## Blasting in Quarries and Open-Pit Mines

Some interesting information on shot firing by electricity at quarries and open-pit mines was given by Mr. N. S. Greensfelder, on a paper presented last September, at the San Francisco meeting of the American Institute of Mining and Metallurgical Engineers. The note following is taken from the paper.

At open-pit mines and quarries, the usual practice is to shoot simultaneously a number of holes containing relatively large charges of explosives. Better results and greater efficiency from the explosives are obtained in this way, than if the holes fired one at a time. Simultaneous detonation may be accomplished either by the use of electric blasting caps or cordeau-bickford detonation fuse.

Where convenient it is advisable to detonate the cordeau with an electric blasting cap. The average rate of detonation of cordeau is about 17,500 ft. per sec.; when it is placed along an explosive charge in a deep hole the entire column of explosive is detonated at a rate equal to that of the cordeau. This increases the shattering effect of the slower explosives, and, consequently, decreases the cost of secondary blasting. When the explosive charge is not continuous, but is placed at different points along the hole, cordeau furnishes a particularly convenient and efficient means of firing. The charge can be broken as many times as desired, because the cordeau extends along the entire length of the hole and, therefore, detonates all of the explosive. In the deeper holes it is necessary to use countered cordeau and often advisable to use double countered cordeau neither of which break as easily as the plain cordeau.

An Ohio company producing crushed stone found that the amount of explosive necessary was reduced more than 10 per cent. by replacing electric blasting caps with cordeau. Missed holes were also practically eliminated. At the Nevada Consolidated Copper Co., where churn-drill holes are first chambered by dynamite and then loaded with black blasting powder, it has been found that the holes can be loaded more quickly and with greater safety with cordeau than with fuse and blasting caps and the danger from unexploded caps and powder in missed holes has been eliminated.

Although cordeau has certain advantgages over blasting caps in firing deep churn-drill holes, electric blasting caps are still used at many mines and quarries. Their initial cost is less and, if the work is properly done, they give good results. In holes containing large charges of explosives, a good precaution is to place two or more electric blasting caps in each hole, or two caps in each separate charge in the hole if several charges, separate by stemming, are used. If the holes are wet, waterproof caps should be used; if there is over 30 ft. of fluid in the hole, submarine electric blasting caps are desirable. Care should be taken in loading to prevent injuring the insulation or breaking the wires. Frequent galvanometer or ohmmeter tests should be made when loading large charges. Electric blasting caps should not be handled during an electrical storm, as in a number of instances they have been detonated by the lightning discharges. If the ground is damp, the joints should be taped or raised off the ground to prevent grounds or short circuits. Each circuit should be tested for resistance with a galvanometer or ohmmeter, and if a blasting machine is used, its capacity should be tested with a rheostat, before an attempt is made to fire the shot.

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# Hydro-Electric Power Development as Related to the Electrification of Railroads

**A Paper in the Symposium on the Water Power Problem, Presented at the Fall Meeting of the American Society of Civil Engineers at San Francisco on Oct. 4-5**

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The title of this paper may lead to the assumption that cheap and abundant hydro-electric power in itself would justify the electrification of steam railroads. In the writer's opinion, such an assumption would be incorrect. The electrification of steam railroads, thus far, at least in the United States, has come about more largely from causes other than cheapness of electric power. The necessity of avoiding smoke and steam in tunnels and other restricted places, and the need of increasing the capacity of tracks or other terminal facilities have generally been the determining factors which have brought about electrification. However, it is not improbable that conditions in this respect may change; doubtless, increase in volume of railway traffic and the known economies of electrification will tend to increase the use of electricity for the operation of railroads in localities where cheap and reliable hydro-electric power is available.

Something more than a mere showing of economy will be necessary to bring about a change from steam to electric operation of railroads. Electrification will involve a large increase of invested capital, and, at the same time, the retirement of many facilities which would not be needed with a change of power. Under the many adverse conditions with which the railroads in this country have contended in the past few years, their financial credit has been impaired; only a few of them have a surplus of earnings available for improvements, and the additional capital necessary therefor cannot be readily and cheaply obtained. Under the accounting rules of the Interstate Commerce Commission, the cost of facilities which are retired must be charged to profit and loss; such charges would be quite large, would be undesirable, and would have much the same effect as if they were charged to operating expenses.

