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The apprentice system in two of the most important of the mechanical trades has so deteriorated in this country by intensified production and the influence of trades unions that methods of reform are being seriously discussed by prominent employers and engineers. Professor J. E. Sweet says the apprentice system is a relic of the past, and some other method must now be originated for training young men who expect to become expert mechanics. In and about Syracuse it is almost impossible to obtain properly equipped artisans for the large industries that are growing at an unprecedented rate. Professor Sweet proposes to establish in Syracuse a school of trades and it is now understood that the great foundation made by Andrew Carnegie in Pittsburg is to be almost entirely a trade school. At the recent meeting of National Founders' Association it was stated that in and about New York City the systematic training of boys to become skilled molders has become practically impossible. Under present conditions in the foundry there is neither time nor opportunity properly to instruct apprentices and produce good workmen. The molders will not take the trouble to teach beginners, the employers are too busy in the office to give the subject proper attention and labor unions have restricted the number of apprentices so that the available supply of molders is becoming too small. The National Founders' Association has made an appropriation for the support for four years of a new type of trade school, in which skilled handwork is to be taught for its own sake, for the purpose of earning good wages, and not as the adjunct of the usual manual training school. The experiment will be watched with interest, for it can have application to many trades which require better workmen and more intelligent foremen.

Government waterway improvement work contrasts somewhat with private railway construction. For example: In 1879 the state of Kentucky ceded to the United States the improvements which it had made on the Kentucky River, consisting of five locks and dams, and the government went to work to build more locks and dams and make the river navigable from its mouth to the head of navigation, a distance of 261 miles. In the 26 years four new dams and locks have been built, the old ones have been repaired, two or three more have been commenced, much "snagging in the pools" has been done and 176 miles of river are now open to traffic, leaving 85 miles, or one-third of the whole distance, still unnavigable. On this work the government has expended $2,479,615, which on the 176 miles open would be equivalent to $14,000 per mile; this in addition to the unknown amount previously expended by the state. To complete the remaining 85 miles to Beattyville it is found will require a large addition to the authorized amount, and judging from the past rate of progress the Louisville Courier-Journal fears that it will be a decade yet before navigation will be extended to that point. When the long contemplated work is completed the government will have a winding, tedious waterway 261 miles in length, covering an airline distance of about 110 miles. Meantime private enterprise has paralleled the general course of this crooked stream with railways which are taking the traffic to all parts of the country, near and far, at vastly greater speed and probably at lower cost, considering first investment and time required, than this half artificial waterway can ever afford. The Kentucky River is only one of numerous examples that might be cited of river improvement works upon which the government is yearly expending tens of millions with scarcely appreciable results, while private capital has covered the same country with railway lines which have made interior river navigation practically unnecessary and obsolete.

The Chicago Milwaukee & St. Paul will be the first company to own a continuous railway from Chicago to Puget Sound. Its intention, long entertained, is now publicly announced and work will soon be in progress along 1,500 miles of new road between the Missouri River and the Pacific coast. This company already owns a line from Chicago to Evarts, S. D., due west from Saint Paul, 805 miles from Chicago, one-third the distance to the coast. From the Missouri River it will push westward across the remaining half of South Dakota and over the entire width of Montana and Washington to some point near Tacoma and Seattle, from whence it will fork to each of those termini. Running nearly due west to Butte, the great mining center of Montana, the line will at first lie parallel to and about 125 miles south of the Northern Pacific and nearly twice that distance south of the Great Northern. But in western Montana the three great competitors will begin to approach, and the new line will touch each of the others at various points until at the two great points on Puget Sound it comes into active competition with both. From Chicago to the Puget Sound cities the distance by

the new route will probably be close to 2,300 miles, or practically the same as that by the Northern Pacific and perhaps 50 or 75 miles more than by the Great Northern. The Saint Paul Company will lose no time in pushing this great enterprise, which will enlarge it into a system of nearly 9,000 miles, stretching from Lake Michigan to the Pacific and from Lake Superior to Kansas. Extensive terminal properties have been acquired at Tacoma and Seattle, and surveying parties are scattered along the entire route. The contract for building 700 miles from the Missouri River west has been awarded, work has begun on the western end, and in about three years this long expected line is likely to be in full operation.

THE ILLUMINATION OF RAILWAY SIGNALS.

To trace the growth of an idea always is an interesting process, but in the statistics which have been collected concerning "colors for signal indications," printed in another part of this issue, we find a truly remarkable rate of progress. When it is remembered that for nearly 60 years railway men were educated to regard red as the sign for danger, green as the sign for caution and white as an indication of safety, we have before us in the present tendency a splendid example of the power of abstract reason, because a comparative few really have experienced any disaster due to the mistaking of a foreign white light in place of a semaphore. Therefore, reviewing the list of railways which already have adopted green for "proceed" and yellow for "caution," some surprise is justified at a list which contains so many great names after so short a space of effort.

