A STATISTICAL ANALYSIS OF THE DETAILED OPERATING EARNINGS AND EXPENSES OF A RAILROAD.

by

ROBERT HASKELL KIMBALL.

THESIS FOR THE DEGREE OF BACHELOR OF ARTS in the COLLEGE OF LITERATURE AND ARTS of the UNIVERSITY OF ILLINOIS.

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THIS IS TO CERTIFY THAT THE THESIS PREPARED UNDER MY SUPERVISION BY

ROBERT HASKELL KIMBALL

ENTITLED A STATISTICAL ANALYSIS OF THE DETAILED OPERATING

EARNINGS AND EXPENSES OF A RAILROAD

IS APPROVED BY ME AS FULFILLING THIS PART OF THE REQUIREMENTS FOR THE DEGREE

OF BACHELOR OF ARTS in the COLLEGE OF LITERATURE AND ARTS.

Maurice H. Robinson

David Reiley

HEAD OF DEPARTMENT OF ECONOMICS.
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1. INTRODUCTION.

It is the aim of the writer in this brief treatment of a large subject to analyze to some extent in detail the operating receipts and disbursements which our railroads are daily coming in contact with in ordinary run of business.

Railroad income is drawn from two sources; (1) from operation, and (2) from interest on loans and investments. The writer wishes only to consider the operating receipts and disbursements which our railroads are daily coming in contact with in ordinary run of business.

Railroad operation is complex and its many items of expense vary continually so that in order to maintain the most successful operation and get the best results it is essential to watch the details and the larger items will take care of themselves.

In order to fully understand the variance in these expenses and to predict approximately future expenses and earnings, it is necessary to consider them over a series of years. The writer has endeavored to do this, for four of our large railroads, namely: the New York, New Haven and Hartford, the Southern, the Chicago, Milwaukee and St. Paul, and the Lake Shore and Michigan Southern. In the first two roads, the period studied was ten years, while in the latter two it was five, due to the lack of obtaining sufficient data.

2. SOURCES OF MATERIAL.

The sources of material consulted were rather meager. Railroad reports of the various companies were used when possible.
ble, but these were found inadequate in many cases, due to lack of uniformity in classifying detailed earnings, and expenses.

The writer bases his outline upon the Interstate Commerce Commission's Classification of operating expenses and used those roads which have adopted this classification, wholly or nearly so. Frequent changes in classification; in detailed expenses, changes from company to system; changes from annual to semi-annual reports; reports by divisions of the road; in short lack of uniformity, made the gathering of material somewhat difficult. Twenty eight railroads were investigated out of which half a dozen could have been used.

The reports of the railroad clubs and the railway magazines, and technical reports furnished some valuable material.

Among the standard books on railroading referred to were:

American Railway Management. Haines.
Railway Mail Service. Tunnell.
The Science of Railways. Vols 4, 5, 6 and 10 by Marshall Kirkman.
Poors Manual of Railroads.
State Railroad Commission Reports.
3. OPERATIVE EARNINGS.

(a) PASSENGER.

Passenger earnings vary according to the policy of the road. They bear a ratio of freight earnings of about 20 to 7 or about 20% to gross earnings from operation. But in case of the New York, New Haven, and Hartford railroad, passenger earnings for 1905 were about 79% of freight earnings and 39% of gross.

Railroad passenger earnings are by no means insignificant, and should be carefully watched. A larger proportion of profit is derived from a dollar of passenger traffic than from a dollar freight traffic, hence a large movement of passenger traffic even at low rates insures a good income.

Passenger traffic may be classed as through, local or suburban. It is to some extent the creative of circumstances or governed by local conditions. It sometimes happens that legislative requirements or demands from the public compel a railroad to furnish passenger facilities not warranted by the financial results obtainable. Competition has compelled the railroads to keep up their passenger equipment, and today as a result we have fast trains, costly sleeping cars, excellent dining car service, improved automatic brakes, vestibuled cars and modern heating and lighting apparatus. Expenses in passenger traffic are due to such demands of the public and to
competition. Transportation is made safer to-day than ever before and without any increase in rates.

Through business is smaller than local traffic and constitutes about one-third of the entire passenger business. Railroad passenger earnings arise from the sale of local commutation and through tickets and from special trains and excursions, such as tourist parties, to fairs, conventions, etc. It seems to the writer that a greater income would be derived by the railroads if they would conduct more holiday excursions to accommodate the masses of people. At a recent Yale-Harvard game, the New York, New Haven and Hartford railroad received $53,000.00 or about one day's passenger receipts for the whole line. More could be done to develop new travel at special low rates with a benefit both to the public and the railroad.

Losses due to railroads from passenger traffic are rather heavy. First, a considerable loss is incurred through "scalpers" operations, who reap a rich harvest at the expense of the railroads. Other expenses such as advertising, heating, dining cars and sleeping car service, and maintenance of equipment are indespensible.

In passenger earnings the curves show a decided increase in business with the tendency upward. Money is being continually spent for more comfortable accommodations to passengers while in freight traffic an effort is being made to reduce cost of haul. The freight train load has doubled since 1890 while passenger has remained practically stationary. The passenger earnings have steadily risen but not as rapidly as
have the freight earnings.

Passenger earning may be broken up among different classes of passengers. For instance, the following percentage of the different classes of passenger traffic were figured from the Chicago and North-Western Railroad.

Passenger Earnings.---23.93% of whole earnings.
First Class Passenger---10.32% of total passenger.
Emigrant---13% of total passenger.
Round Trip and Excursions---4.11% of total passenger.
Commutation---3.22% of total passenger.
Parlor Car---.15% of total passenger.
Freight---70.49% of total earnings.
Express-Mail, etc.---5.58% of total earnings.

Passenger Earnings are subjected to many expenses similar to freight charges, and passenger earnings are drawn upon to pay joint expenses from these two sources of profit.

(b) FREIGHT.

Freight earnings are most remunerative part of railway operation. These earnings are derived from local and interline freight transportation. The traffic manager's duty is to classify the freight so that it will give the highest net return to the company.

Roads differ in percent of high and low grade freight and also differ in the rates per ton received as is shown by one of the charts. These receipts vary from year to year according to conditions which are unavoidable. Competition is the
factor which decides often what the rate shall be.