The admitted economies of electrification have to contend with a constantly increasing efficiency of steam locomotives. Much study has been given to steam locomotive design with a view to greater efficiency; superheaters, stokers, better water, and many other appliances have made the modern steam locomotive a much more efficient and reliable prime mover than is generally supposed. This, together with the revision of gradients, additional and better facilities, and improved methods of operation, tend constantly to reduce the margin of economy which would justify electrification.

**Some Advantages of Electrification.**—Electrification has some outstanding advantages which probably never can be equaled by steam operation. Some of these advantages are the longer continuous operating periods possible with electric lomomotives, their greater power in single units, with less destructive effect on rolling stock and track than steam locomotives, the elimination of coal and water facilities, and the reduction in the number of engine terminals and the delays occasioned thereby. It is evident that these and all other advantages arising from electrification will vary with each particular railroad and for different points on the same railroad, and must be weighed as against all the factors affecting the cost of steam operation, of reducing gradients, and of increasing track and other facilities so as to cheapen present steam operation, and, lastly, the increased investment cost of electrification, including the retirement charges of facilities that would be retired. It is evident, therefore, that the cost of electric power is only one of many factors entering into the problem, but the more reliably and cheaply electric power becomes available, to that extent will it prove a favorable factor in electrification. To the extent that hydro-electric power is more readily available, more reliable, and cheaper than steam-generated power, to the same extent, approximately, will it be a more important factor. Even so, at this time it does not appear probable that the change from steam to electric operation would be justified for existing railroads, except where the volume of traffic is large, where it can be moved in large units for long distances, where fuel costs are high, and where operating costs due to adverse gradients and congestion of track and other facilities make steam operation somewhat more than ordinarily expensive.

Wherever the determining factor for the electrification of steam railroads has been the need of avoiding smoke in tunnels or densely populated terminals, or of increasing the capacity of tracks or other facilities, the insistence of the demand for the change has been so great, as a rule, that the cost of power has been only a minor factor. Generally, such cases have involved only restricted areas and have left much larger areas to continue to be operated by steam. The economies of electric operation in such cases probably would be increased materially by largely increasing the mileage of road electrically operated. The greater the extent of electrically operated mileage, the more important factor will become the cheapness of electric power.

Coal and fuel oil costs vary from time to time; in the last few years, the fluctuations have been extreme and, what is even more important and, at the same time, an indictment of American business and industrial methods, is the fact that fuel supplies have sometimes been uncertain. On the contrary, it would appear that, once the installation has been made, hydro-electric power would fluctuate as to supply within well defined lim-

its, and that the cost, or at least the selling price, would be constant, or nearly so, for long periods. The ability to contract for an ample and reliable supply of hydro-electric power at favorable prices extending over a long term might easily prove a controlling factor in the electrification of railroads, especially for new railroads where the cost of coal, water, and engine terminal, as well as other facilities incident to steam operation, would be eliminated.

**Why Sections of the St. Paul Were Electrified.**—To illustrate this problem better, reference will be made to the electrification of sections of the Chicago, Milwaukee & St. Paul Ry., which is probably one of the largest electrification projects with respect to main-line mileage. Electrification was considered coincidently with the location and construction, in 1906-08, of the extension of this railway system from Central South Dakota to the Pacific Coast, a distance of about 1,400 miles. The extension crossed several mountain ranges where long and heavy gradients were necessary. Undeveloped water powers were abundant and power requirements for industrial uses were largely absent. These conditions led early to the suggestion that parts of the extension should be electrified; accordingly, the railway company acquired several water-power rights, and, at some places, located its lines with reference to the development of these powers. However, electrification was delayed, and on the completion of the railroad, it was operated by steam. It was not until several years later, about 1914, that the electrification of the section between Harlowton and Deer Lodge, Mont.—228 miles—was begun, and previous to the completion of this section, work was begun on the adjoining section from Deer Lodge to Avery, Idaho, making a total of 440 miles of main line. These sections crossed the main Continental Divide and the Belt and Bitter Root Mountain Ranges. Recently, the 209-mile section between Othello, in Central Washington, and Seattle and Tacoma, was electrified. A gap of main line between Avery and Othello (226 miles) is left, which undoubtedly would have been electrified before now, except for the abnormal conditions brought about by the World War and Federal control.

