The Maintenance of Way Convention.

The fourth annual convention of the American Railway Engineering and Maintenance of Way Association was held at the Auditorium Hotel, Chicago, March 17, 18 and 19, the attendance being about 130. It was the original purpose of the Association to get through in two days, but a Thursday morning session was found to be necessary.

The President of the Association, Mr. G. W. Kittredge, of the Cleveland, Cincinnati, Chicago & St. Louis, called the meeting to order at 9.35 o'clock on Tuesday morning. In opening, Mr. Kittredge made an address congratulating the members on the success of the Association and on the systematic character of the committee reports.

The Secretary and Treasurer reported that the receipts during the year were $6,553, and the expenditures $5,152, leaving a balance of $1,401. The membership at the time of the last meeting was 406; present membership, 454. During the past year the following members have died: Augustus Torrey, Chief Engineer, Michigan Central, member of the Board of Directors and first Chairman of the Preliminary Organization; E. A. Kellogg, Assistant Superintendent, Chicago & North Western; George Montague, Superintendent of Bridges and Buildings, Sonora Railway.

Following are the officers elected for the ensuing year:

President—Hunter McDonald.

First Vice-President—H. G. Kelley.

Second Vice-President—James Dun.

Secretary—L. C. Fritch (re-elected).

Treasurer—W. S. Dawley (re-elected).

Directors to serve three years—A. W. Sullivan, G. W. Kittredge.

The Secretary, Mr. L. C. Fritch, through ill health has been obliged temporarily to give up the duties of his office. Mr. E. H. Fritch was appointed to act as Secretary during the ensuing year, or until the Secretary is able to resume his duties.

There was not time to consider all of the committee reports. Those not discussed were ordered printed in the Proceedings for written discussion during the year. Abstracts or excerpts of various reports, with the gist of the discussions on them, will be found in this issue.

One report, which does not appear, is that of the Committee on Compensation of Signal Pipe Lines. This report contains a drawing of a lazy-jack compensator and also diagrams of pipe lines with rules for making connections at compensators at different temperatures. There is a table showing variations in length to be observed in adjusting pipes at different temperatures from 10 deg. below zero to 110 deg. above.

Classification of Maintenance of Way Expenditures.*

The terms Improvements, Additions, Betterments, Extraordinary Expenses, Maintenance Account, Capital Expenditures, etc., are used to-day frequently without any absolute or uniform meaning. The effect of the determination and ultimate disposition in the general accounts of certain of these classes of expenditures is so far-reaching and affects the general financial results to such an extent that it would seem desirable to establish clear definitions and uniform practice.

Where expenses are not properly grouped, it is impossible to draw valuable conclusions as to the operating efficiency, to make comparisons, or to satisfactorily explain any unusual variations in expenses for any section of road or period. Without such grouping the irregular work and extra expenses, dependent on contingencies of all kinds occurring at any moment in railroading, will effectually block any attempt to readily ascertain correct unit costs of maintenance proper, to make comparisons and forecasts of practical value.

The following definitions are given in the paper to cover the various groups proposed for the proper classification of maintenance of way expenses.

The term "Repairs" to represent all expenses for the regular maintenance of the property is sub-divided to four sub-groups according to the following rules:

Current Repairs to consist of regular, constant, annually recurrent expenditures for repairs and sundry minor work, required regularly from year to year to maintain in an economical and efficient manner the physical condition of the property and keep the track and structures in shape and safe for operation, embracing all charges for superintendence, labor, materials and sundry items, in the nature of fixed expenses, regular forces, or customary material purchases, necessarily required for the regular maintenance of the property and the safety of the track and structures; provided, such charges are not in the nature of large expenditures incurred for unusual, unforeseen contingencies, for large special requirements not distinctly repair work or not uniform on all sections of a road, or for extensive non-annually recurrent repairs or renewals.

Contingent Repairs to consist of unusual, unforeseen expenditures due to severe storms, floods, fire, accidents and casualties of all kinds, necessitating expensive emergency work, and, in many cases, subsequent extensive repairs or renewals; provided, such work is not of such a comparatively small nature as to belong properly to the uniform and routine work of the regular maintenance of way forces, even if the expense is caused by an unforeseen contingency.