About seventy percent of the earnings from railroads occur from freight business. The receipt per ton are lower in the United States than in any other country while the passengers are the highest. Freight receipts average about .787 cents per ton-mile, while passenger average about 2.0574 cents per passenger per mile.

Many claims arise against freight service due to losses, damage, delays and overcharges, and these must be met from operating earnings.

The freight earnings are to a large extent dependant on good track, equipment, terminal facilities and a high grade of labor. Just as these increase or decrease, so the freight earnings will vary to some extent. Competition, however, tends to make the railroads more liberal regarding betterments and compels a high grade of equipment and labor. Over one-half of the freight traffic consist of coal, iron ore, and other minerals while about 1/7 may be credited to manufactured products, 1/9 to forest products, and 1/10 to agricultural products and the remaining 1/8 may be divided among general merchandise, animal products, and miscellaneous unclassified commodities. This traffic includes between 9000 and 10000 different kinds of commodities grouped into ten or eleven classes with a certain rate to each class according to the road. These rates vary to length of haul, weight and class of goods.

These special classification lead to the adoption of certain kinds of cars such as stock, oil, refrigerator, etc.,
and hence necessitates extra equipment. A uniform classification is extremely desirable among the railroads in order to facilitate quick movement of traffic and make the accounting more simple.

(c) MAIL.

Earnings derived from the transportation of U.S. mail are comparatively small. There is no satisfactory basis for the compensation received from this carriage. The government fixes the requirement by law, and the railroads must accept them. The change from the pouch form of service, to the railway post office car service has added extra expense to the railroad due to extra fittings necessary in the car. Railroads paid for service on basis of weight and number of cars furnished. The weight of mail handled annually is approximately 350,000 tons. 86% of this being carried by the railroads on 50,000 miles of track. Various acts of congress have determined the amount to be paid the railroads. Rates based on weight are as follows:

<table>
<thead>
<tr>
<th>Average daily weight of Mails over whole route</th>
<th>Pay per mile per annum</th>
<th>Rate per ton per mile</th>
</tr>
</thead>
<tbody>
<tr>
<td>200</td>
<td>$42.75</td>
<td>$1.171</td>
</tr>
<tr>
<td>500</td>
<td>64.12</td>
<td>.702</td>
</tr>
<tr>
<td>1000</td>
<td>85.50</td>
<td>.468</td>
</tr>
<tr>
<td>1500</td>
<td>106.87</td>
<td>.390</td>
</tr>
<tr>
<td>2000</td>
<td>128.25</td>
<td>.351</td>
</tr>
<tr>
<td>35000</td>
<td>149.62</td>
<td>.234</td>
</tr>
<tr>
<td>50000</td>
<td>171.00</td>
<td>.187</td>
</tr>
<tr>
<td>Each 2000 lbs. in excess of 5000</td>
<td>21.37</td>
<td>.058</td>
</tr>
</tbody>
</table>
Rates allowable in full size post-office cars are as given below:

<table>
<thead>
<tr>
<th>Length of Car</th>
<th>Rate per Annum per mile of track.</th>
<th>Rate per mile run by cars.</th>
</tr>
</thead>
<tbody>
<tr>
<td>40ft.</td>
<td>$25.00</td>
<td>3.424 cents.</td>
</tr>
<tr>
<td>45ft.</td>
<td>30.00</td>
<td>4.109</td>
</tr>
<tr>
<td>50ft.</td>
<td>40.00</td>
<td>5.479</td>
</tr>
<tr>
<td>55-60ft.</td>
<td>50.00</td>
<td>6.849</td>
</tr>
</tbody>
</table>

This rate per mile per annum includes a round trip over the mile run. The compensation which the railroads derive from mail has decreased rapidly in relation to the amount of mail handled.

In 1897 the average rate per ton per mile for mail was 13.87 cents as against .99 cents per ton for freight and 2.04 cents per passenger per mile. But the decrease in rates since 1984 to 1897 has been greater in mail than another rate, being 39.73 percent, with the decline in freight rates at 36.54 percent and passenger 26.85 percent for the same period.

The ton mile earnings from mail and express are approximately 12.68 cents and 11.27 cents respectively, when reduced to a comparable basis. In short, it cannot be said that railroads profits derived from mail transportations are exorbitant. They are slightly higher than express charges but this is due to a difference in the service rendered. One method of treating the fairness of rate for carrying mail is to compare the decline in railway mail pay with the decrease in passenger and
freight rates. Investigations show that mail charges have fallen much faster than passengers but not quite as rapidly as freight.

(d) EXPRESS.

Express includes other matter than mail, or personal baggage carried on passenger trains. Such articles as valuable papers, books, magazines, paper money, coins, precious stones and perishable products are sent by express to insure quick delivery. The U.S. Government accepts only packages weighing four pounds or less and leaves all packages over this for express transportation. In contract with the railroad line the express company is insured a monopoly over the lines included in the agreement for which the railroad company receives from 40 to 60 percent of the total receipts to the express company according to the volume of business done by the express company.

In actual practice express charges are three or four times greater than freight charges. In the plotted curves for express revenue earnings, a decided increase is noticeable, but this increase is steady due to the steady development of business throughout the country. The mail and express earnings keep very close together, and their increase and decrease are usually at the same time.

(e) MISCELLANEOUS.

This item of earnings is, in fact, the dumping ground for all earnings from operation which can not be placed under the above classifications. This may include rentals, storage,
stock yards, steamers, elevators, balance of car mileage, switching charges or receipts from telegraph companies. Some of these may be grouped separately according to the nature of the annual report of the road, but usually they are grouped together. There is often a difference in the receipts derived from these sources but the decrease in one will be offset by the increase in another so the curve for the whole group will be uniform. This was found to be true in the roads investigated.

4. OPERATIVE EXPENSES.

Operating expenses bear an extremely important part in railway operation and should receive the closest attention. This division is extremely susceptible to manipulation and great care should be exercised in watching every separate item and reducing every separate cost whenever possible. The Interstate Commerce Commission divides operating expenses into four main classes and these will be followed by the writer.

(a) MAINTENANCE OF WAY AND STRUCTURES.