For various reasons, the railway company found it undesirable to add to and develop its own power requirements; therefore, it disposed of the power sites and made long-term contracts for power. The powers of which the railway company had obtained control were small compared with those now depended on, and the cost of their development would have been relatively much higher. They would have been subject to wide seasonal fluctuation as to quantity, and there would not have been the same high degree of reliability of power supply that exists under the present arrangement. The net cost of power to the railway company would also have been greater; at times, it would have been obliged to purchase power, and, at other times, it would have had surplus power to sell. The power now used and that already under contract for the 226 mile gap between Avery and Othello will be hydro-electric power. The contracts for power are with the Montana Power Co., the Inter-mountain Power Co., the Washington Water Power Co., and the Puget Sound Light & Power Co., the first named company supplying the greater part. All these companies control large supplies of developed as well as of undeveloped water power. The contracts for this power run for long periods. The first contracts were for 99-year terms, and the later contracts will expire practically concurrently with those first made. The cost of the current delivered at the railway company's sub-stations is the same for all contracts, and at a very low price. The several power contracts are interrelated with agreements between the several power companies which, in effect, is practically equivalent to one contract covering all the railway's requirements for the electrified section. The railway company is, therefore, depending not on the individual power resources of these several companies, but on their combined resources, as the generating stations of the companies are so many and so completely tied together as to insure an uninterrupted supply for the entire electrified section. The 18 or 20 generating stations supplying power under these contracts extend over a territory from Central Montana to Puget Sound, a distance of more than 650 miles, with a north and south width of nearly 200 miles. The drainage areas supplying these powers not only cover a much larger territory, but they also differ greatly as to climatic and topographic conditions, a factor which it is believed insures a reliability of power supply under the most extreme conditions. The combined capacity of these stations is more than 360,000 kw. Within this area, and adjacent to it, are many undeveloped water powers. There can be no question but that this combination of ample, reliable and cheap power, supplied under long-term contracts, at a low price, is an important factor in justifying this extensive railway electrification.

The other factors justifying the electrification were the remoteness from fuel supplies, the long stretches of steep gradients, the character of freight traffic, which permitted it to be concentrated in large train units, the considerable mileage of railway electrified, and, last, but not least, the fact that the railway company would be able to control the flow of traffic over the electrified sections in such manner as largely to eliminate extreme peak loadings. All these last named considerations, of course, would apply more or less equally to an electrification using steam-generated current.

In this connection, it is interesting to note that this railway prior to electrification used oil for locomotive-fuel purposes exclusively for the main line and for the branches from Deer Lodge to the Pacific Coast, the oil being shipped by water from the Southern California fields. At that time and for a period of several years, oil was cheaper for the railway than coal, and had the further advantage of minimizing fire risks, an important consideration because the line crosses several forest reservations. Later, for those sections of the railway that were not electrified, it was necessary to change from fuel oil to coal.

Of the various electrifications of steam railroads in the United States, the majority are using steam-generated current. The several electrifications centering in and about New York City, the Pennsylvania Ry., at Philadelphia, Pa., and its West Jersey & Sea Shore Ry., the Norfolk & Western Ry., the Detroit, Sarnia, Hoosac, and Baltimore Tunnels are all operated by steam-generated current. Both steam-generated and hydro-electric currents are used for the Canadian National Ry. Tunnel at Montreal, Que., mostly the latter, whereas for the Great Northern Ry. Tunnel in Washington only hydro-electric current is used. The Butte, Anaconda & Pacific Ry. (which carries a heavy freight traffic) and the Spokane & Inland Empire R. R. lines use hydro-electric power exclusively, the former being supplied by the Montana Power Co.

