as satisfactory on three as on two shifts. Probably something depends on the degree of scientific control which the management exercises over the operation, and the use of precision instruments of control.

Flint glass manufacturers would much prefer three shifts of 8 hours to the prevailing practice of two shifts of approximately 8 hours, because of economies in heat, etc. But the workers oppose having an early morning shift. The Corning Glass Works, whose workers are not organised, changed their hand workers from two 10-hour to three 8-hour shifts in August 1921. The company declares that the change resulted in increased output per running hour; a longer working week (for the plant); reduced overhead charges; better services; less absenteeism; and reduced labour turnover. The operators of bulb and tube machines have also been changed by this company from two 10-hour to three 8-hour shifts, with an increase in hourly machine output of 20 per cent.

The chief window glass manufacturer believes that men do not decline in efficiency during an 8-hour day as they do during a 12-hour day, and that, especially on the operation known as

flattening, the 8-hour shift pays from every standpoint. A company which manufactures sheet glass found that three shifts brought distinctly better results.

Three shifts were introduced into the plate glass industry because of the sentiment of the men in favour of it. The largest producer declares that the change has worked out satisfactorily, the new system not costing nearly so much as had been anticipated Some of the other producers, when interviewed, had not yet noted increase in efficiency. There is no tendency in any branch of the glass industry to return to 12-hour shifts.

All the ceramic industries other than glass are still predominantly on 12-hour shifts, so far as continuous-operation workers are concerned. In the case of the cement industry, which is the most important industry in this group from the shift standpoint, important progress has been made. The largest and third largest cement companies have nearly all their plants on three shifts and a considerable number of the other companies are on that system. In 1920 the Portland Cement Association collected careful cost figures for 86 plants. Of these 51 were on two shifts, 22 on three shifts, and 13 partly on two and partly on three shifts. It was found that in the two-shift plants it took on the average 1.035 man-hours to produce a barrel of cement, while in the three-shift plants it took only 0.823 man-hours. In those plants which had gone to three shifts only in part (that is, in those departments where the system could most economically be introduced) it took only 0.756 man-hours. The managements of various cement plants have pointed out specifically where under three shifts they were able to make savings in manning ; they have given figures showing notable increases in output and striking reductions in labour turnover. A company which changed to three shifts in 1921 found that it required no increase in the labour force. There was a slight increase in the number of shift workers, but this was balanced by a decrease in the number of day workers, the day workers also being quickened by the general improvement in the tone of the plant.

The burning of lime is quite solidly organised on two shifts in most parts of the country. However, in a group of lime companies centering in Illinois four out of twelve plants are on three shifts ; in addition, plants operating on two shifts have an arrangement by which the men are actually on hand for only 10 hours. Elsewhere little change has been made away from the 12-hour system. A striking exception is the Charles Warner Company, which has two lime plants near Philadelphia on three shifts. By a carefully studied arrangement it was found possible to put the men on three shifts without any increase in personnel. At first the men opposed any plan which would involve harder work during a shorter day. But after trial the plan won their enthusiastic support.

In the typical brick plant about 11 per cent. of the workers are on shift work, as burners, engineers, etc. In some localities burners work exceedingly long hours. The usual shift, however,

is 12 hours, which occasionally is so arranged that the burners need be in attendance only 11 hours. In most parts of the country the three-shift system is unknown. But in a few localities, especially Illinois, a beginning has been made. One of the largest face-brick plants in the United States, which is located in Illinois, went to three shifts about 1915. Where one hot kiln, plus one kiln requiring firing once in sixty minutes, had been the maximum assignment to any one burner before the change, under the three-shift system the minimum is two and one-half kilns, and the actual quotas run from two and one-half to five. The men also pay better attention to their work. Owing to there being three instead of two firemen, more inspection is required. But the foremen, who are also on three shifts, are more alert. The change has without question been profitable to the company, and there is no question but that the men also prefer it.