(1) ROADWAY: A very important factor in successful railroad management is good track maintenance. Our needs of to-day demand heavy traffic, many cars, speedy service and powerful engines and hence a better roadway and track, it follows that renewals must be constantly made to meet these additional requirements. Improvements in track have not kept pace with improvements in rolling stock, yet great attention is now being paid to ballast, drainage, ties, and rails. Of course such expenses will fluctuate according to the rate of renewals. Such
items as ballast, sand pit rights and privileges, tools, fixtures, rail fastenings, block signals, interlocking apparatus, piers, retaining walls, dykes, breakwaters, grade crossing expenses, and all necessary expenses directly connected with track maintenance are changed to this account. According to the curves this expense is quite variable. It is the greatest maintenance of way expense, being about 15 percent of the total operating expenses. These variations are due to the equalizing of other needed expenses. For example, when a large amount is expended for equipment, a cut must be made in other expenses and roadway will be liable to suffer for that year but it will receive its share the next, and the other items will have to bear the brunt of the expense. The amount of earnings also decide the amount of expenditures. It is also entirely possible that needed roadway expenditures may suffer because of poor management or an overruling desire to pay dividends on the capital stock.

(2) RAILS: This expense includes the cost of rails laid less the value of rails taken up, plus cost of inspection and transportation. This account should vary only according to cost of rails per ton and percent of renewals. The cost of rails has not increased materially over the time studied, yet renewals have constantly been made which accounts for the variation. Such expenses as cost of rail attachments, angle plates, bolts, frogs, switches are not charged to this account. Rate of renewal should be constant. Wear of rails depends on weight and speed of trains, conditions of rolling stock, standard of
ties, ballast, surfacing, alignments, gradients, and curves, more than ton mileage. Steel rails cost approximately $28.00 per ton.

(3) TIES: The cost of inspection, original cost, cost of delivery, preservative process, tie plates, and maintenance of the ties, fall under this expense account. Such factors as wear, deterioration, damage, loss by fire, freshet or accident necessitate an increase of this expense. The life of a tie varies with the wood, climate, ballast, drainage, mode of dressing, chemical treatment, bearing surface of the rail, speed and weight of rolling stock, track alignment, and weight of rail. So this expense is directly connected with that of roadway and indirectly with equipment and conducting transportation expenses. Owing to the approaching scarcity of wood many experiments have been made. Ties are chemically treated to preserve them and several railroads have their own plants for such work. This prolongs the life of the tie from eight to ten years. Metal and concrete ties have been tried with varying success. It taken about 2500 ties to the mile of road at an approximate cost of 70 cents per tie. In view of the fact that the annual consumption of ties for renewals is 76000000 and for new construction 14000000 it makes it more difficult every year to get ties, and the future expense will probably be greater. Some railroads are going to the expense of planting trees for ties. The expenses from this source vary in the charts according to rate of renewals and to extra cost of materials. A decrease in the curve is explained by rate of renewal decreasing. It is
estimated that a tie can be chemically treated for 20 cents but this high cost has prevented much of such treatment at present. But in the future, this treatment will have to be resorted to.

(4) BRIDGES AND CULVERTS: This account includes the cost of bridges, their repairs and renewals, expenses due to locomotives and work trains while making such repairs, wages of laborers, and supplies and materials consumed in construction and repairs. Steel, iron and wood bridges, stone or brick arch, iron, or ordinary piping and open culverts are the principal items in this account. During recent years this expenditure has largely increased due to the increased volume of business which demands heavier and stronger bridges. In the Chicago, Milwaukee and St. Paul curve a decided decrease is noticeable in this item. This subdivision also contains the expenses due to watching, and tending bridges and the operation of draw bridges. The tendency from the railroads is to increase this item making the road safer and better for travel. Wooden bridges are becoming rarer every day and the use of steel constructed bridges makes an added expense. The higher cost of labor also enters into the advanced price.

(5) FENCES: Road crossings, Signs and Cattle Guards. Such expense as right of way fences, street railway and road crossings, over head bridges, viaducts, crossing drains, signs, mile posts, crossing gates, cattle guards, hedges, street lights and street repairs or sewers for which the company may be charged come under this heading. All maintenance of such items is
placed here. These are not an essential part of the roadway for moving trains but are expenses which grow out of abutting interests, property holders, and the general public along right of way. An increase in this expense is due largely to density of population and public demands for safety. It may have a direct relation to loss and damage, and injuries to persons. This expense curve is uniform except in cases of an improvement when it arises as in the case of the New York, New Haven and Hartford Railroad.

(6) BUILDINGS AND FIXTURES: Under this account we find expenditures for renewals and repairs of all buildings used in connection with the operation of the road. Such items appear here as wages paid laborers in constructions, heating and lighting, apparatus and fixtures, stock and fuel yards, hydrants, cisterns, grading and improving grounds, and the expense of removing old buildings for construction of new. Interior fixtures such as carpets, chairs, desks, safes, stoves, tables, etc., should be charged here. Increases in this expense are due primarily to betterment of property in providing more substantial facilities for accommodating the public. Economies may be effected by increasing buildings, and this should show in the other items. So this curve may be even more irregular than the other maintenance curves. The expansion of trade demands more and better buildings than ever before.

(7) DOCKS AND WHARVES: Certain expenses, such as renewals and repairs of docks and wharves, sheds thereon and inclines thereto repainting and engines to operate cars on
piers, are charged to this account also expense due to operating pile-drivers, tugs, barges, floats, dredges, mud scows, etc. when making such repairs. In short, all costs of water facilities not afloat should be a part of this expense account. This is one of the minor expenses of most roads as it is outside of regular rail transportation. Yet the curve of the railways investigated show uniform regularity in expenditures in this expense. The greater the money expended in such equipment, the greater is the variation.

(8) TELEGRAPH: Expenses due to repairing and renewing telegraph and telephone equipment, become a part of this account. This includes poles, wire, instruments, switch-boards, telegraph signs, and tables. It also includes wages of employees engaged in keeping the lines in working condition and the cost of their tools. This is also a minor expense and its curvature over a series of years is regular in case of good weather. In cases of severe storms, it might increase largely, or it might be effected by a slight increase in cost of material as cooper wire, poles etc. repairs run from $2.50 to $5.00 per mile of line.