**Electrifications in Foreign Countries.**—The abundance and cheapness of hydro-electric power, especially as compared with steam-generated power, have probably been more the controlling factors in the electrification of steam railroads in foreign countries than in the United States. This is shown in the official reports made to the International Railway Congress held in Rome, Italy, in the early part of 1922. As to Sweden and Norway, Mr. Ofverholm, chief of the Electrical Department of the Swedish State Railways, and official reporter to the congress, states:

"Sweden, Norway, and Denmark have not the necessary quantity of home-produced coal. The coal fields that exist in the south of Sweden are quite inadequate, and the coal is of poor quality. On the other hand, Sweden and Norway have plenty of water power, though this is not the case with Denmark. In the first two countries, railway electrification on a large scale has been contemplated, in order to utilize water power instead of depending on imported coal. In Denmark, owing to the lack of water power, no such schemes are in existence.

"The desire to make the railways independent of foreign coal has been entertained in Sweden for a long time."

Later in the report, where the program for electrification is being considered, he states:

"The chief point is to make the railways independent of foreign coal: therefore, the lines that have the highest coal consumption should be the first to be electrified." . . . "The research work carried out in connection with the electrification has included an investigation of the total amount of hydraulic power available."

The reporter for Italy, Mr. Alfredo Donati, states:

"The new program for the extension of electric traction in Italy which was drawn up by the Administration of the Italian State Railways in common with the Government, anticipates the electrification of about 2,800 miles of railway which has been selected with care from amongst those which, owing to their gradients and their heavy traffic, now consume the greatest quantity of coal."

It was stated that this program when completed will effect an annual saving of about 1,250,000 tons of coal and a consumption of about 600,000,000 kw.-hr. of current per annum, the greater part of which will be generated by water power. This program, however, is not altogether to save coal, for, later, it is stated that, on certain of the lines to be electrified, the limit of traffic which could be carried by steam traction, had been attained, and electrification had become necessary for increasing the carrying ca-

pacity of the lines; also, that, on a number of Italian lines, electrification has been hastened on account of the difficulties of steam operation through the numerous tunnels.

The Federal Railway Commission of Switzerland, reporting to the International Congress, concludes with the following statement:

"The electrification of the Federal Railways is an economic necessity, and ought to be brought about if regular working at all times and under all conditions is to be assured. We must not forever remain dependent on foreign countries, which may withhold their coal, or at any rate dictate their prices without consideration for us. Of the total imports in 1920 (approximately 991,700 tons), 303,914 tons or 30.5 per cent, came from England, and 553,986 tons, or 55.9 per cent, from America, while our former principal sources, Belgium, the Sarre Territory, and the Ruhr Valley, only delivered to us altogether 65,500 tons, or 6.6 per cent. This fact shows on what casual conditions our coal supply, and, consequently, the working of our railways, depends, without taking into account the disturbing factors arising out of strikes, transport difficulties, etc."

France, according to M. Sabouret, chief engineer, technical department of the Orleans Railway, reporter to the International Congress, has an ambitious electrification program. In addition to some electrification already completed, and the program for the state-owned railways, the Orleans Ry. Co. has a program for the electrification of 1,240 miles of railroad, the Midi Railway for 1,680 miles, and the Paris-Lyons-Mediterranean Co. for a considerable mileage.

The Orleans Ry. will use largely hydro-electric power supplemented with some steam-generated current from a station near Paris; the Midi Railway will use largely, if not exclusively, hydro-electric power; the Paris-Lyons-Mediterranean Co. will obtain its principal sources of current from hydro-electric plants on the Upper and Middle Rhone River. All three railways will develop their own power, and, in some cases, the developments will be made jointly with the state-owned railways. These three railways have under consideration a plan for the joint development of hydro-electric power on the Truyere River, in which the development would exceed 200,000 HP., the supply being exceptionally regular. The plan is to divide the power between them in such a manner as to supplement for each railway the minimum power from its own stations during periods of low water. The reporter says:

"The flow of the watercourses of the Central Plateau is complimentary to those of the Alps and Pyrenees; the Truyere will feed the Rhone and Garonne basins during the winter, and the Central Region during the summer. This large program of the organization of hydro-electric energy shows clearly the obligation imposed on the three companies of associating themselves in a work of unification required in the national interest and to promote the linking up of the three great producing districts."

