sized match and confusion colors of bunting for daylight work, or illuminated plates and lanterns of transmitted color for bad weather or night, are to be lined in a row in any order whatsoever, just as the wools are promiscuously thrown upon a table. The five test colors similar to the ones I have employed for the near tests are placed in an upper tier. Just as with the near-work tests the candidate employs one eye at a time. This done, he is then made successively to designate by the actual position of the color in the lower line the nearest numerical match to each of the upper test colors. This selection by number is to be handed to the examiner, who after having obtained the true color names of the numbers chosen for the occasion by the attendant, places the choosings upon suitable blanks for permanent registry.

To obtain the different percentages of light stimulus and to simulate as nearly as possible changes in character of weather (fog, rain, etc.), variously tinted glasses can be used, although preferably the candidate can by this plan be tested during the actual states of weather.

An experimental track with a number of open switches so arranged that the sidings pass directly beneath certain colors would be useful for practically testing the color vision that is necessary to employ while running locomotives, trolley cars, etc., at full and even high rates of speed.

In marine service the danger is increased. All vessels carry a green light on the starboard side, and a red light on the port, each being so boxed as to be seen forward and amidships. These are accompanied by a low white forelight, and sometimes by a high white aftlight. Hence, by comparison, a vessel's course can be easily distinguished. If, under such conditions, however, a heavy fog, or snow, or a rainstorm were to exist, it can be understood how an official with subnormal color perception, judging these important color distinctions by their intensities alone during the best of weather, is placed in a position that practically amounts to the absence of signals.

For the detection of the defect in marine and naval work, quite simple modifications and adaptations of color testing by which adequate data may be obtained can be made.

In all railway or marine testing, care must be taken that both the test and the later working colors* should be graded in proportionate sizes and relative intensities of tone, thus giving similar distance values to every color used in the tests. That this should be done will be at once appreciated when it is remembered that different degrees of vividity of color areas of equal size produce such alterations in impressions that the colors give rise to false perceptions regarding their relative distances from one another.

Again, the dominant colors of the reflecting surface near which the test is made (as, for instance, the green of a hillside, the gray and white of a mountain top, and the blue of an ocean surface) all play important rôles as to the value of the tests.

The character of the illuminant itself is of the greatest importance. The blue of diffuse daylight, the greenish or nearly white tint of incandescent zirconia or metallic oxide mantles, the varying degrees of yellow rays from oils, illuminating gas and carbon loops, and the purples of free arcs of electricity, show how variable in tint color areas must become when exposed to these different agents.

Endeavors should be made to try to overcome the totally different values that are empirically placed upon the hues of the test colors themselves. This might be done by assuming pigment hues which are equivalent, with the midway bands in the corresponding portions of the solar spectrum. Such selections could be determined mathematically and analytically by an international commission, and reproduced in pigments from a consensus of examination by national or sectional sub-committees of competent observers possessing normal color vision.* These pigments could then be used for signal boards, signal lights, and test colors in any given locality.

There should not be any degree of standard in regard to the color capacity of any railway or marine official whose routine duty consists in the differentiation of color. Such positions are relatively so few when compared with the great supply of available candidates, and the responsibilities are so grave, that no exception should be made. Such candidates should be rejected without a particle of sentiment.

The lack of systematic and periodic re-examination of the color sense is another great evil. This inefficiency in color testing is most reprehensible. After every case of severe injury or attack of illness that might in any way be likely to produce visual disturbance, an examination should be made; and, moreover, among those who are known by strict, and yet silent surveillance, to use any toxic agents, such as tobacco and alcohol, the tests should be both painstakingly and frequently tried.

The increased responsibility acquired by civil service, in which older subjects who are more prone to exhibit acquired color defects than younger ones, and who are at times given positions that usually necessitate the greater employment of normal color organs than before, should be especially subjected to careful periodic repetitions of some of the more important measures which are employed for the determination of the amount and degree of the color sense.

Losses of color in the so-called visual fields are quite common. They assume many forms, and quite frequently are expressive of definite types of both local and general disease.

