fare at cost on the previously-outlined basis would yield the railway $610.50, while the flat-rate, 5-cent fare yields $600, as indicated in Table V on page 623, the two figures in this case being in substantial agreement.

The elimination of the 2-mile trip would clearly require that 6 cents be made the flat rate for the remaining lines, and the elimination of the 3-mile and 5-mile lines would raise this flat rate first to 7.5 cents and then to 10 cents.

It must be evident then that the "jitney" bus can compete in the matter of the cost of operation only under very special conditions with the electric railway, and it should be borne in mind that each passenger now riding 2 miles on an electric car contributes something toward the cost of carrying the passenger who rides 10 miles. If the "jitney" bus, then, is permitted to compete with electric lines for this short-haul business, it is obviously but a step toward the zone system of fares.

Electrical Night at N. Y. R. R. Club

Recent Progress in Steam Road Electrifications Described before the New York Railroad Club

The eleventh annual electrical night of the New York Railroad Club was held Friday, March 19, with some 500 members present.

Following the opening remarks by William McClellan, chairman of the committee on electrical subjects, George Gibbs of Gibbs & Hill, consulting engineers, New York, was introduced.

MR. GIBBS' REMARKS

Mr. Gibbs first discussed, with the aid of slides, the electrification of the Norfolk & Western Railway. The superiority of electrification in this case, he said, was due largely to the presence of a long, continuous grade and the opportunity it afforded for the maximum utilization of equipment. If electrification should be extended, say for the entire division of 120 miles, the economies would be less because grades occurred in the middle of the adjoining sections.

Speaking about the equipment in hand, Mr. Gibbs said that twelve electric locomotives were replacing thirty-two steam locomotives. This was due in part to the fact that an electric train would have but two electric locomotives, header and pusher, as against three steam locomotives; and in part to the elimination of engine watering and coaling.

One characteristic of the new locomotives was their ability to exert full tractive effort for a considerable time, say five minutes, while standing. In starting trains it was difficult always to get synchronous action of the header and pusher. With regenerative control it had been found feasible to go down grade at 15 m.p.h. without the use of brakeshoes. As much as 8000 hp had been put into a train, an amount, he believed, never before reached in either steam or electric operation.

Mr. Gibbs then discussed the Paoli electrification of the Pennsylvania Railroad, also with the use of slides. In this case the reason for electrification was that it would reduce existing track congestion at less expense than would the acquirement of land for more track and terminal facilities. It was not, then, a question of securing a direct return on the investment. Among Mr. Gibbs' views were some of the newly-installed light signals which show rows of white lights in any one of three positions—horizontal, 45-deg. and vertical—to take the place of the usual movable semaphore arms.

MR. EATON'S REMARKS

The next speaker, G. M. Eaton, Westinghouse Electric & Manufacturing Company, presented a series of slides which showed the progress of the Norfolk & Western locomotives from the receipt of the Baldwin chassis to their completion at the Westinghouse works. In discussing various details of the locomotives Mr. Eaton mentioned the liquid rheostat. This device has no moving plates. Instead of moving the plates to vary the resistance, a valve and pneumatic cylinder are provided for the converse act of raising the water.

PROFESSOR PENDER'S REMARKS

Harold Pender, professor of electrical engineering University of Pennsylvania, then discussed the use of electric motor trucks in large freight houses and stations. As in other kinds of electrification, density of traffic determined the question of economy. In one instance of freight moving with two-wheel hand trucks the cost was $5.33 per ton-mile whereas electric trucks in one Chicago freight house had lowered the cost to 39 cents per ton-mile and in another Chicago house to 48 cents per ton-mile. These costs included labor, interest, depreciation, cost of energy, etc.

W. S. MURRAY'S REMARKS

W. S. Murray, of McHenry & Murray, consulting engineers, New Haven, in taking the floor first referred to his earlier New Haven progress reports before the American Institute of Electrical Engineers and to his more recent paper before the Franklin Institute (see ELECTRIC RAILWAY JOURNAL for Jan. 30). He referred to the maintenance costs of locomotives there given and said that these costs, within a few months, would be brought to 6 cents per locomotive-mile and possibly to less.

Operation of single-phase locomotives showed that even without regeneration a most remarkable absorption of starting peaks took place, although the New Haven electric zone is on practically level track. It was found that when 3000-ton electric trains were placed in operation, instead of the expected peaks in the power station load line during the period of acceleration, the load line was actually improved. The explanation of this phenomenon was that when a number of heavy trains are in translation on level track a train that is starting draws down the voltage of the line slightly, not enough to interfere with the schedules but yet far enough to leave the trains in translation at speeds which exceed those corresponding to the lower voltage.

Mr. Murray then discussed what he termed "the visualization of the kilowatt-hour." He said that the capacity of the Cos Cob station had been slightly taxed, but an opportunity had been offered to buy a 4500-kw supply at the eastern end of the line. The question was, what would this comparatively small addition mean? The power records of the New Haven Company had been kept and analyzed so carefully that it was known in advance that the additional 4500-kw could be applied to handle twelve 3000-ton freight trains. On the basis that 1 lb. of coal in the power house delivers as much energy as 2 lb. of coal in the locomotive, it was calculated that the substitution of electric for steam operation of twelve trains would save $70,000. The reduction in engine repair costs with consequent increase in mileage and the saving in line losses, due to using the available energy nearer the points of supply, meant further economies. In fact, the total saving was about $150,000.