The Purington Paving Brick Company of Galesburg, Illinois, which has one of the largest single paving brick plants in the world, is also on three shifts. Writing late in 1921, the president of the company stated :

> Fifteen or twenty years ago we ran our paving brick plant 10 hours. By slightly speeding up the brick machines we found we could make all we could take care of in 9 hours. About eight years ago we decided that by speeding up our machines more we could manufacture all the brick in 8 hours that we could dry and burn. We therefore put the entire plant on an 8-hour basis with the exception of the burners, who were working 12 hours — really about 11 hours rather than 12, as they left about one hour before their time was up and depended upon the next shift to carry the work on.
>
> After running our plant about one year on an 8-hour basis, we had a great deal of dissatisfaction from the burners, who were complaining that they had to work 12 hours, while the rest of the plant worked 8 hours. Again, we found the 8-hour day was in effect all over the country, and we decided to make the change ourselves before it was forced on us by our burners. We have worked it long enough to decide that it is much better to work them 8 hours. While the cost is higher, still we get enough better burns to pay for the extra cost. During the hot summer months it is quite difficult to keep burners, and at the present time it would be almost impossible to get the burners to work 11 or 12 hours. . . Our records will show that we are more successfull in running the plant on an 8-hour basis than a 9 or 10-hour basis. The burner foremen still work 12 hours.

The few burners employed in plants manufacturing terra cotta and pottery are nearly always on 12-hour shifts. A few plants, however, have gone to three shifts. A terra cotta plant superintendent said that efficiency was higher on three shifts, and that, considering the importance of careful burning, the practice paid. The superintendent of a pottery on three shifts thought the practice warranted from a humanitarian standpoint, but that the 12-hour shift was better from the standpoint of operations, as applied to kiln firemen.

Chemical Industries

The chemical industries are considerably more numerous and diversified than the heat-process industries, but usually not large

individually. Nearly all the chemical industries have some continuous-process work, but usually only a part of the process is continuous, and the number of men employed in the continuous-operation departments is not large. A few men can handle a great tonnage of acids or fats. However, the refining of sugar and petroleum and the crushing of cottonseed give employment to a considerable number of shift workers.

Heavy Chemicals

The manufacture of acids, soda, and other heavy chemicals is now predominantly on three shifts. The change began some years ago and seems to be complete so far as concerns the large companies in the greater part of the country. In certain sections there are 12-hour plants. The managers of 8-hour shift plants, while intending to remain on that system, have often been sceptical regarding increases in efficiency. An exception to this attitude is the position taken by the Tennessee Copper Company, whose sulphuric acid product outweighs their copper product in importance. In 1921 the output was 0.878 tons of acid per man per day as against 0.372 tons in 1913, taking into account workers in mines and smelting works as well as in acid plants. While part of this gain was due to other causes, reduction in the manning scale and increase in efficiency due to working three shifts were, in the opinion of the acid-plant superintendent, very important features.

Scattered over a large portion of the United States are fertiliser plants, many of which have a small unit for the manufacture of sulphuric acid. These employ from four to eight or nine men apiece on shift work. Without exception, so far as could be found, these acid plants are on 12-hour shifts. While one man formerly connected with the industry thought such plants could be put on three shifts with profit, there is at the present time no tendency in that direction.

The manufacture of explosives is also carried on in many small plants. The labour policy of these varies with the locality. The largest manufacturer of explosives states that nearly all his shift workers, who are few in number, are on 8-hour shifts, but that there may be a few here and there on 12-hour shifts.

Dyes are manufactured in large plants, but the number of persons on strictly continuous work is small. A few men are on 12-hour shifts, but more frequently the shifts fall short of 12 hours of actual attendance. The leading manufacturer of industrial alcohol has all but one minor plant on three shifts. About 25 per cent. of those employed are shift workers. Most of the wood distillation plants of the South and some at least of those in the North are on 12-hour shifts, or shifts averaging that length. The leading manufacturer of refined corn products works three shifts.