Symptomatic in character, they oftentimes help demonstrate the exact position of intracranial disturbance, prove the actual functioning condition of inflamed and degenerating local tissues, give answer to situations of gross orbital change, and serve to distinguish functional complaint from organic disorder.

They are obtained in various ways: first, by ruled blackboards upon which small colored objects are carried toward central fixing points; second, by perimeters, which are mere mechanical contrivances for carrying small areas of color inward upon graduated metallic arcs toward fixed central points: and third, by similar movements of the outstretched fingers, lighted tapers, and focussing mirrors.

To be strictly accurate they should be repeated under varying conditions of time, luminosity, distance, and position. *Charles A. Oliver.*

COLOR PERCEPTION, SUBNORMAL; RAILWAY AND MARINE EXAMINATIONS.—The examinations made to detect cases of defective color perception were so unsatisfactory in the railway and marine service that in 1890 the British Board of Trade asked the Royal Society, "What is the best test for color blindness?"

A committee was appointed, including some of the most distinguished members of the Society, and after two years' work they unanimously reported as follows:

"1. That the Board of Trade, or some other central authority, should schedule certain employments in the mercantile marine and on railways, the filling of which by persons whose vision is defective either for color or form, or who are ignorant of the names of colors, would involve danger to life and property.

"2. That the proper testing, both for color and form, of all candidates for such employments should be compulsory.

"3. That the testing should be entrusted to examiners certificated by the central authority.

"4. That the test for color vision should be that of Holmgren, the sets of wools being approved by the central authority before use, especially as to the correctness of the three test colors, and also of the confusion colors.

* Unfortunately, it has been found by repeated experiment that the very colors which are the earliest and the easiest lost are the ones that must be used for practical purposes.

* Lovibond's tintometer, Rood's flicker photometer, or Abney's color-patch apparatus might be of value in this direction.

If the test be satisfactorily passed, it should be followed by the candidate being required to name without hesitation the colors which are employed as signals or lights, and also white light.

"5. That the tests for form should be those of Snellen, and that they should be carried out as laid down in Appendix 6. It would probably in most cases suffice if half normal vision in each eye were required.

"6. That a candidate rejected for any of the specified employments should have a right of appeal to an expert approved by the central authority, whose decision should be final.

"7. That a candidate who is rejected for naming colors wrongly, but who has been proved to possess normal color vision, should be allowed to be re-examined after a proper interval of time.

"8. That a certificate of the candidate's color vision and form vision according to the appointed tests, and his capacity for naming the signal colors, should be given by the examiner; and that a schedule of persons examined, showing the results, together with the nature of the employments for which the examinations were held, should be sent annually to the central authority.

"9. That every third year, or oftener, persons filling the scheduled employments should be examined for form vision.

"10. That the tests in use, and the mode of conducting examinations at the different testing stations, should be inspected periodically by a scientific expert, appointed for that purpose by the central authority.

"11. That the colors used for lights on board ship, and for lamp signals on railways, should, so far as possible, be uniform, and that glasses of the same color as the green and red sealed pattern glasses of the Royal Navy, should be generally adopted.

"12. That in case of judicial inquiries as to collisions or accidents, witnesses giving evidence as to the nature or position of colored signals or lights should be themselves tested for color and form vision."