(9) STATIONARY AND PRINTING: Expenses in printing due to books, blank forms etc. fall under this account when used solely for maintenance of way and structures. Pens, ink, pencils, circulars, desk conveyances, type writers, letter presses, mimeographs, and duplicating processes are also a part of this expense as well as other necessary office supplies. This is a small item of expense and it has no fluctuations. It is steady and uniform.
(10) OTHER EXPENSES: Irregular expenditures not otherwise disposed of fall in this class. It may include such incidental expenditures as material used in a laboratory attached to a machine shop, detection expenses, newspapers for employees reading rooms, etc. It is not a large account and should not be.

(4) MAINTENANCE OF EQUIPMENT.

(1) SUPERINTENDANCE: This is one of the smallest items under maintenance of equipment. Its expenses includes the salaries and expenses of superintendents of motive power and car departments, auditor of motive power, and machinery master mechanics, car builders, car builders, general foremen, their clerks, and attendants and also the general expense of their offices such as fuel, heat, light, etc. There is no violent fluctuations in this curve, nor should there be as it is practically a fixed charge.

(2) LOCOMOTIVES: This account includes, the cost of rebuilding, repairs and renewals of locomotives, tenders, snow plows, furniture, loose and movable tools and supplies used in connection with the locomotive. It may include repairs of a "pusher" engine belonging to another road over which trackage rights are granted. It also includes the cost of locomotives, tenders etc. belonging to, or purchased to make good the original number charged to equipment or construction, including royalties for patent, or insurance or repayments from other roads. The Interstate Commerce Classification of operat-
ing expenses gives about two hundred and fifty items directly connected with engine repairs. This is one of the largest expenses of equipment. It is steadily on the increase and fluctuates a great deal due to different retrenchments of equipment as business permits. Such expenses as cleaning out boilers, painting smoke stacks, etc. would not come out of maintenance but are direct current expenses. A nominal repair figure to engines is about 6 cents per mile while yearly maintenance amounts to about $2800. Larger and more powerful locomotives increased the expense. This division must be kept up if the road wishes to run, hence the increase in plotted curves. An increase in weight and speed in standard of service also increases this expense.

(3) PASSENGER CARS: Repairs and renewals of all sorts of passenger cars enter this division. It includes wood work, axles, brakes, etc., and heating and lighting apparatus, oil boxes, springs, trucks, wheels, windows, repainting, and similar expenses. It may include cost of inspection and necessary tools, or payments made foreign companies for damaged cars. Also purchased cars to replace those worn out or destroyed. It includes the eighteen classes of passenger cars and the articles of passenger car furniture and fixtures. Such cars as are run in the passenger train come in this class as mail, express, smoking etc. As the type of car becomes more elaborate, the expense will increase. Such elements as conditions of track, curvature, grades, mileage per car per day, number of stops, weather, speed, length of trains and yard
usage enter into this equipment expense. It may be estimated at 1 1/4 cents per car mile or about 600 dollars a year. Public demands, competition and increased traffic have kept this curve a steadily rising one.

(4) FREIGHT CARS: This expense includes all expenses which go to make up freight equipment and keep it up to a higher standard of efficiency. Similar conditions enter in this expense as in passenger car expense. Such expenses as trucks, wheels, brakes, fixtures, etc. and damages to foreign freight cars fall under this account. This equipment must also be maintained, hence it fluctuating upward tendency. Freight equipment is becoming much heavier, and had greater capacity. Steel cars are replacing wood, hence increasing expenses. Furniture and movable fixtures of caboose, cars are included here. Freight car maintenance may be estimated at about 6 mills per freight car mile or about $54.00 per freight car per year.

(5) WORK CARS. Under this division fall all expenditures on account of repairs, renewals or rebuilding of work or service cars. Such as repairs or renewals of wood working, repainting, etc. as in above classes with similar factors entering to increase expense. All cars assigned for commercial uses of the road come under this head. Wreck cars, boarding cars, derick cars, etc. make up this class. This expense is usually the smallest equipment charge and its curve is uniform.

(6) MARINE EQUIPMENT: Includes all material and labor necessary to maintain marine equipment in efficient working order. It includes repairing hulls, decks, masts etc. and of ferry
boats, steamers, transfer boats, tugs, barges, etc. and also for repairing boilers, engines, machinery, wheels, rudders, shaft and fixtures for said boats. This curve varies according to the rate of betterment and the condition of the weather. Small repairs to boats while in service would fall under operating marine equipment.

(7) SHOP MACHINERY AND TOOLS: This expense includes such repairs and renewals as maintenance of boilers, stationary, engines, furnaces, forge and all machinery for car and locomotive shop and round houses. This item is steady and uniform in curve and renewals should be made constantly to cheapen locomotive repairs as modern high grade machinery cheapens the cost of repairs.

(8) STATIONARY AND PRINTING: Same as in Maintenance of way and Structures only for the maintenance of Equipment of department. It is practically of the same nature and is the same curve.

(9) OTHER EXPENSES: This is of the same nature as other expenses under maintenance of way only it applies to equipment. It includes such costs as round house expenses due to lighting, heating, labor, watchmen, and water for boilers. Also Y.M.C.A. educational courses, reading rooms are placed here. Here are grouped the general irregular equipment expenses.

(c) CONDUCTING TRANSPORTATION.

(1) SUPERINTENDENCE: This is an expense of operating officers and their clerks and attendants. That is general superintendents, those men who carry on the movement of trains
and get the traffic. Increase in train mileage of traffic density will affect this curve. But uniformly it is steady from year to year. This expense also includes general incidental office expenses as heating, lighting, ice, water, rent etc.

(2) ENGINE AND ROUND HOUSE MEN: This expense is one of the greatest under conducting transportation. It includes wages of all engineers and firemen engaged in running locomotives, and wages of all round house employees as hostlers, cleaners, smoke stack inspectors, etc. Actual work on the engine is placed under the equipment division, but the cost of handling dead engines at terminals, is charged to this account. This expense is liable to large single fluctuations due to changes in contracts in hiring engineers and firemen and also to the higher cost of labor. On all roads it shows a rapid rise with a tendency upward. Increased mileage means increased expense in this division.

(3) FUEL: This account includes the cost of fuel consumed by all locomotives including freight charges and wages of fuel agents and their employees engaged in handling and accounting for the same. It also includes such supplies as are necessary to the handling of the coal as wheel-barrows, shovels, etc. This account varies greatly due to increased coal costs, increased volume of business, and increased car miles travelled. Its original cost varies greatly in different parts of the country, and ranges from one dollar per ton to six dollars. Facilities for handling, grades, curves, skill in firing, speed number of stops, all enter into the cost. It is undoubtedly
the heaviest expense under conducting transportation and every effort should be made to keep it down. Engines "popping", leaky steam chests and unrepaired equipment are drains on the coal pile. Extremely cold winters may vary the cost in fuel from 25 to 50 percent. Oil is being experimented with as a fuel for locomotives.

