man can expect to become an engineman, it must be a good pair of eyes that can stand it, without some protection.

The constant jarring, with the swaying and rolling of an engine traveling at a high rate of speed, is another factor in making signal reading difficult.

The constant supervision of an engine takes no small part of an engineman's time and attention, and his duties are far more than sitting on a seat and watching for signals. This is especially true when there is any trouble with the various mechanisms under his care.

Certain atmospheric conditions are not only a source of great annoyance in reading signals, but often completely obscure them at a distance, sufficient within which to control a train. Fog, snow, mist and rain take precedence in the order given, and when it is necessary for better vision to have the head out of the cab window the impinging of fine particles of snow, mist or rain, against the eyes blinds one almost instantly. The force of the wind when running at a high rate of speed causes the tears to flow and blurs the vision after a very short exposure. Night signals are usually seen at a greater distance than the day signals in these atmospheric conditions.

Atmosphere laden with water vapor, such as fog, is a great factor in absorbing light and while the greatest absorption is at the rear end of the spectrum with a gradual decrease towards the violet end, light having a preponderance of blue rays such as an arc light, has a much shorter range in fog than a light source having a greater intensity in the red end of the spectrum, such as a kerosene flame. There are no recorded data as to range reduction caused by fog, but, observation has lead to the conclusion that the range of a signal is frequently cut down to 1/20 of the clear weather range, while in dense fog the reduction is probably much more.

Rain and hail do not interfere as much with the range of a signal as other atmospheric conditions; however, tests conducted by the German Light House Board showed 30 per cent reduction on an average, in rainy weather.

Snow interferes greatly by accumulating upon the roundels and lenses and markedly reduces the range of a signal if the air is full of flakes.

Dust and smoke in the atmosphere tend to shift the hue of a light toward the red end of the spectrum as they interfere with the transmission of the shorter wave-lengths. Dense smoke has an effect upon the range of a light similar to fog.

As may naturally be expected dirty roundels, lenses or reflectors greatly reduce range as well as change the saturation of the color. Alinement of the semaphore lamp with reference to the track has much to do with the distance a signal may be seen. The lens is so constructed as to converge the rays of light falling upon it in a relatively parallel beam, a slight deviation in the adjustment of a lamp will throw the axis of the beam off the track as well as reduce the amount of light projected in the desired direction.

Neighboring lights which may be mistaken for signal lights are kerosene, gas, incandescent (carbon), arc and acetylene lamps. This is more liable to occur if there is smoke or dust in the air.

Dusk and early dawn are times of day when signals are most hard to recognize. There is not sufficient daylight to determine the position signals and what daylight there is seriously interferes with recognition of the night signals.

Thus it will be seen from the factors enumerated above, those requiring good vision and those tending to interfere with it, the best known standard of binocular single vision and color perception is none too good, and not only must the man have this, but it must be "quick vision," for he may for an instant be able to see through some break in the interfering media, and must be able to read his signals in that instant.

IN A RECENT REPORT presented before the National Congress of Railroad Workers, at Paris, following an investigation of the causes and means of averting railroad accidents, it was recommended that a third man be placed on the locomotive, whose sole duty would be to observe the signals.

THE TRAIN DIRECTOR.

The work of the train director in the principal tower at the Pennsylvania Station, Pittsburgh, Pa., is the subject of an interesting article by Lester B. Vernon, in a recent issue of the Pittsburgh Gazette Times, from which the following extracts are taken:

"In a three-story brick tower just outside the station is to be found the brain that presides over the movements of trains in and out of the Pittsburgh terminal. The tower is known as 'UF,' and subordinate to it are the other four towers that stand guard over the entrances to the city. Go into the yards, if you can get past the keeper of the train-shed gate, and watch for a moment the ceaseless bustle. Perhaps you see a New York flyer sweep into the yard. It drops into a labyrinth of switches and passes from track to track almost as if the engine were human, selecting the course most suited to the station.

"Or you might almost believe that there is but one possible course into the station. On all sides you see the ever-moving shifters with their coaches, mail and baggage cars likewise threading the maze. Another through passenger train makes its way into the station, but this one by a different course. And so on, without end, but through it all you will never once see the old familiar opening and closing of switches.

"If you would see the one mind and the four hands that in a day cause these innumerable train movements by as many touches of the button, you must visit 'UF' tower. Here, on the second floor, in a point that overlooks every point in the entire yards, is the train director. On an average, 500 passenger trains pass over the tracks in and out of the station each day. As soon as a train makes its appearance in the city, the train director in 'UF' is notified by the tower just outside his jurisdiction, over the telephone, of the train's arrival. He is told on what track it is entering the city. Of these tracks there are 18 from the east, numbered successively from one to 18. In a bird's-eye view of the yards, the whole series of tracks appear to be crossed as if by a huge pair of scissors. By means of this crossover section any point in the yards can be reached from any other center or the exchange through which all the shifting from tracks to tracks is accomplished.