In a further discussion of the subject the committee make a number of statements which it is well to keep in mind. "The variations in the amount of this deficiency in color perception are numerous, and when small are often exceedingly difficult to classify. We have to regard these deviations from normal vision more from a practical than from a theoretical standpoint, and in testing for them we have to take the broad view that the color blindness which has to be detected is that which may be dangerous to the public in the industries already mentioned." "In a testing room, when signal lights are used as tests, color-blind persons may possibly be able, with practice, to name the different colored signals correctly, recognizing them by their relative brightness, and by their dilution with neutral color. The practical tests the committee have carried out confirm this view; men who are absolutely color-blind having passed such a test without being detected. It might be supposed that if the colors of signals could be rightly recognized in the testing room they would be equally well recognized elsewhere. It must, however, be recollected that the atmospheric conditions of the testing room are often very different from those which are found outside. As a rule any judgment of the color of a signal which depended on its brightness would be fallacious. A dirty glass or a misty atmosphere would introduce a liability to error. The red signal of danger might then be mistaken for the green or white signal of safety, and vice versa. It must also be remembered that a signal light, as a rule, has no white light adjacent to it with which to compare it, and thus a decision as to whether a light is neutral or slightly colored has to be arrived at under great disadvantages." "In the color blindness induced by disease or injury, although the loss of color sense is usually confined to a small area of the retina, yet as it is the central area and therefore the part on which the image of small objects naturally falls, the danger of mistaking a color is as great, and even more so than in congenital color blindness." "The standard test colors which have been approved by Professor Holmgren have been referred to the spectrum. The first standard is a light green color, which can be matched with a green in the spectrum (λ 5660) when forty per cent. of white is added. The second standard skein is light purple or pink, and its complementary color is a green in the spectrum (λ 5100). The color is diluted with about forty per cent. of white."

"All tests in which the wools are suspended from a bar, even though the test skeins may be of proper color and tone, should be avoided, since the order of arrangement might be ascertained by some means or another by those who are tested. It is quite true that the order might be changed: but in an examination of this character, where large numbers may be under trial, any frequent changing of the order would be impracticable, and hence there would be no security that the test was efficient. The same objection applies to all diagrams of color which the examined are required to match with standard colors." "The Committee would not insist upon the examiner being a medical practitioner, but it is probable that a medical training would be of advantage. They are further of opinion that there should be a periodic inspection of the different testing stations by duly qualified ophthalmic surgeons, who should report upon the condition of the testing appliances and upon the mode in which the tests are carried out: and who might be the authorities to whom an appeal from a rejected candidate should be referred. In no case should any test be allowed in substitution of those recommended, though supplementary tests might be tried if desired. The passing or rejection of the candidate should always be based on the tests which have been laid down." In 1892 a Committee of the British Medical Association made a report on "The Efficient Control of Railway Servants' Eyesight," in which they recommended: "2. That the test for color sense should be that of Holmgren carried out in strict accordance with his direction. After this test has been passed the candidate should be required to recognize and name promptly the colors used in signalling. We wish to emphasize the importance of employing glass of standard color in railway signal lamps: as recommended by the Committee of the Royal Society."

In Holland the rules governing the examination of the eyes of the employees of the Dutch state railways are more complete than in any other country. They were arranged by Prof. H. Snellen, who is also the consulting ophthalmic surgeon, to whom all cases of doubt are referred, but the ordinary examinations are made by ophthalmic surgeons at various convenient places on the lines. Article 10 provides that "The color sense is to be estimated—(*a*) qualitatively, by pseudo-isochromatic tables of Stilling, and with wools, according to Holmgren's method; (*b*) quantitatively, by Donders' method, which must be applied in every instance without exception."

In a small and compact country like Holland, it is possible to carry out methods of examination which would not be practicable in the United States, where one railroad company in several instances operates more than seven thousand miles of track, and has an army of employees widely scattered along its lines. My experience with two large railways in the United States, the Burlington and the New Haven systems, has shown that very good results can be obtained by having the examinations for color perception made in accordance with carefully prepared instructions, drawn up by an ophthalmic surgeon who has had some experience in these matters, the routine examinations being made, in one case by the medical examiners of the road, and in the other case by employees selected for this work on account of their good judgment and intelligence; in each case the examiners were first carefully tested to make sure that their color perception was normal, they were then instructed in the methods to be followed in making the examinations, and were provided with printed instructions and blanks on which the records of the examinations were to be made, and with the necessary materials for making the tests, these materials having been previously approved by the ophthal-

mic surgeon. Cases of doubt were referred to him, and on one road the reports of all examinations were sent to him for final approval. In this way a check could be kept on the work of all the examiners, and uniformity of standards and tests secured.