Soap and Allied Products

Soap is rarely made by continuous operation, but connected with a soap plant there may be auxiliary operations which are continuous processes. Usually the number of shift workers is almost negligible ; they may be on 12-hour shifts. An exception to the general rule is found in the main plant of the Procter and Gamble Company, America's largest soap manufacturers. This plant refines its own cottonseed oil and has auxiliary and regular work on shifts, so that about 25 per cent. of the employees are on that basis. Prior to March 1919 these continuous-operation workers were on shifts averaging 12 hours. Between March 1919 and the spring of 1921 the plant operated on three 8-hour shifts In the spring of 1921 the day workers went from an 8-hour to a 9-hour day, and, in order to put all workers on a equality, the three-shift system for shift workers was displaced by a five-shift system.

Under the five-shift system, two shifts are always on duty at the same moment, the time of starting and stopping being different, however, for the two shifts. Under the original plans, three of the five squads worked 10-hour turns and two worked 9-hour turns. By a later plan two of the groups work 8½ hours, one group works 10 hours, and two groups work 10½ hours. The number of workers is constant throughout the twenty-four hours. Men work according to the same schedule every day in the week. No one begins or ends work between midnight and 7 a.m. The plant is closed down so far as main operations are concerned for twenty-four hours each week-end. Shifts are rotated once a fortnight.

It should be observed that the possibility of this smooth arrangement for carving 9 or 10-hour shifts out of a twenty-four-hour day depends on the fact that when men return to work the second day they do not relieve those who have relieved them, but they relieve those who have relieved their partners on the shift or shifts which paralleled their own. The system has two other special characteristics : first, only half of the men quit work at any one time (except at the week-end) ; second, men work in not one but two positions, so that sometimes they must learn two jobs. The Procter and Gamble Company found that there was considerable gain in efficiency in going from the two-shift to the three-shift system. They report that the production per hour is as great under the five-shift system as it was under the three-shift system.

A Chicago glue company reported that 10 per cent. of its employees were on shifts, which had been changed from two to three. The manufacture of drugs, perfumes, fine chemicals, etc., so far as investigated, is on three shifts.

The electro-chemical industries are in the main on three shifts. In one locality, where the 12-hour shift is practically universal, the electro-chemical industry was found to be on 12-hour shifts. A company which had changed from two to three shifts on its

electric furnaces stated its belief that the three-shift schedule is the most satisfactory and economical method for their operation, and that production efficiency is greater and the physical efficiency of the men better maintained.

Sugar, Oil, etc.

There are three distinct branches of the American sugar refining industry: first, the sugar mills of the South, which refine Louisiana cane sugar; second, the sugar refineries of the Atlantic and Gulf, and Pacific, seaboards, which refine imported sugar; and third, the beet sugar factories of the northern and western interior.

The mills which refine Louisiana sugar are, so far as could be learned, wholly on two shifts. The manufacture is seasonal, lasting from 45 to 90 or 100 days. Nearly all the workers are on shifts. The refiners of imported sugar operate throughout the year. While the actual refining is a continuous process throughout, there is a considerable amount of day work in mechanical upkeep, packing, etc., so that the number of shift workers might be in the neighbourhood of 50 per cent. Most of the companies, apparently, are on two shifts; but two or three of the smaller or moderate-sized companies — and also the company which is the largest of all — are on three shifts.

The American Sugar Refining Company went to three shifts in its various plants in the spring of 1918. Hourly wage rates were raised about 50 per cent. But this was a time of rising wages; at about the same time the other sugar companies raised their hourly wages to a corresponding degree; and from 1918 to the present time the hourly wage rates in the 8-hour and 12-hour plants have been on the same level. Notwithstanding the fact that the men could earn much more elsewhere, the American Sugar Refining Company has had no difficulty in getting men, nor have its employees wanted to work overtime. The company states that the efficiency of the men is 15 per cent. greater on the shorter hours. Not only do the men do more individually, but, since going to 8 hours at each of the refineries, there have been outstanding months during which output records for many years have been broken.