These references are illustrative of the development of the electrification of railroads in other countries; they appear to indicate the probability that hydro-electric power, by virtue of its cheapness and other qualities, has been more of a factor in extending electrification in foreign countries than it has been in the United States.

The Pacific Coast, with its vast hydro-electric power potentialities, seems to present favorable conditions for the electrification of steam railroads. The power possibilities are probably in excess of commercial and industrial needs and are likely so to continue, whereas coal and fuel oil supplies are becoming more costly and less certain. The topography of much of the country traversed by the railroads and the extent and character of the traffic result in railroad-operating conditions which probably could be met more economically by electrification than by steam.

**Advantages of Electrification for New Construction.**—In the case of new railroad construction, assuming that, in spite of excessive and oftentimes conflicting regulation of the railroads by Federal and state authorities, capital for new railroad construction can be found, electrification would offer advantages for such lines as have promise of a reasonable volume of traffic. The saving in first cost of water and fuel facilities and in the fewer engine terminals required would be considerable, and it is probable that the location of the line and the ruling gradients adopted would be such as to reduce the cost of construction as compared with a road intended to be operated by steam.

It is possible that the requirements of the Federal Water Power Act may make it impossible to contract for power for periods longer than 50 years at the most, and together with state regulation of public utility rates, may make uncertain the permanency or uniformity of power rates extending over long periods; if so, the progress of railroad electrification may be somewhat retarded.

The subject of this paper has been covered in such a brief and general manner that no conclusions are warranted. However, it would seem reasonably safe to assume that hydro-electric power would be an important factor in steam-railway electrification under the following conditions:

(a).—When cheap and available over such an extended area as would include a large main-track mileage for the individual railroad under consideration.

(b).—When supplied from several sources tied together so as to insure reliability.

(c).—When it can be contracted for long periods.

(d).—When its cost reduced to terms of locomotive tractive effort, is cheaper than that of steam-generated power

## Constructive Measures Needed for the Railways

### From the Recently Issued Annual Report of Herbert Hoover, Secretary of Commerce

Our transportation facilities have lagged far behind the necessities of the country. Progress has been made in their restoration from the demoralization of war, but our rolling stock, our trackage, and many of our terminals are unequal to our needs. Some increases in equipment have been made during the past year; yet they are entirely insufficient as the result of long-continued financial starvation. The deficiency in transportation finds its visible expression in car shortage; and while the recent strike has temporarily aggravated the situation, the trouble is far more deep-seated. Except during periods of business depression or strikes there has to some degree been continuous car shortage for the last six years. Furthermore, car shortage reaches its most acute stage during the four or five months of peak load in the fall and early winter.

**Short Transportation and Price Levels.**—Railway cars are the red blood corpuscles of commerce, and we suffer from commercial anemia every year, because they are starved. The losses through short transportation are a tax upon the community greater than the cost of our Government, because such a shortage not only stifles the progress of production and introduces speculation into distribution, but it also seriously affects price levels. No better instance exists than the lift in the price of coal by over 300 per cent in 1920, when there was no strike, and over 60 per cent in 1920, after production following the strike had been resumed. In both cases the mines could have produced 30 per cent more coal, and if the railways could have transported even 20 per cent more, then prices would have been normal. Furthermore, this very shortage is one of the most deep-seated causes of the instability in the bituminous industry and its recurrent strikes. The car shortage also directly affects our farmers, because in every car-shortage period a price differential on grain below the Liverpool price (and yet in excess of the railway rates and handling costs) sets in of from 5 to 15 ct. per bushel. The losses to live-stock growers are very great because of the necessity to feed stock beyond the fattened stage. And there are regularly great losses in fruit and vegetables because of the lack of refrigerator cars.

**Our Railways Most Efficient in World.**—The management of our principal railways today, by all the tests of administration, of load factors, of mechanical efficiency, etc., is the most efficient transportation machine in the world in so far as it is not limited by causes beyond the managers' control.