In order to have the approval of the operating officers of the great transportation lines, and to obtain their consent to the adoption of these examinations, the tests used must be simple and efficient, and in some portion of the examination they should correspond as closely as possible to the actual conditions of service. The record of the examination should be in such shape that, if necessary, the actual results of the test can be reproduced at a future time; in this way both the company and the men have better protection, for if a man is rejected he does not have to rely only on the word of the examiner that his color sense is defective, but his record will show wherein he has failed; and in case of accident the company can show from the record that the accident did not result from any defect in the color perception of the men concerned.

For the last ten years I have been using sets of Holmgren's worsteds in which all the reds and greens have odd numbers, and the confusion colors even numbers; there are, however, only reds and greens enough in the Holmgren sets of one hundred and twenty-five colors to carry this numbering to 100, and the remaining twenty-five colors, including most of the yellows, are designated by letters. The first forty colors in the set have been given the same numbers as the corresponding colors on the Thomson stick, which was used on these two roads before the Holmgren test was adopted; in this way the records of the first forty numbers, both before and after the change, refer to the same colors. Small numbers are stamped on aluminum tags which are wired to the colored skeins and lie concealed in the worsted, so that the numbers are not seen by the person being examined; but after he has made his selection of the colors which look to him like the test skein, the examiner looks up the tag on each skein and makes a record of the numbers chosen. At the central office, where the reports of all the examinations are received, a standard set of worsteds is kept, sewed in numerical order on a large piece of white cloth, and in case it is desired to show from the recorded numbers all the colors that have been selected in any case, it can be readily done by reference to this set. When not in use this standard set is to be kept protected from the light, dust, and moisture. In most cases, however, it can be seen at a glance from the recorded number whether the Holmgren test has been passed successfully or not. Only two test skeins are used, the green for the general determination of the fact of defective color sense, and the rose, or light purple, to show whether the defect is more for red or for green. In Holmgren's original set a bright red test skein was also supplied; of this Holmgren himself says, "it is not necessary for diagnosis, and only serves as a confirmation," but in my experience it has often confused the results of the former test, rather than confirmed them. A man who has shown by the former tests that he was defective in his color perception would often make no mistake with the bright red test skein, and would think he was unfairly treated because, in spite of his making no error in the last selection, he was still classed as defective in color sense. Therefore, as the bright red test skein gives no additional information it has been omitted.

In addition to the Holmgren test with colored worsteds some form of test with colored lights should be used. Arrangements should be made to vary the area of the color shown, to have red and green glasses of different shades, to have smoke and ground glasses combined with the colored glasses, to show either one light at a time or two together, and to have some simple means of recording the glass shown and the name given to it.

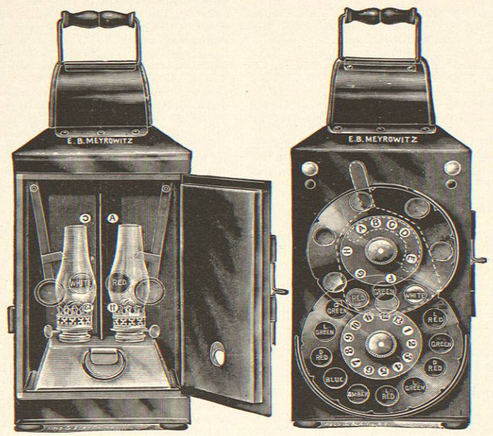

FIG. 1469.—Lantern used on the State Railways of Belgium, on the New York, New Haven and Hartford System, and on some other American railroads, for making ordinary railroad examinations.

Some ten years ago I used a Donders lantern, but did not find it satisfactory for making ordinary railroad examinations; I therefore arranged a new form of lantern, which has been modified from time to time, and in its present shape is now used on the state railways of Belgium, on the New York, New Haven and Hartford system, and on some other American railroads.