The beet sugar industry, like the Louisiania cane sugar industry, is seasonal, the season lasting not more than ninety days. Nearly all the companies are on 12-hour shifts, almost all those employed being shift workers. But one outstanding company has operated on three shifts for three seasons. According to the general superintendent of this company:

> For seven years prior to the change we found our number of operating men required to be practically constant from year to year, and think it represented practically a minimum crew under these conditions. While after the change we had to overcome the disinclination of labour to work efficiently, which required about two years, we feel that we are again very near to a minimum basis as to number of men under present conditions, and find that we require only 87 per cent. of the number of men per shift

required for seven years before the change. This smaller number of men has increased capacity over 22 per cent. We feel that the three-shift system is only one factor in the increased capacity of our plants, but that it is nevertheless one very important factor. We also find that a better quality of work is being performed since the change, as measured by losses in production and economy in use of materials.

In recent years a large portion of the table-salt industry has gone from two to three shifts. In a number of plants visited none had made any very striking increases in efficiency. In some sections of the country plants are still on 12-hour shifts. There is no likelihood that the three-shift plants will return to two shifts.

The refining of petroleum is an example of an industry which adopted three shifts almost simultaneously shortly before the United States entered the war. In most parts of the country oil-well drillers are on 12-hour shifts. In one or two places this seems to be true of pumpers or other field workers. But the refineries, with a third or so of shift workers, are solidly and permanently on three shifts.

In the manufacture of cottonseed oil most of the labour is in the crushers ; comparatively few workers are in the refineries. The crushers employ a large number of men, and, unless it may be in Texas, they seem to be without exception on 12-hour shifts. Sometimes the few day workers also work 12 hours. The industry need not be seasonal, but owing to an over-development of crushers many of the plants run for from thirty to sixty days only. The average is about ninety days. Mills of the large companies may run for eight or nine months. A few 12-hour workers are employed in cottonseed oil refining and in linseed oil refining ; but their total number is insignificant.

Heavy Equipment Industries

Of the industries which operate continuously for mechanical reasons, paper manufacturing is the most important. The question of two versus three shifts, or tours, as they are called in this and some other industries, early attracted interest. For some time much of the industry has been on three shifts. This is particularly true of the making of newsprint, and of the more important paper-making districts. However, there are branches of the paper industry, such as the making of tissue paper, and various outlying centres of paper manufacture, where the two-shift system is still followed.

A report issued several years ago by the State of Massachusetts showed that of six paper mills which went from two to three shifts between 1912 and 1914 the percentage increase in pay-rolls ascribed to the change was in the case of two mills 0.2 and 0.9 per cent. respectively, or practically nothing ; in the case of two other mills, 26.8 and 17.7 per cent. respectively ; and in the case of the two median mills 4.2 and 5.7 per cent. respectively. These figures well illustrate the great diversity in the results obtained on going to three shifts, and at the same time the general modera-

tion in the increase in costs. The figures, of course, do not show whether there were increases in efficiency other than those reflected in the pay-roll, which would tend to offset increases in pay-roll costs. Mr. Robert B. Wolf has given detailed evidence regarding the profitable installation of three shifts in three paper mills with which the was connected (7).

The flour mills in America's leading milling centre went to three shifts just twenty years ago. For a while some workers were retained on 9 or 10-hour shifts, but in 1918 the 8-hour day became general. The 8-hour shift is now the practice in all important milling centres. Country mills, when they operate continuously (which is rare), are apt to run 12-hour shifts ; a single shift of 10 hours is the common practice.

The rubber industry, so far as it operates continuously, is on three shifts, or at least on some arrangement other than two 12-hour shifts.

In the manufacture of breakfast foods practice was not found to be wholly uniform, there still being 12-hour work at some factories. The leading company changed to three shifts about 1910 with great success. Costs were kept to their former level, and with the passage of years have been materially reduced. Bakeries operate more or less through a large part of the day, but not, ordinarily, on a definite shift basis. In Chicago bakeries operate on three 8-hour shifts.

The Ford Motor Company (the largest automobile manufacturer in the United States) follows a unique plan by which the various departments operate on two or three 8-hour shifts, in accordance with the volume of requirements. Some of the other large companies operate on two 8-hour shifts. The Ford Company has blast furnaces which are almost without parallel from a technical standpoint. These are operated on three shifts. Although the wages paid are much higher than those paid by other steel companies in recent months, production costs are said to be exceptionally low.

