Annual maintenance is cheap when good ties cost little and when they last many years. This was the condition 20 years ago. White oak ties cost in certain regions as little as $0.20; the standard rails were about 60 lbs., the axle loads about 15,000, the cars with only 40,000 lbs. capacity, trains comparatively few. Ties were rarely rail-cut and lasted indefinitely. The annual cost of $0.20 tie ($0.40 in track) lasting 20 years, was $0.48 per year.

Now inferior woods cost more than best white oak formerly did, axle loads have increased, car loads have increased, trains are more frequent and heavier. It is a race between fungus and rail to see which will destroy the tie sooner. A good tie in main track costs at least $1 and, unless treated, wears out in seven years. Annual cost, $0.213. At this rate it would cost a road with 25,000,000 $4,000,000 a year more than it did 20 years ago. Creosote, at a cost of $0.25, put on heavy tie plates at a cost of $0.35 more, and the first cost rises to $1.60. Such a tie would have to last 16 years to give a yearly cost of $0.213. Will it? Assume that it lasts 10 years, the annual cost becomes $0.273. This is $5,500,000 a year more than it was about 1905.

There is at present no immediate prospect of any economical substitute. In 1904, a St. Louis patentee thought he could make a cast-iron tie for $3.50. The interest and tax charges alone on this tie would be $0.245. Assuming the tie to last 30 years and to have a scrap value of $1, the tie would cost $0.328 to maintain. There is still nothing fulfilling the purpose as cheap as a good wood tie. It is at present unreasonable to consider any substitute, even with a certain life of 20 years at a higher cost than $1.67, since $0.20 a year is sufficient to maintain best main-line ties.

Tie expense is reduced to a minimum by five rules: (1) Buy the ties carefully. (2) Spend all on protection that the gain in life justifies. (3) Use them at once. (4) Do not take them out before they are used up. (5) Assort them for proper use.

Careful buying insures a price reduction of about 10 per cent. and a quality increase of about 20 per cent.

To allow ties to lie fallow for two years shortens the life two years and adds about $0.14 first cost.

Many ties are removed from one to five years before they are really gone.

A new, rotten tie costing to lay in track $0.80 and lasting two years, costs per year $0.456, or more than twice as much as the maintenance of the best main-track tie, plated and preserved.

TEST ON NEW WINNIPEG PLANT.

Official tests were made from February 5th to 7th, on two of the three new water wheels installed by the city of Winnipeg. Mr. E. V. Caton conducted the tests after the wheels had made a 30 days continuous run. The results showed that 7,220 h.p. could be obtained by each wheel under 46 feet net head at 80 per cent. gate opening. Escher Wyss and Co., who supplied the water wheels, had guaranteed 6,800 h.p. under a net head of 45 feet. The efficiency of the wheels is calculated to be 88 per cent. at .8 gate opening.

These machines have been placed in the city's power plant at Point du Bois, Man. The tenderers were required to bid on machines which would develop the maximum possible power when using the existing wheel pits and concrete draught tubes. The pits and tubes were designed for units of 5,200 h.p., and each tenderer was at liberty to quote for wheels of the largest size he considered possible. Heavy penalties were named for failure to meet the guaranteed h.p.

STEAM VERSUS WATER POWER.

THE Ferris water-power bill, recently under the consideration of the United States Senate, was the occasion of many expert opinions from engineering experts in both hydro-electric and steam power plant construction and operation. The Senate committee held a number of hearings on the question of cost of installation and operation and the relative efficiency of both types. The differences of opinion expressed were marked, as will be shown by "Power's" résumé of the arguments.

Paul M. Lincoln, president of the American Institute of Electrical Engineers, advised that increased efficiency and lower unit cost of installation in the steam plant within recent years altered the hydro-electric situation materially, and that the value of potential water powers had perhaps been overrated because of failure to consider this fact.

"There is much public misconception," Mr Lincoln stated, "as to the profits of hydro-electric companies, which are generally considered as very large because of the idea that water power costs nothing and the cost of operation is small, while the company's income is large. On the contrary," he stated, "the interest, sinking-fund charges, taxes and depreciation on the larger initial cost of water-power installations are comparable with the cost of coal in a steam station. The invested capital in a water-power plant is so much greater than the public realizes that with interest charges at not more than 5 or 6 per cent., in a majority of cases from 70 to 80 per cent. of a water-power company's income is absorbed. This return to capital is not profit.

"When the cost of installation for water-power development amounts to $100 per kilowatt capacity against an installation cost of $50 per horse-power for steam," declared Mr. Lincoln, "it is always a serious question whether the steam plant is not likely to be more economical and profitable."

Several other electrical engineers testified along the same lines, urging the discrepancy between steam and water-power installations and the growing efficiency in steam generation of power, to such an extent that advocates of the water-power bill intimated the possibility of an organized effort on the part of the electrical engineers and water-power companies to affect the pending legislation by depreciating the potential and actual value of water powers in the minds of the committee.

In support of his argument Mr. Lincoln said that engineers have claimed it would be cheaper to install a steam plant in St. Louis to furnish light and power in that city than to transmit hydro-electric power from the Keokuk dam. An auxiliary steam plant, he claimed, could undoubtedly be installed in Buffalo to take the peak of the load for that city while the Niagara Falls Power Co. carried the main part of the load, and the combination would give Buffalo cheaper power than is now being furnished by the Niagara Falls company. In other words, the cost of the hydro-electric installation to carry a high peak is disproportionate to the return from this peak. He admitted, however, that, considering the entire load factor, the Niagara water power transmitted to Buffalo was developed cheaper than power could be generated there by steam. When questioned about Western power development and costs, he suggested that if water-power installation cost more than $150 per kilowatt capacity in Los Angeles, it would probably be found that steam power could compete with it.