Special Repairs to consist of such minor items, necessarily permanently chargeable to maintenance account, even if not distinctly repair work, which items if charged to current repairs would tend to vitiate the comparative statistical value of the current repairs account, or which items are too small and the work too insignificant to warrant charging to extraordinary repairs or classing as a permanent improvement to the property.

Extraordinary Repairs to consist of large non-annually recurring repairs or extensive renewals in the nature of maintaining the property, provided such work does not constitute a betterment or addition.

Improvement; this term to represent all expenses which create a specific, permanent, physical improvement, tending to increase the value of the railroad property as a whole, in the form of a betterment or an addition to the property, sub-divided to two sub-groups according to the following rules:

Betterments to consist of any permanent betterments to the existing property and facilities, constituting an actual, distinct, positive, permanent, physical improvement, tending to increase the value of the railroad property as a whole, the charge to cover in all cases only the difference in cost of the new improved structure or facility and the estimated cost of replacing the old unimproved structure or facility; the term betterments to apply in general to work such as replacing bridges with a more permanent character of materials, strengthening bridges for increased loading, rebuilding buildings, structures, auxiliary appliances and facilities of various kinds on a larger scale and with a better class of materials, increase of track mileage due to rearrangement and remodeling of existing yards and track layouts, stone ballasting, etc.; provided, the work in question does not consist merely of extensive repairs or remodeling and changing of existing facilities producing no visible extension or important enlargement of such facilities.

Additions to consist of any permanent addition to the existing property and facilities, constituting a distinct, separate, new, permanent, physical improvement, tending to increase the value of the railroad property as a whole, such as new roadbed, tracks, bridges, buildings, structures, or other auxiliary appliances and fixtures, etc.; provided, such addition or improvement is not in the nature of repairing, renewing, replacing, changing or remodeling any existing facility.

*Synopsis of a report presented at the March convention of the American Railway Engineering and Maintenance of Way Assn., by Walter G. Berg, Chief Engineer of the Lehigh Valley Railroad.

Train-Order Signals.*

The replies to the Committee's questions on the subject of train-order signals disclose a good deal of cloudiness in the minds of members, due in part to the use of train-order signals for other purposes, and combining the functions of two or more signals into one, and calling it a train-order signal. This combined use is perfectly legitimate in some cases, and in other cases leads to confusion. A train-order signal naturally merges into a block signal, and it is often difficult to define the line between them. A circular was sent to 152 members, and answers were received from but 40. A train-order signal is not always a fixed signal under present practice; flags and hand lamps being used for that purpose by a large number of our members. Only one member seems to be using the old-style banner or revolving train-order signal, and it is fair to assume that it is gradually giving way to the semaphore pattern. He has already adopted the semaphore for double track.

Of the semaphore patterns which are now in use, the arms for both directions of traffic are generally placed on the same mast, and the lamp and mast centers coincide. Some members place the lamp on the side of the mast, but this leads to two different patterns of semaphore castings, which is not economical or convenient. . . . Even when a railroad has the necessary signal system for operating the trains under block signal rules, it becomes necessary at times to issue train orders, may be to give notice of a washout or wreck, or to order the use of one of the tracks in a reverse direction. To do this arrangements are now being made to put up special signals on the Eastern Division of the Pennsylvania Lines West of Pittsburgh.

Where block signal systems are used, when it becomes necessary to issue train orders, the attention of engineman and conductor is called by

(1.) Same signal as used for blocking on Chicago, Burlington & Quincy; Chicago & North Western; Lehigh Valley; Sante Fe; Southern Pacific, Delaware, Lackawanna & Western, and others.

(2.) Separate train-order signals on Central of New Jersey; Illinois Central; Michigan Central; Philadelphia & Reading.

(3.) A red or green flag or lantern on Baltimore & Ohio. (Where automatic blocks are used, train-order signals are also used, controlling first automatic distant signal blade in each direction.) Boston & Maine; Erie; Long Island; Pennsylvania Lines West of Pittsburgh.

When running on a track in the reverse direction, the engineman and conductor are notified of train orders by—

(1.) Regular train-order signals, where placed for both directions on one mast, on Chicago, Burlington & Quincy; Chicago & North Western; Delaware, Lackawanna & Western; Galveston, Harrisburg & San Antonio; Illinois Central; Lehigh Valley; Pennsylvania Lines West of Pittsburgh; Philadelphia & Reading; Southern Pacific, and others.