(4) WATER SUPPLY FOR LOCOMOTIVES: Under this account may be placed the cost of the water furnished all locomotives and the labor expended in handling the same. Pumping machinery, tools, water rights, and privileges and water used in round houses for various purposes. This expense is indirectly related to the volume of business. It is in reality a fixed charge. Its curve shows a steady upward tendency with slight fluctuations, due to increased locomotive equipment and increased expense due to heating, lighting and operating water stations.

(5) OIL-TALLOW-WASTE: This account is easily regulated as the articles are definite and easily measured, conditions affecting use are uniform. Such materials as oil, tallow, waste, wool, grease, rags etc., are classed here. It is a large item and its increase is fairly steady during the latter years.

(6) OTHER SUPPLIES FOR LOCOMOTIVES: Such supplies as are needed in locomotive operation not designated in previous accounts, come in this account. It includes such movable articles as lanterns, soap, axes, crow-bars, oil cans etc. This curve is uniform throughout.

(7) TRAIN SERVICE: This account covers the cost of moving revenue trains between terminals excluding motive power
expense. It includes such expenses as wages of conductors, brakemen, flagmen, car porters etc. It fluctuated considerably and has risen rapidly during the last few years. Higher wages is responsible for this rise and this expense cannot be sacrificed or cut only at the expense of personal safety, or delayed train movement, which means increased repairs and extra fuel cost.

(8) TRAIN SUPPLIES AND EXPENSES: This account includes those supplies incidental to regular train movement yet not used on the engine. It includes such expense as heating, lighting, cleaning and lubrication of cars, icing, refrigeration of cars, transferring freight, and miscellaneous supplies used in transportation, also during car deficits. (if any). This curve has steadily increased due primarily to increased volume of business.

(9) SWITCHMEN, FLAGMEN, AND WATCHMEN: This is distinctly a wage account. It includes the wages of all yardmen, switch-tenders, watchmen, detectives, signalmen, crossing gate keepers and flagmen, station policemen, etc. and wages paid such laborers for joint use of track. This expense may be increased through larger and better terminal facilities or more crossings or stricter city ordinances regulating these crossings. Its curve is steady but has increased upward during last decade due to labor prices and greater number of men hired.

(10) TELEGRAPH: Includes all expenses due to operating telegraph and telephone facilities, such as rents, salaries of operators, cost of chemicals for batteries, fuel, light, and
other expenses of telegraph offices, wages of employees superintendents and miscellaneous supplies. Expenses may arise also from delays, over burdened wires, and irregular demands. But usually this curve is steady with no fluctuations and is a minor operating expense.

(11) STATION SERVICE: This is also primarily a wage account. It is made up of wages of those whose services are not directly connected with trains movement but necessary to the handling of freight and passengers. It includes labor relative to section operation, such as receiving, delivering, billing, routeing, quoting rates, selling tickets etc. It may include cost of warehouse operation, gate keeping, checking baggage, keeping accounts, expenses at stock pens to some extent. This curve is a large expense and is quite irregular due to advances in wages. It closely follows the train service curve. With increased mileage, stations must increase and hence this means increased station service expense.

(12) STATION SUPPLIES: This account is similar to the other supply account. It embraces, costs for heating and lighting depots, freight and passenger officer, engines which convey freight from boats to cars, supplies used for stations and yard signals, implements for handling freight etc. A list of over one-hundred minor station supply articles fall under this class. It is a material account corresponding to the labor account. This expense gives a curve of steady increase with few sudden deviations caused by increased use and cost of material.
(13) SWITCHING CHARGES-BALANCE: This account represents the net balance paid to other companies for switching cars or locomotives. From other roads similar charges are deducted giving this net balance. This expense is sometimes borne directly by shipper, and other times it is included in freight rate. It is sometimes paid by the railroad. These charges have risen rapidly on the roads studied due undoubtedly to the amount of assistance received from foreign roads due to the interline nature of the traffic. These balances will necessarily vary according to the road.

(14) CAR MILEAGE-BALANCE: This account represents the net balance paid to other companies, firms or individuals for use of cars interchanged on car mileage basis. One car is interchanged for a similar car on another road. The mileage rate is constructed on the basis of cost. The curve for this expense varies according as the supply and the demand for cars vary due to the demands of trade.

(15) HIRE OF EQUIPMENT: This includes such expenses as have not been accounted for under the latter account. It will include hire of locomotives and certain kinds of cars which are not under the interchange plan and are rented outright. Hire of equipment of special design to meet irregular needs when it is cheaper to hire than to maintain its own, is the source of expense in this account. Its curve is regular and rising.

(16) LOSS AND DAMAGE: Delays, loss, damage or destruction of freight, express or baggage and other property in-
trusted for transportation and all expenses directly incidental thereto are charged to this account. Live stock is included here. Wages of employees engaged as adjusters or witnesses in case of suits are charged to this account. This account should be in direct relation to train miles and equipment charges. As mileage increases and equipment increases, the curve will vary as shown in chart. Such expenses are settled through the claims department which determines liability of the carrier. It is exposed to the most extreme fluctuations due to its uncertain nature, but new interlocking devices have lessened this. Factors entering into this expense are discipline in service and character of goods carried.

(17) INJURIES TO PERSONS: In all injuries to employees or other persons, either seriously or fatally the charges which accrue such as gratuities and compensation paid to injured or disabled persons, salaries of surgeons, fees of doctors, coroners, undertakers, hospital attendance, medical and surgical supplies, funeral expenses and payments made for ejectment from trains are charged to this account. This account will be largely affected by the maintenance standard and will vary with it. The discipline of the service also is a determining factor in the size of this expense. Agencies such as Y.M.C.A., club houses, etc. are organized to raise the standard of labor. The tone of public sentiment may lessen or increase the size of this account. Such factors as speed, weather conditions, and careless operation influence these charges. This curve fluctuates according to the irregularity of the expense and its tendency is upward.
(18) CLEARING WRECKS: It includes all expenses due to clearing wrecks, such as cost of labor and material required to place wrecked equipment on track due to wrecking trains operation, tools, reloading of freight, baggage or mail, watching expenses, board of passengers delayed by wreck, feed for stock so delayed, cost of temporary track, etc. It provides for all such extra ordinary expenses. This curve is very regular and its rise is slight due to uniform expense charged to it. Better wrecking outfits have reduced the expense to a minimum.