"There are 67 switches operated in 'UF' tower. A certain movement, ordered by the train director, requires the operation of various groups and numbers of levers. Each leverman has his end of the machine operating about half of the levers. Thus, if switches Nos. 3, 7, 8, 14, 15, 34, 43, 46, 52 and 60 are to be thrown to set up a train route, the first five of these levers will be thrown by the man at one end of the machine, and the last half at the other. Thus the levermen must co-operate on every movement.

"But to have a route set up, the train director does not, in fact, call out for the number of the switches he desires thrown. Instead he merely calls out the number of the track on which the train is approaching, the section of the crossover it will follow and the track beyond that is to be opened for it. The crossovers are lettered instead of numbered. These letters are from A to K. Thus there are 18 tracks uniting in a central trunk, with 11 arteries or passages, and dividing again into 20 tracks. Or, stated differently, there are 20 tracks and 18 tracks separated by a crossover that has 11 different passages, the tracks being numbered and the crossover passages lettered.

"The formula by which the train director gives orders would be, for example, as follows: 'From 13 to 11, or M and E.' If the train director would say: 'From 13 to 11 on E and M,' the levermen would know that the movement was in the opposite direction, because route E is under the east signal bridge and route M under the west bridge. Thus the movements of 500 trains a day are all controlled from two boards and four telephones without the necessity of the operators ever seeing a track, a switch or a train. Telephones tell the director every train that comes and goes,

blinking electric lights tell him every track and switch in the yards and station that are in use or idle, and electric levers open and close all the passages possible over the network of tracks.

"The train director works only four hours, it being considered that the strain of that office is too heavy to be borne for a longer period. He then becomes assistant train director, and the man who has been assisting him for four hours becomes director. Thus there are two train directors on duty all the time, each required to work eight hours, four of which are as active director and four as assistant. The assistant answers the telephones and aids the director in keeping in touch with the multitude of details.

Fig. 1. Snow Plow and Three Pusher Locomotives Starting Out to Open Up the Line.

"Everyone is perhaps familiar with the loud-speaking telephone or the annunciator in the waiting-room that is used for calling trains. The same contrivance has been applied between the towers. Connecting 'UF' with 'BU,' the two busiest towers in the yards, the operator needs only to speak in an ordinary voice into a transmitter, and his words are repeated in the room in the other tower as if he were present. There is no receiver as with the ordinary telephone, but the message is received from a horn which hangs over the

Fig. 2. Snow Plow Buried Deep in Hard Snow and Stuck Fast. Mound of Snow to Right of Picture Indicates Where Nose of Plow Is Buried.

director's head and can be heard in any part of the room. This device entirely eliminates the formality of calling up as with the ordinary telephone, for a direct connection between the two towers is maintained at all times, and the men are thereby enabled to converse as informally as if they sat side by side. It comes the nearest to bringing two widely separated rooms together that has ever been invented, and the loud-speaking telephone, with the elimination of the receiver and the head harness that have been the ban of dispatchers, stands as one of the most extraordinary inventions used by the railroad."

SOME SNOW STORM

A recent blizzard in the vicinity of Kingston, N. Y., caused quite a little trouble on the Ulster & Delaware Railroad. The portion of the road shown in the illustrations is about eight miles outside of the automatic block signaled portion of the line. The storm caused a two-day delay in traffic and all train schedules were canceled for this time. The snow plow was used continuously for a few days to keep the track clear after traffic was again moving.

Fig. 3. Three Engines Pulling in a Train, and Unsuccessful Attempt to Extricate Plow. Cupola of Plow Only to Be Seen in the Picture.

In the automatic signal territory the storm did some heavy damage and put the signal system out of commission. The pole line newly installed last year, carrying the signal and telegraph wires, was almost completely destroyed. The wet snow was so heavy that it clung to the signal posts and about half of the blades were held in the "clear" position by the frozen snow. It was necessary for the men to chop away this ice covering before the signals could be operated.

Fig. 4. Cut Made Through Deep Snow After Plow Had Passed Through. Men at Work Shoveling Out a Flangeway.

The accompanying illustrations show views of the snow plow and serve to give some idea of the severity of the storm, and the amount of snow that fell. The line was restored to normal conditions about March 30.