kind to assume responsibilities; the active mind which originates suggestions; the love of mechanics and of details which shows itself in hours (off duty) spent with intricate bits of mechanism; adaptability to unexpected conditions; deliberate (rather than impulsive) weighing of facts and arguments; manual and mental accuracy (logic), and concentration of thought. In short, a capacity for both dynamic and static effort, push and determination. Proper attention to these qualities in judging of candidates forever puts in the background the "hit or miss" method of selecting men for promotion.

It is not sufficient to sit idly by and expect these "apprentices" to work out their own results. In the absence of an organization specially provided for learners, the signal supervisor is the man on whom the principal responsibility rests. He must frequently come into contact with his men in the field; and by demonstration, illustration and argument, convey the lessons derived from the ever-varying "troubles" encountered and solved on other portions of the line. In this way all the men will grow and broaden in signal knowledge.

More than this; many signal men are coming to believe that an apprentice school should be maintained by every signal supervisor. It is difficult to educate the apprentices (we may use this as a general term for new signal maintainers or assistants) except by some systematic scheme for making available a knowledge of the mysteries of the vast number of details which make up the fund of knowledge of the experienced man. Apprentice schools develop the capabilities of the pupils, and automatically serve to establish the line of promotion of the pupils. Only by observation and study of these capabilities can a high-class signal supervisor be developed from the ranks.

The limited education of an apprentice who has not had suitable schooling advantages, need not be considered as a discouraging obstacle. It is, of course, desirable to get men with a good knowledge of English and common mathematics; and if graduates from high schools, academies, trade schools, colleges or universities can be secured, so much the better. But in the absence of the education desired, the apprentice school should take up and teach the courses. The supervisor should see that this is done, even though it becomes necessary to hire instructors. Usually, however, the more essential education can be obtained through night schools.

George M. Basford, at one time signal engineer of the Chicago, Milwaukee & St. Paul, and an honorary member of the Railway Signal Association, writing in the "Railway Age Gazette" of July 23, 1915, says: "Great works require great leaders. Great leaders require perfection of training in the ranks. Perfection of training in the ranks, in turn, produces and develops great leaders. Therefore, it appears that the men in high authority to-day will leave the legacy of greatest value to the future if they properly attend to the training of the recruits coming into the ranks."

This fundamental truth applies to signaling as well as other fields. The signalman's work and duties, considered as a joint function of mechanics, electrics, engineering, operation and accounting, is now recognized as one of the important branches of the railroad service; and we may say, not only that this is an opportune time for developing and inaugurating movements of this kind, but that there is very definite need and demand for action.

CHARLES HANSEL ON SIGNALS AND INTERLOCKING.—At the meeting of the International Engineering Congress, in San Francisco, Cal., September 20 to 25, a paper was presented by Charles Hansel, entitled "Signals and Interlocking," in which he outlined briefly the development of the a. c. track circuit, referring to it as "marking an epoch in safe and economic railway operation;" described the progress in the use of the upper-quadrant semaphore signal, and discussed the present status of automatic train control at some length.

Letters to the Editor

SWITCH AND LOCK MOVEMENTS IN MECHANICAL PLANTS

TO THE EDITOR OF THE SIGNAL ENGINEER:

I have been very much interested in reading your editorial on electro-mechanical interlocking, in the September issue, especially the portion referring to the use of switch and lock movements instead of facing-point locks.

You say, "This constitutes quite a radical departure from generally accepted practice. From long usage the plunger facing-point lock has come to be associated almost inseparably with mechanical interlocking, and the switch and lock movement at mechanical plants has not, in the past, been considered good practice. Many signal men, therefore, will 'want to be shown' *before they will accept this innovation as good and safe practice.* The short locking dog in the switch and lock movement does not have travel enough to allow either for buckling of the pipe line or for the lost motion in connections and foundations, which always has to be guarded against; and the lever stroke might be completed with an obstruction in the switch point. The Pennsylvania officers, however, feel very confident that they are on safe ground." You go on to state that, "Better construction and heavy concrete foundations have made the use of these movements safer * * * and, moreover, * * * there is the additional protection of the switch indication circuit applied through the indicating lock lever."

The particular sentence which especially attracted my attention was that, "Many signal men, therefore, will 'want to be shown' before they will accept this innovation as good and safe practice." It is true that some years ago the Railway Signal Association specifications were changed so as to require the use of facing-point locks on all mechanically-operated switches in the main line, and this change was made because of the features in the switch and lock movement itself to which you call attention.

As we have analyzed the situation here, switch and lock movements are not of themselves undesirable. This opinion is supported by the fact that the almost universal practice in this country is to employ switch and lock movements for power-operated switches (low pressure pneumatic, electro-pneumatic and electric) and the results are entirely satisfactory. These switch and lock movements are not materially different in design from the ordinary mechanically-operated switch and lock movement, in that they have the short locking dog and may not lock if there is an obstruction in the switch; also they will not operate if the power fails. While delay may be occasioned by these obstructions and failures, no dangerous conditions present themselves if, when such failures occur, the signals cannot be cleared and, therefore, train movements over them are prevented.

We, therefore, concluded that the objection to the mechanical switch and lock movement was not due to inherent defects in the device, but to the inability to determine whether it functioned properly. In power-operated plants this information is secured by the indication lock, so arranged that if the switch is not in the proper position and locked, the stroke of the lever cannot be completed and consequently the interlocking released. It therefore occurred to us that the application of a similar device on the mechanical switch and lock movement would make it as safe as the power-operated. If there is lost motion in the connections from any cause or an obstruction in the switch, the switch and lock movement will not complete its stroke, the indication will not be received and we have the same conditions as if the movement were operated by compressed air or electricity instead of by a pipe. We therefore made our installations on this basis.