(19) OPERATING MARINE EQUIPMENT: All expenditures arising from operation of steamships, steam boats, vessels, ferry boats, tugs, barges, scows, etc. are included under this account. It also includes wages of officers and crews and wages of all other employees rendering service on this equipment, also dockage, canal dues, rentals, cargo transferage, steamboat inspection, license, custom dues, health, inspection, clearance dues, towage, etc. Certain supplies, expenses due to operation of wharves, payment for use of power, etc. are charged to this account. This account is independant of all others due to nature of the business. This curve has risen steadily due to increased business.

(20) ADVERTISING: This account includes salaries and expenses of advertising agents, billposting, cost of printing time tables, advertising in newspapers and periodicals, bulletin boards, folders, cards, dodgers, handbills, maps, photographs, posters, etc., also premiums to fairs, and stock shows, immigration boards and other means for attracting traffic. It
does not include general notices such as stock holders meetings, etc. which are not of the nature of advertising. This is an extremely uncertain account and may hide certain fraudulent expenses. As much advertising is paid for in services which tend to make this account smaller than it ought to be. Such advertising expenses as fast trains, beautiful station architecture and grounds are not included. Its curve is steady and rises upward due to competition demands or increased business.

(21) OUTSIDE AGENCIES: This is a wage and supply account. It includes wage and expenses of agents engaged in the procuring of competitive business and their employees. Such items as furniture, supplies, rents, office expenses, fast freight lines, and traffic associations expenses are charged to this account. It is a fixed cost from month to month and is the direct cost of getting the business. It is a competitive expense and varies with the degree of competition on the road. Its curve is irregular due to different forms of traffic organizations on different roads.

(22) COMMISSIONS: This expense is similar to the above. It includes payments to agents of other companies and outside parties for services relative to either freight or passenger traffic but does not include commissions paid to original company in form of salaries. The curve varies with the amount of competitive business.

(23) STOCK YARDS AND ELEVATORS: Wages, cost of supplies and all other expenses incurred in the operation of
stock yards, or elevators, are included in this account. It is
practically a distinct business, as operating marine equipment
and varies according to the nature of the road's traffic. But
on anyone railroad the curve is regular according to the volume
of business.

(24) RENTS FOR TRACKS, YARDS, AND TERMINALS: (a)
Tracks. This includes all payments to other lines for rent or
use of tracks for running trains whether by a fixed periodical
charge, proportion of interest on valuation and expense incurred
in maintaining or on the trail mileage basis. Temporary rentals
are not included.

(b) Yards. Includes all payments for use of side tracks, delivery or repair tracks at points other than terminals.

(c) Terminals: This includes payments made for use
of facilities at terminal points such as main tracks, side tracks
freighthouse facilities and proportion of payments for handling
freight union depot facilities etc. at terminal points.

This curve's tendency is upward due to increased de-
mands at times when railroad equipment is not adequate and to
the increased value of terminal facilities to the railroads.

(25) RENTS OF BUILDINGS AND OTHER PROPERTY: Rents
of buildings leased, and other property such as depot grounds,
union depots, general and other office, docks, wharves, ferry
landings, elevators, stock yards, fuel yards, repair shop, etc.
which have to do with operation of the road are charged to this
account. This expense is smaller than the above rents and its
curve is very regular and slight due to the fixed nature of the charge.

(26) STATIONARY AND PRINTING: This account is similar to same accounts under equipment and way and structures. It includes such expenditures as are made relative to conducting transportation. Such items in stationary and stationary supplies as printing books, blank forms, time tables, tariffs, ticket, way bills, etc., appear in this account. Various supplies such as pens, mucilage, indexes, postage, shears, waste baskets, etc. are included here. This curve is stationary as the expense is practically fixed and no general causes tend to change its, except changes of forms used which is a rare occurrence.

(27) OTHER EXPENSES: This account includes incidental expenditures not classed in above accounts relative to conducting transportation. Expenses such as gratuities to employees reading rooms, Y.M.C.A. operation, extraordinary bulletins, strikes, dues of transportation associations, officers of associations and demurrage bureaus are classified under this account. This curve is irregular and is a minor expense.

(d) GENERAL EXPENSE:

(1) SALARIES OF GENERAL OFFICERS: All salaries of general officers are included in this account. Such officers are president, vice presidents, counsels, solicitors, secretary, managers, chief engineers, general superintendents, comptrollers, auditors, purchasing agents, treasurers, land commissioner, etc.
Such officers are not special to any department. This curve is regular and should not fluctuate, but in good times prosperity increases the salaries and we have an upward rise in wages and also the present railroad complexity demands capable management and cities in turn demands high salaries.

(2) SALARIES OF CLERKS AND ATTENDANTS: Such employees as paymasters, cashiers, tax agents, traveling porters, cooks, for special cars, and all general office employees are charged to this account. A great proportion of this expense is due to auditing and preparing statistics of costs etc. This curve follows very largely the one above and is influenced by similar causes. The demand and supply of labor and the volume of business done are determining factors.

(3) GENERAL OFFICE EXPENSES AND SUPPLIES: The two preceding accounts include all salaries paid to general office employees and this account includes all other expense exclusive of stationary. Expenses of heating and lighting offices of general officers, expense of general officers, expenses incident to care and supply of general offices as pay car and special car expenses while in use by general officers. The curve is regular for this charge because it is a regular expense.

(4) INSURANCE: All premiums for insuring the property intrusted to it, and also premiums for insuring passengers and other employees against accident or death are part of this expense. As the rates do not vary greatly this curve remains stationary and increases only as far as extra insurance is taken out.
(5) LAW EXPENSES: This account embraces the salaried legal services employed, such as division counsels, solicitors, etc. It includes all expense of their offices, except stationary, for law books, legal forms, printing briefs, testimony, etc. It also includes fees and retainers paid for attorneys who are not regularly employed by the road, and amounts paid to arbitrators, costs of suits, special fees, and all legal and court expenses of all kinds not otherwise provided for. This expense is determined by the railroad attitude towards the laws. Such expenses as lobby blackmail etc. if practised by a railroad would come under this heading. Negligence of operation temper of the people, and density of traffic are factors entering into this charge. Its curve is irregular, due to irregular expenses incurred.