(2.) Red flags and hand lamps where train-order signals are placed alongside of track on separate masts, on Pennsylvania Lines West of Pittsburgh. . . .

It will be observed that in the case of double track, the regular train-order signals are used on most railroads for trains running in the reverse direction, and it may be considered good practice when the signal arms are on one mast, because this signal signals *trains* and not *tracks;* but the plan allows of no expansion, and has been known to cause accidents where three or four tracks merge into two. When the train-order signals are so located as to govern trains only on the tracks alongside of which they are placed, they should not be used for trains running on a track in the reverse direction. The train-order signal has not heretofore been located with the exactness required by interlocking signal rules, but it is now time to bring this signal into line and place it where it belongs. The fixed train-order signal should be of such design and so located that, when the railroad becomes of enough importance for block signals, the very same signal can be used in its next stage, the telegraph block signal, without throwing it away and getting another one of different design.

The American Railway Association's third and fourth requisites of installation of interlocking plants are: (3d)

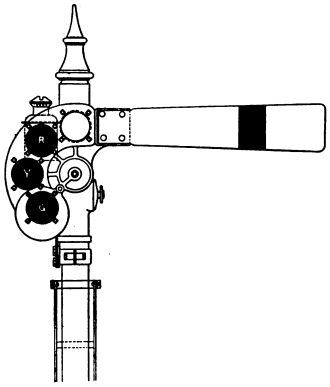

Fig. 13.—Proposed Standard Semaphore—American Railway E. & M. W. Association.

"Signals, if practicable (to be either over or upon the right of and adjoining the track to which they refer." (4th) "Semaphore arms that govern, (to be) displayed to the right of the signal mast as seen from an approaching train."

The first recommendation, therefore, of the Committee is that these two requisites be adopted with reference to fixed train-order signals for all numbers of tracks from one up.

The second recommendation is, that where it may be deemed advisable, for special reasons, to use a bracket mast, no more than two uprights be placed on the bracket. One of these uprights may be a stub to indicate a track not signaled. In other words, no more than one track should intervene between a bracket signal mast and the track for which its left upright carries the signal arm.

When a railroad has more than two main tracks, it is almost sure that it will be operated under block signal rules. Nevertheless, there are times when train orders or instructions must be issued. The methods in general use are: (1) Same signal as used for blocking; (2) separate train-order signals; and (3) the proper colored flags or hand lamps. So far as the first method is concerned, it is not logical, and does not mean "train orders," unless some special rule is formulated. In a block signal system the engineman and conductor should remain on the train till the "proceed" indication is given, unless, indeed, the delay is prolonged. If it is the intention to give them orders, they should know it as soon as the train reaches the telegraph office, or before. The second method is doubtless the logical and correct one. It seems to the Committee, therefore, that it is proper to indorse the practice of using flags by day and hand lamps by night, stop being for "31" orders, and caution for "19" orders. It is important, though, that a regular place for displaying these be predetermined, and there seems to be no better way than to place a regular flag socket with hook on the side of the signal station next to the approaching train, and convenient for the operator to reach from one of the windows.

The third recommendation of the Committee is the indorsement of the use of flags and hand lamps.

The fourth recommendation is the definition of "train-order signal" as follows: "A signal, fixed or otherwise, of two indications, which in the stop position informs the engineman and conductor that they are to receive orders at the telegraph office, and in the clear position announces that there are no orders for them."

A fixed train-order signal at the present time is a two-indication semaphore arm, having a sweep from horizontal to 60 deg., 75 deg. or 90 deg. Necessarily, the arm casting in each case is different. It is undoubtedly the best practice to have this range from horizontal to 90 deg., which is our fifth recommendation. The result of

*Extracts from the report of the Committee of the American Railway Engineering and Maintenance of Way Association, March, 1903.

the vote recently polled on that question in answer to our circular was 24 in favor of 90 deg. angle, eight in favor of 70 deg., and 23 in favor of 60 deg. . . .