The textile mills are rarely operated with strict continuity. Night shifts are common, however, and where the night shift is long, as sometimes happens when the schedule is arranged on a five-night basis, practically the whole twenty-four hours, outside meal hours, are occupied. The three-shift system has been adopted in a few places.

Mines are frequently operated on two and sometimes on three 8-hour shifts. The work of pumpmen and engineers is generally continuous in mines. In some regions these men are on two 12-hour shifts (as in anthracite mines in Pennsylvania); in other regions they are on three 8-hour shifts.

Service Industries

Among the service industries of a more public character great progress has been made in the direction of establishing 8-hour

(7) See *The Three-Shift System in the Steel Industry*, Bulletin of the Taylor Society, Feb. 1921. New York City.

shifts. Factory power plants are often on 12-hour shifts, or on some more less flexible arrangement of shifts approximating to that length ; but public service electrical generating plants are almost without exception on three 8-hour shifts. The change to three shifts, when made, did not, as a rule, result immediately in a large reduction in manning or other savings. But with the passage of years the equipment in the stations has become larger and more elaborate, the operating standards insisted upon have become more rigid, and managers feel that present operations could not be satisfactorily carried on with a 12-hour day.

The manufacture of gas is a continuous-process industry employing a substantial number of shift workers. It also is mostly on three shifts, though the change has usually occurred more recently than is true of the generation of electricity. Stations for pumping water for cities are in a few instances on 12-hour shifts ; but as a rule they seem to be on 8 hours.

Until recently the manufacture of ice was one of the great strongholds of 12-hour shift work. In the southern part of the country and in many small towns ice plants are still run on 12-hour shifts, this including almost everyone about the plant — engineers, ice pullers, etc. Now most, though not all, of the great cities have their main ice plants on three shifts. The growing practice of buying electric power is reducing the number of firemen and engineers, and so lessening the volume of continuous work in the industry.

Most of the men employed in the navigating and engineering departments of a ship — including all the officers and the fireroom crew — are on a three-watch system ; except that on very small vessels, such as tugs, and on large vessels on the Great Lakes, some of the officers are on a two-watch system. The watches for seamen have varied. Shortly after the war the seamen were put either on day work for 8 hours or on a three-watch system. Later the agreement to this effect was abandoned, and, on some ships at least, a two-watch system, or day work for 9 hours, was established.

The railroads are now on 8-hour shifts so far as concerns their shops, roundhouses, telegraphers, switchmen, and some of their level-crossing guards, with a few exceptions in cases where it is much more convenient to have men work for somewhat longer than 8 hours. Originally the 8-hour day was adopted as a basis for payment rather than as an operating practice. Later an actual 8-hour day was widely introduced. In 1922 the basis of pay was changed from 8 to 9 hours for certain railroad clerks, freight handlers, and express and station employees. The hours of duty of train service employees vary widely and are often much more than 8.

Hours on street railways vary, and are not strictly uniform for the employees of a single company ; but they are usually 8, 9, or 10 hours. The day for employees of telegraph and telephone companies usually approximates to 8 hours. Post office employees are limited by law to an 8-hour day ; but railway mail clerks,

though not averaging more than 8 hours, commonly work longer than this during days when trips are being made. Employees of express companies are, for the most part, on an 8-hour day.

The hours of policemen on patrol are now commonly 8, though there are sometimes special arrangements which make the day an hour or two longer than this. Policemen doing detective or traffic duty are apt to work a little over 8 hours. Firemen were formerly on duty continuously with certain days off, but now are commonly on a two-platoon system. They are permitted to sleep during their period on duty.

Watchmen are on 12-hour shifts nearly everywhere. In a few instances, however, they have been put on three shifts.

Elimination of the 12-Hour Shift

From the foregoing account of shift systems, it will be seen that there is a considerable volume of 12-hour shift work in American industry. If it be regarded as progress to move from 12-hour to 8-hour shifts, then the United States is considerably behind the rest of the world in this respect. It does not follow that the United States will permanently continue with 12-hour operation. The movement from two to three shifts in the last five or ten years has been striking, and very little of the ground so gained has been lost. A few industries are entirely on three shifts ; all but a few are in part on three shifts.