Although the change in lighting has not followed the scheme devised by Mr. E. C. Carter, chief engineer of the Chicago & Northwestern, most of the credit for our changed attitude lies in his two-light indication for caution, which for many years remained the sole exponent of a more rational conception, and has proved so satisfactory that probably it will persist long after every other important railway shall have abandoned the practice of half a century.

Of the 13 lines which are included within the phrase "adhering to green for caution but preferring the later form," many are highly representative; but, unfortunately, while many of them are considering a change, it is not decided yet. In the case of some others, the favorable opinion is that of an individual who, although clothed with authority, is not able to prevail in a matter of so much importance. Yet, even excluding such a hopeful state of affairs as is shown by 13 replies for, compared with 12 replies against, a change, of all the responses received, 45 per cent already have adopted the new method. And if the rate at which sentiment has altered during the past year or two is sustained, it will not be long before "the exception proves the rule" in a somewhat novel sense.

In seeking for causes which may have contributed to delay in the adoption of green as an indication for "proceed," three are evident at once and they will be named inversely to their importance. Inertia, therefore, is the first and in this instance is a surprisingly small factor, since of 53 separate organizations we discover but four whose spokesmen fail to state a decided preference. As the second cause, it seems a far cry to the expectation of a successful illuminated blade which will give a signal of position by night as well as by day. Who that has dwelt for a dozen years within the signaling fold does not remember the "parabolic" semaphore of ignoble fame, and others more respectable but not the less failures from a practical standpoint. If the illuminated blade was an ignis fatuus, certainly its light shone with an encouraging beam, and it was worth every effort to attempt the perfection of a device which represents the ideal in semaphore lighting. Therefore, the sole reply to our circular which mentions this arrangement may mark its recrudescence in palpable form.

But the most important restraint to any change is the complication which is brought about by train markers, train order boards and switch lamps, with the multitudinous differences of opinion which qualify the use and arrangement of these devices. Many difficult questions are introduced here which cannot be ignored, but granting them their entire force, it is evident that they have been subdued on a large proportion of our mileage, to which fact is subtended the probability that the use of green for proceed and yellow for caution will prevail upon most of the railways in this country within a very short space of time.

THE TURBINE LOCOMOTIVE.

The successful and extensive application of the steam turbine to most of the purposes for which the reciprocating steam engine is used has led engineers to speculate upon the possibility of its use as a locomotive engine, and several designs for such an application by prominent builders have already appeared in foreign technical journals. The principal objection to the usual design for the simple engine in locomotives is the destructive effect of the counterbalance for the reciprocating parts at high speed which is damaging to the track and to the engine. There is also the wear and expense for repairs, much of it due to the constant stopping and starting of the piston crosshead and valve twice during every revolution. The former objection, relating to counterbalance, is successfully overcome by the use of four cylinders with pistons arranged so that the reciprocating parts balance each other, but it is at the expense of a duplication of parts which still retain the longitudinal motion of piston and crosshead, and the expense for the repairs of these parts must increase with the number. There is also the constant uncertainty of the crank axle with the restricted surface of the main rod bearings and the inaccessibility of bearings when they require removal for the adjustment of wear or on account of heating.

Although the four-cylinder balanced locomotive is a marked improvement in its operation, in the matter of maintenance and repairs it must of necessity be a more expensive machine. At present it is regarded by many as the ultimate improvement in the steam locomotive and its final form before giving way to the electric motor. The advantages of the rotary engine in having a uniform turning moment, perfect balance, simplicity and fewer moving parts and its ready adaptation to high speed, appeal to engineers as attractive features in the further improvement of the steam locomotive for competition with its electric rival.

The most favorable conditions for the steam turbine are high velocity, constant speed and revolution in one direction. In its application for driving electric generators, these conditions are easily met and appear to be a natural development. The steam locomotive, however, requires the engine to work under conditions entirely opposite to all these, that is, it must have a variable speed, much of its work done at slow speed, and it must be reversible. A reversible turbine has been developed in connection with its use for marine purposes and it is now in successful operation. The most difficult feature in the application of the turbine to the locomotive is the possibility of getting a maximum turning moment for starting and one of sufficient magnitude to develop a high tractive power at slow speed. This must be combined with economical operation at high speed, and thus far steam turbines have not been developed along these lines. The conditions of engine load in marine service are somewhat similar to those in the