. . . It is the will of the Association, as expressed by the recorded [majority] vote, to have a fixed train-order signal with a sweep of arm of 90 deg., and with a spectacle casting arranged on the "continuous-light" principle. The plan of such a signal is presented in Fig. 13, and it is recommended for adoption as the standard of the American Railway Engineering and Maintenance-of-Way Association, being the sixth recommendation of this report. It will be observed that the arm is so hung on the spindle that it can be placed in a vertical position and yet not be hidden by being in line with the post. The arrangement of the spectacles shown in the drawing is that for a three-position signal; red for stop, yellow for caution and green for all clear. The upper spectacle opening is blank. This upper opening would come into use in case the post were cut off and the lamp placed on top of it, as is done where an arm for trains moving in the opposite direction is placed on the other side of the post. It will be seen that the arm can readily be arranged to use red in both of the two upper spectacle openings, the two thus making substantially a "continuous light." For a two-position signal the upper opening can be left blank and the next two made red to provide the "continuous" effect.

This signal is suitable for either a train-order, or interlocking, or automatic block signal. It can be used for either two or three indications, and is suitable for those roads having red for "stop," green for "caution" and white for "proceed" or "no orders," or for those having red for "stop," yellow for "caution," and green for "proceed" or "no orders." Furthermore, it is adaptable for roads desiring to put two arms on one mast for both directions, because the top of the mast can then be made flat and the lamp placed thereon. The mast, as well as the signal arm and casting, is recommended for standard.

DISCUSSION.

The first recommendation was adopted.

Mr. Cushing (P., L., W. P.): Coming to the second recommendation, I have seen, in an attempt to follow out a bracket signal-mast principle, a signal mast with as many as eight or 10 stubs on it, which seems entirely unnecessary. A little rearrangement of the tracks will prevent such a confusing arrangement; such bracket masts are nothing but a mystery to a trainman. He does not know what they actually mean, and at high speed he cannot accurately count the stubs. The bracket mast should be restricted to two uprights.

The second recommendation was adopted.

Mr. W. G. Besler (Cent. of N. J.): I would like a little explanation of the third recommendation. The committee says that it is proper to indorse the practise of using flags by day and hand lamps by night, stop being for "31" orders, and caution for "19" orders. Why that recommendation?

Mr. Cushing: The "31" order is to be signed by both engineer and conductor, and no train can receive a "31" order without stopping. The "19" order is an extension of rights to a train, and is delivered to the engineer while the train is in motion by a hook or any other convenient apparatus for the purpose. Consequently, when a train is to receive an order of that kind, the operator simply displays a caution signal, and that indicates to the engineman that he must go slow enough to receive the order without stopping.

Mr. Besler: The American Railway Standard Code provides that the train order signal must be displayed when there are orders for the engineer, and the signal remain displayed until the full purpose is accomplished. That order is a red signal, and not a green signal; the caution signal for "19" orders is hardly permissible.

Mr. Cushing: The value of a "19" order is entirely lost if the train is stopped. Its object is to deliver a notice to the engineman that he has extended rights by reason of some other train falling back on rights previously given. Any stop signal means the train must come to a stop, and it is not a proper one to use for "19" orders.

Mr. Besler: The "19" order is used for the same purpose, and covers the same matters as the "31" order, as given by the American Railway Association. There is absolutely no difference.

Mr. Cushing: I know of railroads that are doing it, and that give a different value to these orders.

Mr. C. A. Paquette (Big Four): If the "19" order confers rights on the train, I cannot understand why "19" is the same as "31." I would like Mr. Besler to explain where he differentiates between "19" and "31." I do not understand why you use the "19" order at all under the system of operation which you describe. As a general rule, "19" confers rights, and "31" restricts them.

Mr. Besler: There is nothing in the book of rules which prevents the use of "19" for the same purpose as "31." It is very common to do so, however. Some roads elect to use the "31" form, thinking it is safer to do so, as it requires the signature of the engineer and conductor, or just the conductor. Other roads use the "31" only in exceptional cases, but the use of the "19" is becoming more and more general. There is nothing in the standard code that requires the use of the "19" for any particular form of order, or the "31" for any other particular form of order; it is optional with the despatches which one he shall use.

The Chairman: Have you any amendment to offer to this recommendation, Mr. Besler?

Mr. Besler: I move that the following words be stricken from the paragraph at the bottom of page 15 (second recommendation), in the second line, after the word "night" the words "stop being for '31' orders, and caution for '19' orders;" and in the third recommendation of the committee, strike out the words "and their display as explained in the preceding paragraph."

The Chairman: Does the committee accept the amendment?

