such that the simplest method of operation for trains going to the inbound classification yard demands that they approach Mystic Junction over the Southern division route. The Portland west route freights were transferred over on to the Southern route by making use of a neglected three-mile branch, extending from Wilmington Junction to Wilmington.

The volume of traffic for this move, combined with the traffic on the Salem branch, made it advisable to place the tower in service again, with signaling and interlocking facilities for two new routes.

[*The second part of this article explaining the important new interlockings and reconstruction in the Boston terminals will be published in the August issue.*]

Signaling Half a Century Ago

Report of Massachusetts Board of Railroad Commissioners in 1879 contains numerous references to contemporary signaling development

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IN this age of rapid development of new ideas and consequent change in our point of view, we all have some feeling of pity, and possibly something of a "superiority complex" toward the ideas and inventions of the period just back of our immediate recollection and farther—but, we find by a little study that the people in those days had their problems, and had to go through a process of personal development just the same as we do now. While we have progressed rapidly in the past few years, in those earlier years there were keen minded men thinking and studying, bringing out ingenious devices.

A particularly important comment by the Board of Railroad Commissioners of the Commonwealth of Massachusetts in 1879 was as follows:

"It is evident that the time has not come when the adoption of any one of the devices exhibited for giving automatic signals should be required by law. * * * Nor pending further experience on the part of railroad men, and further experiments by electricians and other inventors, can it be thought strange that railroad companies hesitate to equip their roads fully with imperfect devices, which may soon be set aside for better. * * * It is proper to add that our chief railroad companies have shown a praiseworthy spirit, both in testing new inventions and in adopting those, that, upon trial, have commended themselves to their judgment."

This seems to have something of a familiar sound and recalls the comments not long ago regarding train control.

The feeling of interest in block signaling, even as early as 1879, is indicated by the following from the Massachusetts "Resolves," 1879, Chapter No. 24:

"Resolved that the board of railroad commissioners be instructed to investigate the subject of railroad signals, and to report the result of their investigation to the several railroad corporations in this Commonwealth, and to the next General Court."

Block Signals Studied in 1879

In complying with these instructions the board held many hearings, examined many models, and inspected working signals on railroads in Massachusetts and other states. Their report is printed in the returns for 1879 dated January, 1880, and is both interesting and voluminous. After defining the "Block and Interlocking System" of signals the report says:

"The interlocking of switches and signals combined with the block system * * * not only secures each section from the entrance of a train while it is already occupied, but also blocks the section for any train while the track is broken by the throwing of a switch, or by the opening of a drawbridge, thus removing these causes of numerous disasters, *while it allows a vast increase in the number of trains.*"*

One of the definitions of the system is so well put that it seems well to mention it:

"The method, in brief, is by the use of levers operating switches and signals so interlocked that a signal of safety cannot be given while danger exists and danger cannot exist until after it has been signaled * * * the operator cannot, by negligence or forgetfulness, or even from malice, create a danger, or suffer it to exist, until he has signaled it, afar off, to any approaching train. He cannot open a switch before setting a signal at danger; having opened a switch he cannot leave a signal at safety; he cannot set the signal at safety before closing the switch; he cannot leave the switch half-closed, without giving a signal of danger. All these four errors, each of which has cost many lives, are made impossible in a section of road guarded by this system."

Smash Signal Defined

The "smash signal" now used by some roads, particularly at drawbridges, is mentioned as a contact bar, which "by striking the cab of the locomotive gives a warning somewhat like that of bridge guards which strike the person who is exposed on a freight car." It is again referred to as "a heavy plank, placed 2,000 ft. from the draw and so arranged that it falls by gravity when the draw is opened; and if the engineman still presses on, his locomotive is sure to lose its smokestack." How this is restored to a clear position is not explained.

By a comprehensive description of the combination of the interlocking device and the block system the report describes quite accurately what we can recognize as the controlled-manual system. This is summarized by saying:

"The signal which permits entrance into a section cannot be given without the concurrence of signalmen at both ends of the section. The starting signal is reset at danger by machinery behind every train. The signal that the line is blocked must be given from the station in advance to the station in the rear."

This is followed by the statement that the above is "borrowed from a description of a combination of the Toucy & Buchanan with the Saxby & Farmer devices, which, aided by some subsidiary inventions, are now in use on a portion of the Pennsylvania, and on the Metropolitan Elevated railroad as well as elsewhere." A reference is made to the "ingenious device of David Rousseau, involving the same principles, and accomplishing the same end," which, it says, "may be seen at the New York Grand Central depot."