The method of abolishing the 12-hour shift in American industry will, however, probably be different from that followed elsewhere. Comparatively little is done here by legislation. The trade unions have been lukewarm as respects labour legislation, except in a limited field or fields. The employers prefer to handle labour matters themselves. Even when Congress or the State legislatures pass regulatory measures, their constitutionality is subject to serious question. Nor can a change in hours or shift systems come about by a sweeping agreement or agreements between labour and the employers. Too large a portion of the industrial field is unorganised.

Hence in the United States there has been and can be no simultaneous and universal abolition of 12-hour work. It is a matter for development in the various industries. The steel industry might possibly go to three shifts almost as an industry, should it be urged to do so by the committee of the American Iron and Steel Institute appointed to look into this matter. In any case there is reasonable hope that, following a lead taken by the United States Steel Corporation, the steel industry will cast the weight of its influence in favour of the three-shift rather than the two-shift system. If this should take place, the more important industries now on 12-hour shifts would probably gravitate towards 8-hour shifts.

Whatever may be the method or order, the sentiment and expectation both on the part of the public and of thoughtful manufacturers is that the 12-hour shift will go. It is probable

that the work done during the past two years under the auspices of the Cabot Fund and the Federated American Engineering Societies will help to crystallise and make effective that sentiment Doubtless there will be special sections of the country, special industries, and special types of labour in which the complete abolition of 12-hour work will be deferred. But that the general movement will be away from 12 hours seems clear. The growing appreciation of the importance of this subject and the attitude which the country has come to assume has been well voiced in a statement issued on 2 December by President Harding.

> It is a matter of very much gratification to me that the Federated American Engineering Societies, our foremost organisation of American industrial skill, should have given two years of diligent enquiry, under competent experts, to a subject which is of very deep interest to me and important to the country.
>
> I rejoice to note the conclusions of this great body of experts are identical with those which I have reached. It has seemed to me for a long time that the 12-hour day and the type of worker it produces have outlived their usefulness and their part in American life in the interests of good citizenship, of good business, and of economic stability.
>
> The old order of the 12-hour day must give way to a better and wiser form of organisation of the productive forces of the nation, so that proper family life and citizenship may be enjoyed suitably by all of our people.
>
> This clear and convincing report of the engineers must prove exceedingly helpful in showing that this much-to-be-desired result can be achieved without either economic or financial disturbance to the progress of American industry.

As has already been pointed out with reference to steel and paper, the experience of American manufacturers shows that there is the possibility of great variation in the results obtained on going from two to three shifts. It is an error to assume that the shorter the hours the greater will be the efficiency — this without thought or effort. There can be no doubt, however, that wherever the 12-hour day is in effect there is a great deal of slackness. If ways can be devised by which a shortening of hours can be linked up with an opportunity for performing greater or better service, and if the will to perform such service can be implanted in the workers, there is a possibility of getting an increase in efficiency which will outweigh any increase in cost. In many of the continuous industries opportunities for turning out more output or performing more service on shorter hours do not readily present themselves. There is need for much constructive imagination, but there is hardly a single type of continuous industry where some manufacturer has not solved the problem of getting much better results on the shorter shift.

The driving force behind the movement for the abolition of the 12-hour shift is not, however, the desire to get greater efficiency. The project is usually taken up because the management think it ought to be done or the men demand it. Then plans are thought out of doing it in the best possible way. Nevertheless, the removal of what both management and men regard as an abuse is in the long run essential to efficiency. Only

as such problems are courageously faced and solved, without too minute a regard for expense, is it possible for a management to insist on the men giving their full co-operation in the many ways in which co-operation is essential. This the more progressive concerns realise, and it accounts in large measure for their general satisfaction with three-shift operation and their unwillingness to go back to two shifts, even when they cannot definitely point to ways in which savings have been effected.