Mr. Cushing: No. The Committee thinks this is good practice to recommend. It brings out the particular value of the "19" order. If trains stop to receive a "19" order, I do not see much good in it. It is of excellent service in cases where an order is hung out with a hook, from which it is taken by the engineer, and allows the train to proceed without stopping. It is not dangerous; it is perfectly safe practice. There is no use for anything more than the "31" order if all trains are to be required to stop for orders.

Mr. Besler: There is no cautionary train order signal. The words I asked to have stricken out are in favor of a cautionary train order signal. There is nothing of the kind in existence, nor do I believe that any railroad company would adopt anything of the kind. A train order is put out to help some train, just as has been suggested, and a "19" form is used so that the train may proceed without stopping for that order. The operator receives the order, repeats it as it should be, and with his signal displayed goes to the platform, and by whatever means he has at hand, delivers that train order. He then goes to his office and withdraws the signal if the full purpose of the order has been accomplished by its delivery to that one train. If there are other trains addressed in the order, he must keep the signal displayed. A clearance card is handed with the order given to the first engineer. In my opinion the recommendation is in direct opposition to the work of the American Railway Association. If we strike out these words, I do not know whether there would be any objection to adding the following: "To have a fixed place to hang lamps on or flags, is proper, and in accordance with good practice."

Mr. Besler's amendment was carried:

Mr. Cushing: The fifth recommendation is the sweep of the arm from horizontal to 90 deg. The object of the *final* (sixth) recommendation of the committee is that the association recognize as a signal casting one that may be turned into a block signal in the future; in good block-signal practice to-day there is as much permissive blocking as absolute. By the adoption of this one signal casting we can use the caution position in it when we turn it into the block signal. It is not the idea to use it with the permissive indication for train orders. It is, perhaps, quite necessary, however, to consider that in that connection we recommend a sweep of 90 deg., because if 60 deg. or 75 deg. is adopted as the proper sweep of the arm, when it comes to making that into a block signal in the future it practically means throwing away the signal casting and getting another one with the permissive, because there is no doubt many railroads will use permissive indication for a long time to come.

Mr. J. C. Mock (Mich. Cent.): It is intended to be a universal signal, block-signal, train-order signal and interlocking signal. As soon as a train-order signal becomes inadequate, it is time to dispense with the telegraph block. The idea of the committee is to get a signal which would be universally adopted and used for this purpose of train orders. Many roads have used the same signal for train orders and for the telegraphic block.

Mr. Cushing: The final portion of this recommendation is the adoption of the universal casting, which will take the place of the 75 now manufactured by one company alone, and it can be used in any way anyone sees fit, by changing the position of the glass.

Mr. W. H. Elliott (C., M. & S. P.): The 60-deg. sweep of the arm possesses one thing that is very essential in all good signaling, and that is that the indication is very distinctive; it can be more plainly seen than where the arm is parallel with the pole. The object stated by the committee in adopting the 90-deg. traveler is to have the arm interchangeable and used for all situations. This is a very desirable thing, but I do not think we should give up the distinctness of the arm for the sake of interchangeability. Other parts of the signal cannot be interchangeable, and there is practically but little saved by adopting interchangeability. The shaft has to be different for block signals where there are two castings on one shaft, and this shaft is not adapted for use at interlockings. Then, again, the casting for the 90-deg. sweep is a much heavier casting than the one for the 60-deg. sweep, and costs more. The cap of the casting must be different for the 60-deg. sweep from what it is for the 90. So, to have one part interchangeable, other parts cannot be interchangeable, or they are made much more expensive. Again, there is greater difficulty in moving the arm when the sweep is 90 deg. than when it is 60. There is 30 deg. more travel, and as the casting in each case is weighted about the same, the signalman does more work in one case than in the other. We find great difficulty in keeping our arms adjusted, and getting operators to pull them to the proper position, and with a 90-deg. travel this difficulty would be exaggerated.

Mr. Besler (Cent. of N. J.): I would like to make this motion as the fifth recommendation: "This association recommends as the best practice a fixed train-order signal, with a sweep of arm from the horizontal to 90 deg."—a combination of the two paragraphs recommended by the committee.

The motion was carried. Then, in order that the fourth recommendation should be in agreement with this, it was changed to read: "A fixed signal of two indications, which in stop position informs the engineman and conductor that they are to receive orders at the telegraph office, and in the proceed position announces that there are no orders for them."