It is a square tin lantern twelve inches high and six inches on each face. On the front are two movable discs; the lower carries the following glasses: five red and four green, of different shades, one yellow, one cobalt, one smoke and one colorless glass. The upper disc has London smoke glasses of three different shades, and some clear openings, and by revolving the discs any of these colors, alone or combined with the smoke glasses, can be shown. Between the discs is a movable diaphragm with openings of 2 mm., 6 mm., and 20 mm. in diameter, by which the area of the colored lights can be changed, and inside the lantern are ground glasses which can be used in connection with the colors, or can be drawn aside. The lamp of the lantern has two burners, screened from each other, and in front of each burner is a hole in the front of the lantern so that two colors can be shown at one time; or, by moving the upper disc, one of the openings can be closed, and only one color seen. In this way two reds, or two greens, of different intensity, or a red and green, red and white, etc., can be shown together, or any of them singly. Below each colored glass in the lower disc is a transparent number, illuminated by the lamp, so that the examiner can see it and make his record of the glass shown, but screened from the person being examined; and on the upper disc the smoke glasses are similarly designated by letters. An electric lamp has been recently made for use in this lantern. It has two

incandescent lights, and in the base a series of resistance coils encased in enamel and so arranged that the intensity of the light can be varied by sending the current through more or less of the resistance, by means of a switch which projects behind the lantern. The electric lamp gives a much steadier light than the oil lamp, does not smoke, and can have its intensity varied by fixed amounts; with such a lamp those cases are more easily recognized in which the brightness of the light is depended on to recognize its color. With such a lantern the examinations can be made by day in a darkened room or at night; the colors do not fade. A large number of combinations of color and intensity can be made by means of the two discs; the size of the colored area can be varied. The ground and smoke glasses with the colors give something of the effect of fog and smoke in the air, and the illuminated numbers enable the record of the examination to be quickly and easily made. In the Donders lantern the smallest opening through which the colors are seen is 1 mm. in diameter, but in practice it is a tedious process to make a fair examination of railroad employees with this small opening at the given distance of 5 metres, or sixteen feet; and for the practical purpose of testing the color perception of the central portion of the retina it is sufficient to have the opening 2 mm. in diameter, and place the lantern at a distance of twenty feet from the person examined, which is the distance used in the tests for form vision. With colored lights the recognition of the signal does not depend on the visual angle to the same degree that it does with form signals, or letters, and under favorable conditions the color of a switch or semaphore signal can be seen at a distance of more than a mile.

In the ordinary tests with my lantern the candidate is first asked to name all the colors, as seen in pairs through the largest opening, as "right red, left green," etc.; then the upper disc is turned to close one of the openings, and the diaphragm is placed to bring its smallest hole opposite the other opening. The candidate is then asked to name the colors as seen singly, through this 2-mm. hole. In this way, even when no smoke glasses are used, the name is given to a color thirty-nine times in each test, and it is very rare to find a man who passes the lantern test and fails with the worsteds, but this will occasionally occur. On the other hand, I have had four men, in about a year and a half, who passed the worsted test, both Holmgren's and Thomson's, without difficulty, but who failed badly with the lantern. They were excessive users of tobacco, possibly with some addition of alcohol, and had a small central defect in the retina, which was so small that the retinal image from a skein of worsted held in the hand extended beyond the affected area, and the color could then be recognized at once; but with the signal light the image was formed wholly within the affected part, where its color could not be recognized.

It is not easy to fix a standard for color vision which shall exclude all the dangerous cases, and shall not exclude some men in less important positions, who may have a somewhat feeble color perception and yet not enough to make them dangerous. The rule of the New Haven road is as follows: "No person can be considered to have satisfactory color perception who calls a red light green, or a green light red, under any of the varying conditions of the lantern test; or who selects the grays, browns, or reds with the greens, as looking like the green test skein, *and* selects any of the grays, blues, violets or greens, with the rose or red colors, as looking like the rose test skein of the worsted test." A mistake of one or two confusion colors, with the green test skein, would not be sufficient to reject the applicant, but mistakes with both green and rose tests, or the confusion of red and green in the lantern test, would reject him.