He believed that electrical engineers had the tendency to drive trains too rapidly. The New Haven trains were geared for about 35 m.p.h. While that speed was justifiable on the New Haven, because of its heavy traffic, yet if the speed was 35 per cent less the in-

creased tractive effort obtained therefor would permit the operation of 4000-ton instead of 3000-ton trains. Therefore, in considering engines in the future it would be of great advantage to look to tractive effort as well as speed.

In conclusion, Mr. Murray spoke enthusiastically about the tests on the New Canaan branch with the mercury arc rectifier. It offered the best means to join the advantages of a.c. transmission and distribution to the advantages of d.c. propulsion. One practical result on the New Haven would be the possibility of increasing the tractive effort of the a.c.-d.c. locomotives by 50 per cent with all speed characteristics maintained.

MR. ARMSTRONG'S REMARKS

A. H. Armstrong, railway department, General Electric Company, was the next speaker. Referring to the economies of electrification, he said that the first cost of the Butte, Anaconda & Pacific Railway, including interest during construction, was $1,200,000. For handling practically the same tonnage, the railway had saved $240,000 in operating expenses compared with the last year of steam operation. The success of this electrification had led the Chicago, Milwaukee & St. Paul Railway to adopt 3000-volt d.c. electrification. The 113-mile section between Deer Lodge and Harlowton was well under way. In the entire 440 miles only fourteen substations were required, whereas the Norfolk & Western Railway had four substations in an 11,000-volt a.c. 30-mile electrification. The 3000-volt line was reinforced with but 500,000 circ. mils of feeder copper.

MR. TURNER'S REMARKS

W. B. Turner, Westinghouse Traction Brake Company, then described the advantages of actuating air brakes electrically to obtain simultaneous operation of the brakes throughout the train. As an example, a stop made in 580 ft. with the ordinary brake has been made in 330 ft. with electrically-operated brakes, from a running speed of 40 m.p.h. Not only could emergency stops be made in half the time but all other stops were made in less time, more agreeably and with less strain on the equipment.

CHAIRMAN MCCLELLAN'S REMARKS

Mr. McClellan in concluding the meeting, said that it marked his resignation as chairman after many years of service. He was pleased to see that even in hard times money was being spent on electrification. He ventured to prophesy that electricity if used to its fullest extent would abolish all physical limitations of railroads. Rivers and mountains would no longer be an obstacle. The possibilities of multiple-unit operation were as yet hardly realized. The day would come when single cars would be operated much more freely in trunk line service than to-day. The most startling possibility was in operation through distant control. He thought that the day might come when trains would be operated on automatic stops and signals only, and there would be no employee on the train except someone to look after the comfort of the passengers and telephone in case of emergencies. A still greater improvement that lay in the future was a wide-gage railroad from the Atlantic to the Pacific Ocean for freight only. He was willing to predict the possibility of universal electrification, but the only thing he was not willing to predict was what system would be used.

On the conclusion of the speaker's farewell remarks President Syze thanked Mr. McClellan in the name of the Railroad Club for the excellent work that he had performed as chairman of the committee on electrical subjects.

Storm Plays Havoc on Kansas Pole Lines

The accompanying halftone shows how many of the fifty-three poles between Liberty and Excelsior Springs on the Kansas City, Clay County & St. Joseph Railway were blown down by a storm on Feb. 22. In some instances the poles were on embankments higher than the track, while in others they were on a fill. Both the high-tension and low-tension lines were down at many places.

HIGH-TENSION POLES BLOWN DOWN ON THE KANSAS CITY, CLAY COUNTY & ST. JOSEPH RAILWAY

The section mentioned was out of service for four days. The only previous interruption on this railway was Feb. 22, 1914, when a section of the St. Joseph division was out two hours because of poles blown down in a similar storm. The telephone and telegraph companies lost many poles in eastern Kansas and western Missouri, but no serious damage was reported by interurban railroads other than that shown.

Brooms and Street Cars

A recent discussion of brooms appears in the current issue of *Trolley Topics*, the official organ of the Louisville (Ky.) Railway. It is written by G. B. Powell, superintendent of employment of the Louisville Railway. Mr. Powell says:

"Our present type of broom was invented more than a century ago and is quite an improvement over the 'turkey wing' which was in use at that time. There are many kinds of brooms and their uses are varied, and you will find them in all parts of the civilized world, including the rear platform of street cars. The street car broom has developed a one-sidedness from lack of exercise and from standing, straw-end down, in the same position for days at a time, which gives them the appearance of a run-over shoe. Now if you will give them vigorous exercise about once a trip by sweeping out your car, it will benefit the broom by improving its appearance, improve the looks of your car, cause favorable comment from passengers and prevent the inspector from reporting you to the office for allowing your cars to be dirty."