The sixth recommendation was adopted without modification.

Concrete Masonry.*

Concrete being a mass of broken stone or gravel cemented together by a matrix, it follows that having selected the stone or gravel, it is necessary that the proper amount of matrix be determined; it would appear at first thought that if the voids in the stone or gravel mass be determined that the matrix necessary would be equal to the voids, but further consideration would indicate this to be irrational. If we can imagine a mass of concrete in which the voids are precisely filled, with no surplus matrix, it would necessarily require that the various constituent stones would be in actual contact, and as the planes of their surfaces are not at right angles to the line of pressure, we would have a mass of concrete full of minute incipient cracks. It therefore follows that there should be an excess of matrix to insure the entire surface of all the stone or gravel being covered with the cementing material. This film of cementing material should, however, be as thin as possible, and the excess of matrix be attained by an excess of cement above the voids in the sand; experience shows this should be from 5 per cent. to 10 per cent. of the voids.

Various writers recording experiments with broken stone and gravel place the voids at from 41 per cent. to 50 per cent. of the mass. A number of experiments with crushed blue limestone, well shaken but not rammed, conducted under the direction of the chairman of this committee, gave the following:

Size of broken stone.	Weight of 1 cu. ft.	Per cent. of voids.
Crusher run with dust screened out	89.222	45.16
Stone which passed 2-in. grating and retained in 1-in.	86.741	47.70
Stone which passed 2-in. grating and retained in ½-in.	77.701	50.66
Pea size	75.444	49.63

The sand has usually been required to be "sharp," but it is questionable whether a rounded grain would not give equally as good results, and the ideal sand be one containing grains of varying sizes without reference to their shape, thus reducing the voids to a minimum and requiring less cement to thoroughly cover the grains. Experiments show that with ordinary sand the voids will vary from 31 per cent. to 38 per cent.

Wm. B. Fuller, in the Transactions of the American Society of Civil Engineers, suggests that the sand should equal the actual voids in the stone and the cement be added possibly up to 10 per cent. in excess of the voids in the combined material. This proportion is probably theoretically correct, but it is necessary to bear in mind that, owing to the impracticability of securing perfect mixing in large masses, experience has shown the wisdom of increasing the actual volume of the mortar somewhat above the exact theoretical limits. If we take broken stone giving 47 per cent. of voids, and sand with 32.3 per cent. of voids, we will find the theoretical proportion to be: Cement 1, sand 3.1 and broken stone 6.5, as stated by S. B. Newberry in his article on concrete, in the Proceedings of the Indiana Engineering Society. If now we add 5 per cent. of cement and reduce to the basis of cement 1, we will have cement 1, sand 2.96, broken stone 6.2, or nearly the proportion quite generally used for concretes of 1, 3 and 6; this actual proportion giving an excess of mortar. The same reasoning can be applied to other mixtures and it will devolve upon the engineer to select for each individual piece of work the proper mixture to meet in the most economical manner the purposes required.

In all cases the necessity of thoroughly washing all dust from the stone and wetting it down cannot be too strongly impressed. Concrete as a construction material presented a high compressive strength with a low tensile strength, and to increase its economical application to various types of structures, the method of reinforcing with steel to secure tensile strength was a natural and gradual evolution, and this was simplified from the fact that the thermic expansion of concrete and steel is identical, and the tension modulus of elasticity of the reinforced concrete remains constant up to a stress which is equal to the rupture in case of concrete not reinforced.

M. Considere states that concrete when not reinforced will break with an elongation of less than 1 part in 10,000, yet he remarks the tension faces of a reinforced concrete beam support an elongation of more than 1 in 1,000, without sign of fissure. Prof. Hatt, in writing of this, says: "The excess of elongation over the ordinary concrete may be accounted for by supposing that the wire or other material reinforcement distributes an elongation throughout the entire length of the concrete; whereas the elongation when not reinforced is confined to the section of rupture."

Experiments of M. Hennibique, a French engineer, showed the adhesion between concrete and an iron rod imbedded in it to be from 570 to 650 lbs. per sq. in. of imbedded metal surface, and that a rod imbedded to a depth of 25 times its diameter would pull apart before separating from the concrete.

*Extracts from the report of the Committee of the American Railway Engineering and Maintenance of Way Association, March, 1903.