An important reason for the development of the automatic signal system was said to be due to the fact that the block system, so called, "required a

*Italics ours.

large force of skilled and well paid men" and the inventors of the day tried to supply its place with automatic signals, some of which were claimed to be not only more economical than the block system, but safer. A preliminary remark in the discussion of automatic signals will, no doubt, be particularly interesting to many signal engineers today: "It is a requisite of any system that the normal condition of its signals should indicate danger, so that in case of any derangement of apparatus, accidental or intentional, a warning will be given. Thus, failure to act will, at most, stop or check the movement of a train. It will never cause a disaster. It is, also, absolutely requisite that the danger signal should be given far in advance of the point of danger. A signal displayed at or near the point of danger is utterly insufficient and unsatisfactory." *(This was written in 1879, nearly a half century ago.)*

Various kinds of signals are described in the report, the first being the "Hall' signal, based upon the "open-circuit" system, using disc signals, track machines and line wire control. In 1871, about 16 miles of these signals were in service on the Eastern railroad, now a part of the Boston & Maine, Thomas S. Hall having experimented some five or more years to develop a satisfactory signal system. An interesting feature in the report is that a "tell-tale" signal is described as being 1,000 ft. in advance of the signal to indicate whether or not the signal had assumed its restrictive position after the passage of the locomotive.

Closed Track Circuit Defined

The Union electric signal is described as a "closed circuit" system, and the track circuit as we recognize it today is described in considerable detail. Reference is made to wires which connect the rails together and "are firmly fastened" to each rail, also that "vulcanized fibre" was used for insulation between the "sections." They tell the old story of the stray goat which dragged its chain across the rails of the Providence railroad and gave the alarm to the gateman at Forest Hills crossing. (Boston and Providence railroad is now a part of the New York, New Haven & Hartford.)

Rousseau's safety railway signal is explained as using the open circuit system of control. It was also a clockwork signal, operating for 350 trains with one "winding." This system, however, used a "distance" or cautionary signal 1,000 ft. in advance to indicate the position of the stop signal. An additional device is mentioned, a rod which strikes the engine, and causes the whistle to blow, "and it is said can be applied to the brake and made to stop the train." (Train control in its infancy.)

Bean's atmospheric signal was apparently the forerunner of pneumatic signals as the signal was operated by a leather diaphragm acted upon by another diaphragm at the other end of a line of ¼-in. gas pipe which was connected to a lever. There is also mentioned the indication, by an electric bell, of the movement of the signal.

Tisdale's improvement in mechanical and electrical railroad signals is described as being "an elaborate and ingenious device, by which each passing train sets a signal of danger as it enters a section of the road and rests it at safety as it leaves the section." How it does this is not explained and the same applies to McLeod's automatic air signal, which apparently, was an audible as well as visual signal. The "locomotive cab electric railway signal" is said to have been operated by a battery in the cab which was controlled by levers on the roadbed. "Otterson's signal" depended for its action upon a can of alcohol being overturned by the pressure of the locomotive wheels, which caused a flag or other signal to be displayed horizontally "until the liquid ran back into the can and withdrew the signal from sight."

Interlocking "Gives Promise of Great Security"

In the railroad commissioners' reports for the year 1880 (Massachusetts), a reference is made to a new interlocking plant at Lowell, which is stated to be the first on any considerable scale in New England. "As the interlocking system is not common in the North where heavy snows sometimes prevail, the working of this will be watched with great interest by this board, as well as by all progressive railroad men. It gives promise of great security in the operation of the road at that point." It is the author's understanding that an interlocking plant was installed at Spuyten Duyvil in the latter part of 1875 or early 1876 and one at Batavia in 1876, both on the New York Central.

In going over these ideas and inventions we find the basis for our present systems of signaling and train control. Visual and audible signals; automatic signals of various types, signals which operated manually, the manual block system, the controlled-manual system and mechanical interlocking were all apparently in use and had been experimented with for several years prior to the date of the Massachusetts railroad commissioners' report of 1879.

Sudden Ravings

As George Ade would (maybe) rave it.

ONCE upon a Time, a Rural Product of Hardscrabble, named Claude, yanked hisself out of the Fodder Shocks and Rag Weed, where he had *earned* Twelve Dollars per Month—from March to November—for Nursing along the Things which grew on and out of the Black Loam in Posey County.

He had Decided upon a Railroad Career where the Octopus Came Through with Something Twelve times per Annum.

Claude finally got his Name on the Last Line of the Pay Roll, and, after fifty-four days of Waiting, he reached through the Brass Window in the Pay Car and extracted Thirty-Five Simoleons for his first Month's Labor in the Vineyard of Transportation.

He never knew that Any One would Hand Out that Much at One Time.

Even though fundamentally Handicapped with a Name like Claude, he had an Under-Shot Jaw, a Cast Iron Constitution and an Ability to Make Friends. He Felt he could Get Up in the World, and, some day, be a Face Card in the Decalogue of Every Day Acts which make Railroaders.

He had been Told that the World Owes all of us a Living, only it was a Man's Job to go out and Collect. He felt Certain that any Boob could get Any Thing he Wanted; provided he had Patience and did not want too Much.

By Stepping on Toes and Fingers for Twenty-Eight Years, he Got Up far enough on the Ladder of Success to Cash a Check, each Month, which was Twenty Times more than the First Slug he Hooked out of the Pay Car Window. There was nothing Spectacular about his Rise. He just Out-Worked his daily Play Mates and Out-Lived his Predecessors.