(6) STATIONARY AND PRINTING: This account includes the cost of printing annual reports, blank books, forms, contracts, leases, bonds, stock certificates and stationary supplies used only in general offices and not chargeable to other accounts. This is a heavy item and is affected by the same causes which affect other office accounts. Various methods of work may vary this expense. Clerical labor may be affected by use of duplicating blanks, adding machines, etc. This curve is steady and does not vary to any extent.

(7) OTHER EXPENSES: Only incidental expenditures are included in this account, that are not classified in foregoing accounts. It may include cost of publishing notices of
stock holders meetings, election of directors, of dividends, publishing annual reports in newspapers, fees and expenses paid to directors, and all notices of general character which must be published. This account is small and irregular and its plotted curve over a series of years shows this irregularity.

Mr. Shirley Eaton gives the following percentages of the detailed operating expenses to the whole operating expense. This is about the average of expenses percentages for a well maintained road.

<table>
<thead>
<tr>
<th>Description</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maintenance of way-total</td>
<td>27.23</td>
</tr>
<tr>
<td>Repairs of Roadway</td>
<td>15.38</td>
</tr>
<tr>
<td>Renewals of Rails</td>
<td>2.59</td>
</tr>
<tr>
<td>Renewals of Ties</td>
<td>3.98</td>
</tr>
<tr>
<td>Renewals of Bridges, culverts</td>
<td>3.36</td>
</tr>
<tr>
<td>Renewals of Fences, Crossing Signs, Cattle Guards</td>
<td>.21</td>
</tr>
<tr>
<td>Renewals of Buildings and Fixtures</td>
<td>1.64</td>
</tr>
<tr>
<td>Renewals of docks and wharves</td>
<td>.01</td>
</tr>
<tr>
<td>Telegraph</td>
<td>.039</td>
</tr>
<tr>
<td>Stationary and Printing</td>
<td>.02</td>
</tr>
<tr>
<td>Other expenses</td>
<td>.001</td>
</tr>
<tr>
<td>Maintenance of Equipment-Total</td>
<td>15.57</td>
</tr>
<tr>
<td>Superintendence</td>
<td>.7</td>
</tr>
<tr>
<td>Repairs, Locomotives</td>
<td>5.78</td>
</tr>
<tr>
<td>Repairs, Passenger cars</td>
<td>2.37</td>
</tr>
<tr>
<td>Repairs, Freight Cars</td>
<td>5.75</td>
</tr>
<tr>
<td>Category</td>
<td>Percent</td>
</tr>
<tr>
<td>----------------------------------------------------</td>
<td>---------</td>
</tr>
<tr>
<td>Repairs, Work Cars</td>
<td>0.2</td>
</tr>
<tr>
<td>Repairs, Marine Equipment</td>
<td>0.01</td>
</tr>
<tr>
<td>Repairs, Shop machinery and Tools</td>
<td>0.42</td>
</tr>
<tr>
<td>Stationary and Printing</td>
<td>0.04</td>
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<tr>
<td>Other Expenses</td>
<td>0.3</td>
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<tr>
<td><strong>Conducting Transportation—Total</strong></td>
<td><strong>52.84</strong></td>
</tr>
<tr>
<td>Superintendence</td>
<td>2.48</td>
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<tr>
<td>Engine and Roundhouse men.</td>
<td>8.94</td>
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<tr>
<td>Fuel for Locomotives</td>
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<tr>
<td>Water Supply for Locomotives</td>
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</tr>
<tr>
<td>Oil-Tallow-Waste, for Locomotives</td>
<td>0.42</td>
</tr>
<tr>
<td>Other Locomotive Supplies</td>
<td>0.22</td>
</tr>
<tr>
<td>Train Supplies and Expenses</td>
<td>1.96</td>
</tr>
<tr>
<td>Train Service</td>
<td>6.39</td>
</tr>
<tr>
<td>Switchmen, Flagmen, Watchmen</td>
<td>2.85</td>
</tr>
<tr>
<td>Telegraph Expenses</td>
<td>2.59</td>
</tr>
<tr>
<td>Station Services</td>
<td>6.73</td>
</tr>
<tr>
<td>Switching Charges</td>
<td>0.52</td>
</tr>
<tr>
<td>Station Supplies</td>
<td>0.72</td>
</tr>
<tr>
<td>Hire of Equipment</td>
<td>0.11</td>
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<tr>
<td>Car Mileage-Balance</td>
<td>1.54</td>
</tr>
<tr>
<td>Loss and Damage</td>
<td>1.37</td>
</tr>
<tr>
<td>Injuries to persons</td>
<td>1.36</td>
</tr>
<tr>
<td>Clearing Wrecks</td>
<td>0.13</td>
</tr>
<tr>
<td>Operating Marine Equipment</td>
<td>0.02</td>
</tr>
<tr>
<td>Advertising</td>
<td>0.38</td>
</tr>
<tr>
<td>Outside Agencies</td>
<td>1.97</td>
</tr>
<tr>
<td>Description</td>
<td>Percent</td>
</tr>
<tr>
<td>-----------------------------------------------------------------</td>
<td>---------</td>
</tr>
<tr>
<td>Rent of Tracks, Yards, and Terminals.</td>
<td>.50</td>
</tr>
<tr>
<td>Rent of Buildings and Other Property.</td>
<td>.23</td>
</tr>
<tr>
<td>Stationary and Printing.</td>
<td>1.16</td>
</tr>
<tr>
<td>Other Expenses.</td>
<td>.44</td>
</tr>
<tr>
<td><strong>General Expenses—Total.</strong></td>
<td>4.36</td>
</tr>
<tr>
<td>Salaries of General officers.</td>
<td>.85</td>
</tr>
<tr>
<td>Salaries of Clerks and Attendants.</td>
<td>1.26</td>
</tr>
<tr>
<td>General Office Expenses and Supplies.</td>
<td>.26</td>
</tr>
<tr>
<td>Insurance.</td>
<td>.56</td>
</tr>
<tr>
<td>Law Expenses.</td>
<td>.96</td>
</tr>
<tr>
<td>Stationary and Printing (General offices)</td>
<td>.27</td>
</tr>
<tr>
<td>Other expenses.</td>
<td>.21</td>
</tr>
</tbody>
</table>
CONCLUSIONS.