The New York, New Haven, and Hartford Railroad, which operates 2,060 miles of track and has 29,000 employees, has recently put in effect a very complete set of rules to govern the examinations for vision, color sense, and hearing. These rules were drawn up by me about a year and a half ago for use on a part of their lines, and have worked so well that they have now been improved and extended over all the lines controlled by this company; and as they may serve as an example of what is intended to be a thorough and fair examination, they will be quoted in full.* The rule in regard to "test glasses" is intended to detect cases in which there is such an amount of hypermetropia as would, in the course of years with increasing presbyopia, bring the vision without glasses below the standard required. It is not so complete a test for this condition as could be desired, but it prevents a number of men from entering the engine service who, with advancing years, would find it difficult to pass the vision test. The other rules are self-explanatory. *Charles H. Williams.*

INSTRUCTIONS FOR EXAMINATION OF VISION, COLOR SENSE, AND HEARING.*

(The New York, New Haven and Hartford Railroad Company.)

Each Examiner appointed by the Division Superintendent, subject to the approval of the General Superintendent, will first be himself examined as to his vision, color sense, and hearing, and if this test is satisfactory will be instructed in the use of the following material, which will be furnished Division headquarters.

1. A set of standard test letters on cards, including cards on which semaphore signals are printed; for testing the acuteness of vision.
2. A set of cards with reading matter in print of various standard sizes, and some train orders written on the manifold copying sheets; for the reading test.
3. A set of approved Holmgren worsteds (125 colors, each with numbered tags), and a standard testing lantern, with 13 glasses of different colors, and smoke glasses, and arranged to show either one or two colors at a time; for testing the color sense.
4. A ratchet acoumeter; for the hearing test.
5. Two pairs of spectacles, one with plane glasses, the other with a convex lens of two diopters, for each eye.
6. Blank forms and certificates, for noting the result of the examinations.

The tests should be made in a well-lighted room in which a distance of 20 feet can be measured from the test type to the person to be examined. Dark shades or shutters should be provided so that the room can be darkened for the lantern test. The colored worsteds must be protected from light and dust when not in use.

In case of persons desiring to enter the service insert "App." before the proposed occupation.

Each Examiner, after filling in the results of the tests on the form T 523, will note under the head of Remarks, in each case, "satisfactory," or "not satisfactory," according as the person examined comes up to the required standard or not, and will then sign the form and forward it to the office of the General Superintendent after an impression copy has been taken in the Division Superintendent's office.

The examinations should not be hurried. Some men are nervous when undergoing these tests, and need to be given plenty of time, and to be shown that no unfair advantage is to be taken of them. Do not allow frequent interruptions nor the presence of those not concerned in the test.

Each person should be examined separately, so that no assistance can be given by sign or sound to those who are defective. Much time will be saved by having a clerk to fill in the record on form T 523, the Examiner giving him the data as the examination proceeds.

All cases of doubt should be referred to a Board consisting of the General Superintendents of the Eastern and Western Districts and Dr. Charles H. Williams.

ACUTENESS OF VISION.—Place the person to be examined so that he will not face a strong light, have him completely cover one eye by holding a card over it, pressing it firmly against the nose, taking care not to press on the covered eye; hang one of the 20-foot cards at a distance of twenty feet from him in a good clear light, but not in direct sunlight, and ask him to read the letters on the card. If he can read them correctly, or with a mistake of not more than one letter, hold up another of the 20-foot cards, and, if this is also read correctly, note on the form the distance at which the test letters are read, and underneath it the number over the smallest line of test type read correctly; in this case 20/20, or normal vision. If he cannot read the letters on the 20-foot card at twenty feet, hold up a 30-foot card, then a 40-foot card, etc., until letters are found that he can read; if he cannot read the 50-foot letters at twenty feet let him approach the card until he can see them, or the fact is shown that he cannot see them at any distance. If the letters on the 40-foot line are the smallest that can be seen with this eye at 20 feet, its vision will be noted as 20/40 of normal, the numerator of the fraction being the distance at which the letters are read correctly, and the denominator being the number of feet printed above the smallest line that can be read,—that is, the distance at which they ought to be read correctly by the normal eye.