The situation has been contributed to by the war, but also fundamentally by the cumulation of experiments in public relations to the railways, both national and state. We have tried uncontrolled operation; we have tried negative regulation in the prevention of discrimination; we have tried nationalization; we are now trying positive regulation. Nationalization would be a social and economic disaster; free operation would reconstruct the vicious practices of 30 years ago. Regulation in some form is necessary, but constructive development of this regulation—to preserve the initiative and responsibility of our railway executives, to secure the fine values of private operation, and at the same time to secure public protection and assure adequate service—is absolutely vital and not necessarily incompatible. The present transportation act possesses many constructive features and some weakness. It was the result of compromises in many particulars, and these very compromises are some of its weakest points.

**The Fair Return Section of Transportation Act.**—If the causes of financial starvation were solely a question of war and of hard times, we could afford to wait for a natural solution, but they are not. The Transportation Act

of 1920 affirmatively declared that the rates should yield a fair return on the aggregate real value of the railway properties (as determined by the Interstate Commerce Commission) used in public service and operated under honest, efficient, and economical management. It provided that the fair return during the first two years should be at the rate of 5½ per cent on the railways as a whole, or in each of the major groups in which the country might be divided in the administration of the law, and that during this period there might be added 1½ per cent for rehabilitation. At the expiration of this two-year period the Interstate Commerce Commission placed the fair return at the rate of 5¾ per cent per annum, or 6 per cent less one-fourth per cent to cover income taxation. The law, however, further provided that any particular carrier which earns in excess of 6 per cent per annum shall hand over one-half of that excess into a contingent fund to be administered by the Interstate Commerce Commission "in furtherance of the public interest in railway transportation" either by loans to carriers or by the purchase of transportation equipment and facilities and the leasing of the same to the carriers. The carriers have never earned these amounts and the failure of earnings without charge on the Government is complete disproof of the current fiction that earnings are "guaranteed."

**Weaker Roads Unable to Earn Up to Average.**—Furthermore, the immediate effect of this recapture provision would be that whereas the strong and fortunately situated railways are able to earn in excess of 6 per cent, and are therefore able to secure finance for betterments, the very fact that they did earn in excess of the average would mean that the weaker roads were unable to earn up to the average. It may be accepted as a general proposition that carriers earning materially below the 5¾ per cent return are not in a position to command the confidence of investors which is necessary for expansion to meet the public demand. The contingent fund makes available money which such carriers may borrow, provided, however, that they are able to give the necessary security for repayment. It is easy to comprehend that such a contingent fund may serve the purpose of bridging carriers over temporary difficulties, but it is more difficult to understand how a carrier which, though it may be very essential to its part of the country, is financially a chronic weakling, is to be made strong and capable by becoming more deeply involved. If there is any merit in this device, it seems not to extend to those anaemic carriers that are unable to give the Government the color of assurance of repayment. This device also carries a certain liability to the Government in that carriers that borrow from the fund and fail to pay are likely to become Government railways through their financial difficulties. It would seem that the first of the two uses to which moneys of the contingent fund may be put holds out better promise of furtherance of the public welfare. However, the creation of such a national reserve of transportation equipment has not been seriously undertaken. It would seem that our dire distress in time of car shortage and at times, motive-power shortage would strongly argue for the creation of such reserves. Rolling stock for limited use during 60 to 90 days is probably unprofitable to any railroad, and certainly the stronger railroads can not, and should not, be expected to provide it for the weaker ones.

**Consolidation of Stronger and Weaker Roads.**—The present act contemplated the solution of the problem of the weak roads through voluntary consolidation of the weaker and stronger roads into larger systems to be definitely indicated by the Interstate Commerce Commission. There is no doubt that such consolidation would be a large advance in solution to the whole problem. As the nation has resolved to control rates, and thus to depend no longer on competition as a means of rate regualtion, it should secure the manifest advantages of larger systems. The economies in operation through the standardization and better employment of rolling stock would be constructive themselves, but of vastly more importance would be the strengthening of the foundations for the financing of betterments and for more intelligent handling of rate regulation. The part of the act providing for consolidations has not been advanced very much so far, although a tentative plan of grouping has been issued to serve as a basis for investigation, and hearings have been begun. When the permissible consolidations are once enunciated it is possible that some railways can arrange terms amongst themselves for such consolidations.