In this review of the various detailed operating expenses of a railroad, there is one noticeable feature, which stands out above all others. This is the increase in the various items which go to make up the total operating expense. These increases are slight in relation to such expenses as supplies, insurance, stationary, law, etc. but heavy regarding expenses involving much labor as engineers, station service, etc.

Another noticeable fact, is, the tendency of the roads to improve their equipment and maintain their roadway and structures up to a high degree.

Expenses due to renewals of rails and ties may be in part attributable to curves and alignment of track and also to a poor quality of rail. The mills are overcrowded and the product is turned out so rapidly that it is not up to standard grades, hence it makes renewals necessary more often and increases the expense.

Costly signaling systems are being installed on most roads, which tend to raise the amount of money charged against roadway but in the end it is a saving to the company from loss, damage, and injuries to persons.

Railroad safety appliances are used almost entirely by every road and the law is complied with very closely.

During the year 1905 the railroads expended 850 million dollars in purchasing equipment, this including 542,005 freight
cars, 8,650 passenger cars and 18,154 locomotives and still the country suffers from shortage of equipment.

Another noticeable element in railway cost is that of labor. Today railway labor is of a high grade and receives high compensation as shown by curves. This is rapidly increasing.

In regard to stationary and printing, it has been suggested that it was feasible to abolish many existing forms now used. Station agents are overburdened with useless daily reports. The carbon duplicating process is not used as much as possible. The long distance telephone may solve the problem in the future.

Locomotive expense is very high. Its cost varies with the nature of the road. The cost of labor and materials in different parts of the country vary the cost. Locomotive operation is about one-third the cost of total working expense.

Salaries and wages may be said to constitute two-thirds of the ordinary operating expense account and the other third to materials.

The amount necessary to the maintenance of road bed, buildings, etc. can be and is largely fixed by the management and the necessary appropriations granted for any work of special nature.

Fuel expense is one of the most costly to railroads. The approximate cost yearly to all the railroads in U.S. and Canada is $150,000,000. It is the next largest item to salaries. Owing to themany locomotives in use and the large daily con-
sumption of coal and the conditions surrounding the generation of steam, there is bound to be a large loss. Loose joints, faulty packing ("popping") of engines, inefficient firemen all help to increase the drain on the coal pile.

Locomotive repairs on several railroads per mile run average approximately as follows:

- Pennsylvania (1903) 7.74 cents.
- Chicago and Alton. 6.35
- Louisville and Nashville. 6.96
- Northern Pacific. 7.24
- Missouri Pacific. 7.27

Legal expenses may be increased through blackmail or bribes exerted in order to prevent hostile legislation or threatened suits, which might cause a loss to the stockholders. It is reported that Jay Gould remarked before the Erie railroad investigation committee, that it was cheaper to make legislators than to buy them. Publicity is a remedy for such transactions.

The following percentages are about the average for railroads operating in this country. The relation shown is that of earnings and expenses to gross earnings.

C. B. & Q.

<table>
<thead>
<tr>
<th>Gross Earnings.</th>
<th>100.00</th>
</tr>
</thead>
<tbody>
<tr>
<td>Freight.</td>
<td>66.5</td>
</tr>
<tr>
<td>Passenger.</td>
<td>24.1</td>
</tr>
<tr>
<td>Mail.</td>
<td>3.5</td>
</tr>
<tr>
<td>Express.</td>
<td>2.0</td>
</tr>
<tr>
<td>Miscellaneous.</td>
<td>3.9</td>
</tr>
</tbody>
</table>
It is also a noticeable fact that as our trains have increased in weight during the last ten years, there has been a decrease in cost of transportation as shown by the annual reports. This is due primarily to locomotives of increased power, and the use of tonnage rating methods so as to load engine more uniformly and efficiently. This leads to less train mileage and to greater efficiency of men while at work, because of less hours of employment.

From the foregoing general conclusions it may be seen that detailed cost is of primary importance to the railroad and much time is being spent in order to devise new and better methods in order to effect a saving and yet not lower the efficiency of the railroad in any way.

Future railroad accounting will go still deeper into the details of expense so as to increase the profit by reducing expenses where possible. Competition and legal requirements become more enacting every day, and in order to maintain a sufficient margin between gross-earnings and gross-expenses, it
will become necessary to study every detailed expense and reduce them whenever possible by better economic methods. Increased cost of materials, and labor have meant increased expense. The railroad of the future which closely watches its detailed expenses and eliminates all economic waste will be the successful railroad.

Retrenchments should never be made at the expense of safety and in this respect even increased expenditures for betterments is good economic policy and is a future saving. An increased moral standard among railroad officials will undoubtedly aid in eradicating bribery, dishonesty and blackmail from operating expenses and all expenses due to these evils will be eliminated and we will have at the close of the year; detailed expenses not stained by corruptive entries as they are under some of our railroad managements.
NEW YORK, NEW HAVEN AND HARTFORD RAILROAD.

Curves showing detailed earnings and expenses over a series of ten years in relation to gross earnings and expenses.
New York, New Haven and Hartford.

Each square = $5,000.
THE SOUTHERN RAILROAD.

Curves showing detailed earnings and expenses over a series of ten years, in relation to gross earnings and expenses.
SOUTHERN RAILWAY COMPANY.

Each small square = $300,000.
Southern Railway
AND CONNECTIONS
1905.

Southern Railway System.
Operated separately—Majority Stock owned.
Other lines in which Southern Railway Company is interested.
Principal Connections.

The Southern Railway Co., Atlanta, Ga.
THE CHICAGO, MILWAUKEE AND ST. PAUL

and the

LAKE SHORE AND MICHIGAN SOUTHERN RAILROADS.

Curves showing detailed expenses over a series of five years in relation to gross earnings and expenses.
MISCELLANEOUS CHARTS.

Showing earnings and expenses by months, classification of tonage, per mile, passenger and freight rates, relation of operating expenses to earnings and the mileage of four roads studied.
CHART SHOWING Percentage of Expenses to Earnings for Following Railroads.

PREPARED BY R.H. Kimball

DATE May 11, 1906.