Repeat this test with the second eye, the first being covered in its turn. If the vision is less than normal, repeat the test with both eyes uncovered and open, but if the vision is normal in each eye omit the test with both eyes open.

These tests are to be made without glasses, except as otherwise specified. In case glasses are worn, test first without the glasses and then repeat the test with the glasses, noting on the form T 523, under the head of Remarks, the vision with the glasses.

*The test letters and cards, the tagged Holmgren worsteds, the spectacles and the ratchet acoumeter can be obtained from Millar & Welch, 38 West Street, Boston, Mass. The lantern can be had from the maker, Peter Gray, 12 Marshall Street, Boston, or from E. B. Meyrowitz, 104 East 23d Street, New York.

POSITION SIGNAL TEST.—Place one of the cards with the semaphore signals at a distance of 20 feet, as in the first vision test, and with each eye separately have the person being examined read the signals, as stop or proceed, beginning at one end of the card with one eye, and at the other end of the card with the other eye. Repeat the test with another of the semaphore cards, with both eyes open, and note the distance in feet at which the signals can be read correctly without glasses. The position signal test need not be used for those desiring to enter the service, nor unless the vision is less than 20/30.

READING TEST.—Note the smallest size of print read correctly at the ordinary distance of about 18 inches, either with or without glasses, also whether manifold train orders can be read correctly at that distance.

TEST GLASSES.—In the case of men making application to enter the engine service, either as a new employee, or by transfer from some other department, the following additional test will be made. Place one pair of the test glasses in spectacle frames before the eyes of the applicant, and have him read another of the 20-foot cards, at 20 feet, then try the other pair of glasses. If he can read the letters through the plane glasses, but cannot read them through the convex, or magnifying, glasses, note on the form, under the head of Remarks, "test with test glasses satisfactory"; but if the letters can be read through both pairs of glasses, note "test with test glasses not satisfactory." Engineers and firemen in the service will be tested with the test glasses, and if they have 20/20 or 20/30 vision with *both* pairs of glasses they will be re-examined yearly for vision.

COLOR SENSE.—1. Holmgren Test. Place the whole number of colored worsteds on a table in good clear daylight, put the light green test skein A at a little distance from the other colors and ask the person being examined to select from the heap of colors all that look to him like the test skein, and place them beside it. Have him understand that he is not expected to find an exact match for the test skein, but that he is to choose all the colors that appear to him of the same general color as the test skein, both those that are lighter and those that are darker in shade. If he does not easily understand what is wanted, let the Examiner himself select the colors, then having returned them to the general heap and mixed them thoroughly with the rest of the colors, let him call on the person being examined to repeat the selection. This demonstration will not enable a person who is defective in his color perception to select the colors correctly, and he will pick out as looking to him like the green test skein A, some greens, and also some of the gray or brown confusion colors, which will appear to him of the same general color as the test skein, only varying from it in shade. Note on the form, the numbers on the tags of the colors selected as similar to the test skein A, and also note whether the selection is prompt or hesitating. Return all the colors to the heap and mix them together, then place the rose test skein B apart from the rest, and have the person being examined select as before all the colors that look to him like this skein, and note the numbers on the colors so chosen.

No names should be mentioned in connection with any color in the above worsted tests; the tests should be based only on a comparison of colors.

2. Lantern Test. The room being darkened, light the test lantern and place it 20 feet from the person being examined about on a level with his head. Set the upper disc so that empty spaces come in front of the lights, the letters A and C being illuminated on the upper part of this disc. Push the brass buttons on the front of the lantern so that the ground glasses on the inside of the lantern are brought in front of the lights. Set the handle of the diaphragm at the lowest notch so that the colors are seen through the full-sized openings of the discs. Then turn the lower disc, carrying the colored glasses, which will show two colors at a time, and have the person being examined call the names of the colors as shown; for instance, "left, green; right, red," etc. Note on form T 523 the name given to each color as shown, corresponding to the number on the lower disc under the color.