We had already installed on our power machines an arrangement which we call our "SS" indicator, which we use

as a substitute for breaking the signal control wires through the switch box, and which, I believe, has been described in *The Signal Engineer*. It is so arranged that if a repairman, contrary to rule, does not take the proper precautions and operates a switch erroneously, the signals involved will immediately assume the stop position. This arrangement is also used with the electro-mechanical machine.

We have, therefore, eliminated chances of a signal being clear when the switch is unlocked, due to an obstruction, lost motion or broken connection. We have also insured that the signal will assume the stop position if the switch is unlocked and moved from its proper position after signal has been cleared, which combination might arise from a derailment which might buckle the pipes and operate the switch and lock movement.

There still remains the chance, however, of such a derailment occurring after a train has passed the clear home signal or is approaching it so closely as to be unable to stop. The outside locking device was therefore provided as described in Mr. Post's article on page 260 of the September issue. It will be noted that "These locks are only placed on switches where a track intervenes between the switch and the pipe line, and which face the normal direction of traffic." The reason for this is that it is unnecessary to so protect the track next the cabin, for trains on other tracks will not buckle the pipes affecting this track, and if a derailment occurs on this track and a switch in it were operated, it would have no effect on the train which was off the rails.

In order to convince ourselves that we were working along right lines and that our practice was good, we made some tests at a mechanical interlocking which was being abandoned. The switch was set so that a pull would tend to throw the switch; after which an engine, running about 15 m. p. h., was connected to the pipe by a strong cable with a hook in the end, which resulted in the pipe being badly bent and both arms on the bell crank broken. The electric lock prevented the switch operating pin from shifting in the switch movement, this being held securely in place without damage to either the electric lock or the switch and lock movement. The pull was a very heavy one and the 12-in. base plate, attached to three ties, moved about ¼ in. on the ties, and the ties shifted ¼ in., which permitted the switch to open a corresponding distance, this being partly due to the insecure temporary fastenings. The entire strain was on the switch movement and electric lock, and was not transmitted to the switch, and, with the movement securely bolted to solid ties, the points would not have opened at all under the extraordinary force applied. Two days later, at the same point, a similar test was made on a switch equipped with a facing-point lock. We were unable to get a satisfactory pull, due to defective cable which broke after the pipe had bent about 12 in., without breaking any mechanical connections, however. But the pull was sufficient to show that the facing-point lock would not hold as the lock rod was bent and the switch points opened ⅝ in.

With a facing-point lock, it is possible, if the switch operating rod breaks and there is no spring in the switch rail, to lock the switch in the wrong position. This is not possible with the switch and lock movement. All things considered, therefore, we are convinced that the switch and lock movement, with the electric indication, is a better proposition than the ordinary facing-point lock.

I believe the above result of our experience and tests will be of interest to those signal engineers who are "from Missouri."

Philadelphia, Pa. A. H. Rudd.

Proof Positive.—Railroad Attorney—"You are sure it was our Flier that killed your mule? What makes you so positive?"

Rastus—"He dun licked ebery other train on de road."—*Exchange.*

From Experience and Hearsay

Some Iconoclastic Views on Signal Matters

The man who wants to use the series a. c. motor rather than the induction motor for a. c. automatic block signals, on account of the former having more efficient operating characteristics, does not know the operating characteristics of a signal motor brush, high or low voltage. A lot of the "no cause found" signal interruptions, I believe, are due to brush trouble.

In my opinion, one of the greatest boons to signaling—at least from the points of view of the maintainer, despatcher and passenger who has close connections to make at a junction—is the possible elimination of the brush by the use of a. c. energy.

Eternal vigilance is undoubtedly the motto of the maintainers whose fine records we read of occasionally in *The Signal Engineer*. A lot of men doubt the accuracy of some of these records, but I have worked with men who have made similar ones, and know that it is possible.

Eternal effort to eliminate the parts of apparatus that require eternal vigilance to keep them from failing would soon make it possible for a general increase in the efficiency record of maintainers. I am not the only one who has often wondered whether the designers of some of our apparatus ever actually maintained a signal.

There must be some reason why certain signalmen prefer to retain the "maintainer only" system in preference to using maintainers and helpers, but I would like to see the arguments on that side advanced in this column.

It is said that the word "flirt" has no synonym in the German language and that for that reason, true German girls cannot flirt. I wish then that the R. S. A. would eliminate from its official language the "no cause found" classification for signal interruptions.

I recently asked a supervisor why he permitted so many signal interruptions to pass without locating a cause for them. He replied that the signal engineer's printed form for monthly signal performance report had a column for that kind of interruptions, so he made use of it.

I have never worked with a "light" signal, but I think of it as comparing with a "mechanism" signal about the same as a three-phase induction motor does with a d. c. motor, much simpler to operate and having fewer parts to get out of order.

We are in a fair way to eliminate gravity battery, but someone ought to develop a device which will eliminate that other pest, the kerosene oil semaphore lamp. It seems peculiar that electricity is used to operate all parts of the signal system except the lamp.

One of our school reader stories told us that for want of a nail the shoe was lost, for want of a shoe the horse was lost, and for want of a horse the driver was lost. This parable might profitably be applied to the dragging brake beam question. The want of a simple little cotter pin is responsible for a great many signal interruptions due to dragging equipment, which tears off bond wires, bootlegs, etc., to say nothing of the train derailments which are caused.

If anyone will take the pains to inspect a freight car whenever convenient he will not wonder at the trouble railroads are having on account of dragging beam equipment. I recently made such an inspection, through curiosity, of a large number of cars of all "nationalities" over a large territory and found not a car but had one or more (usually more) cotter keys missing or defective. And they are such little, inexpensive things, and so easily applied.