How far such voluntary action would solve the problem is uncertain, but compulsory consolidation leads into many untenable premises. It might be that there could be invented some inducements to consolidate into the proposed systems, or to lease for consolidated operation, or some form of co-operative operation. If the recaptured profits principle is to be maintained and if it can be enforced by the Interstate Commerce Commission, the assured application of such recaptured profits within such enunciated groups in some form might at least be worth discussion as an inducement to consolidate.

**Control of Rates.**—The alternative of repealing the miscalled guaranty clauses of the act does not fundamentally assist the expansion of the weaker roads, for so long as rates are controlled by 49 different commissions, it is unlikely that the rates would or could be made discriminatory in favor of the weaker roads, and thus the basis for the financing of betterments by these roads would not be materially improved. The suggestion that all rate control should be repealed except control against discrimination or preference would not meet the situation of the weaker roads, because the restoration of competitive rates would enable the stronger roads to again drive the weaker roads nearer to the wall.

Another vivid question in this connection is that of the rates themselves. In an era of wide disparity between farmers' incomes and that in and of industry, the transportation rates have proved to be a heavy burden on agriculture. On the other hand, under present conditions railway earnings are obviously not large enough to assure railway expansion. Some relief both to the railways and the farmer may be obtained by thorough reorganization of the rate structure. Some classes and areas of traffic are carried at actual loss; others are carried at lower rates than the relative value of the commodities warrant; and a series of scientific upward readjustments should be made in some cases in order to give the railways and the shippers of primary commodities and agricultural produce some relief. The recent reduction of 10 per cent in rates on luxuries as well as on primary goods contributed nothing to commerce and impoverished the railways just that much. The tangled skein of rates seems a mesh in which there is so persistent a resistance against every constructive proposal, that we are incapable of rescue except by some complete departure in courage.

**Wage Control and Strike Prevention.**—Another phase of present regulation is the machinery of wage control and strike prevention, which is unsatisfactory. The legislation embraces the important principle of the public's right to secure continuity of service and it carries the obligation of the public to secure just wages to the employes. The Railway Labor Board has performed large services to the employes, to the railways, and to the public. The difficulties arise from the tripartite structure of the board under the act, from its detachment from the rate-making body, and especially from the fact that the act did not orginally contemplate that the Government would be a universal wage fixer. It was the assumption that the Labor Board would only function in case of a major threat of stoppage in service. The failure of the local adjustment boards for direct contact between employes and employers has thrust all disputes on the Labor Board; and in result we have practically governmental fixing of all wages and conditions of labor with a large destruction of personal contracts.

There can be no question that action in some direction is imperative, if industry and commerce are not to be further strangled by a shortage in transportation. Whatever may have been the sins of railway finance in the last generation, we are not only suffering from them, but we have maintained an attitude of bitterness in our public relationship to our railways for which we pay tbrice over in prevention of their proper development.

We must have increased transportation, if we are to maintain our growing productivity. We must therefore find a way out of the cycle of systematic starvation of a large part of our mileage and the denudation of our railway managers of their responsibilities and initiative.

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**Railway Earnings in November.**—Figures issued by the Interstate Commerce Commission show that in November the class I roads had a net railway operating income of $78,869,000, which represents a return of 4.3 per cent on a fair valuation of $19,412,201,000 as of Dec. 31, 1921, this computation being on a seasonal basis which assigns to November 9.4 per cent of the year's income. To produce returns of 5¾ per cent would have required $105,033,000 net for that month, so the shortage for November was thus $26,000,000. For all of 1922 the net railway operating income is estimated at $760,000,000, which is 4.05 per cent on the tentative valuatidn of $18,900,000,000 made by the commission in 1920, and 3.9 per cent on the property value as it now stands.