Repeat the test, placing the handle of the diaphragm in the highest notch so as to have the color seen through the smallest opening, and turn the upper disc so that only the letter C is illuminated; in this way, only one color will be seen at a time. Turn the lower disc and note as before the names given to the colors as shown. In case there is any question as to the color perception of the person being examined, further tests may be made by combining the smoke glasses of the upper disc with the colored glasses of the lower disc and using either the largest or the medium-sized openings of the diaphragm; but the smallest openings of the diaphragm should not be used with the smoke glasses of the upper disc. Also, the ground glasses inside the lantern may be pushed aside to vary the test.

3. No person can be considered to have satisfactory color perception who calls a red light green, or a green light red, under any of the varying conditions of the lantern test; or, who selects the grays, browns, or reds with the greens, as looking like the green test skein, *and* selects any of the grays, blues, violets, or greens with the rose or red colors, as looking like the rose test skein of the worsted test.

HEARING TEST.—Place the person to be examined at a distance of 20 feet, with one side toward the Examiner; have him stop the ear furthest from the Examiner by placing the finger over it, then let him repeat aloud the words or numbers spoken by the Examiner in a conversational tone, and note the distance in feet at which they can be repeated correctly. Have him turn the other ear toward the Examiner, and repeat the test.

With one ear closed as before, note the greatest distance in feet at which the ticks of the ratchet acoumeter can be counted correctly, with each ear. Hold the acoumeter by its narrow edge between the fore-finger and thumb, not shielded by the fingers, and with one flat face directed toward the person being examined.

REMARKS.—Under the head of Remarks note any incident which might impair the accuracy of the tests, as escaping steam, etc., or anything which gives any additional information in regard to the tests.

RE-EXAMINATIONS.—All employees who are required to pass an examination for vision, color sense, or hearing, will be re-examined as follows: 1. At the end of three years from the date of the last examination; or, yearly (for vision) in Class A if one eye is found to have less than 20/40 of normal vision. 2. After any accident which might be caused by defective vision, color sense, or hearing. 3. After any serious accident, or after recovery from any severe illness, or after severe inflammation of the eyes or eyelids. 4. Before promotion. 5. Yearly, for vision, in case of enginemen and firemen who have 20/20 or 20/30 vision with *both* pairs of test glasses.

STANDARDS OF ACUTENESS OF VISION.—The following standards of acuteness of vision will be considered as satisfactory for the different classes mentioned. These standards must be strictly observed, but if in the opinion of the Division Superintendent any exception should be made, the matter must be referred to the General Superintendent for final decision, with full report containing the reasons therefor.

CLASS A.

	On Entering the Service, or Promotion.	Re-examination of those in the Service.
Enginemen. Firemen.	20/20 in each eye, tested separately, without glasses.	Not less than 20/30 with both eyes open, without glasses; each eye should also be tested separately and the vision of each noted.

CLASS B.

	On Entering the Service, or Promotion.	Re-examination of those in the Service.
Passenger Conductors. " Baggage-masters. " Brakemen. Ticket Collectors. Asst. Conductors. Freight Conductors. " Brakemen. Yard Masters. " Conductors. " Brakemen. " Enginemen (retired from road service). Switchmen. Draw Tenders.	20/20 in one eye and not less than 20/40 in the other, tested separately, without glasses.	Not less than 20/40 with both eyes open, without glasses; each eye should also be tested separately and the vision of each noted.
Towermen. Telegraph Operators. Station Agents. Section Foremen.	20/20 in one eye and not less than 20/40 in the other, tested separately, with or without glasses.	Not less than 20/40 with both eyes open, with or without glasses; each eye should also be tested separately and the vision of each noted.
Crossing Flagmen.	Not less than 20/40 with both eyes open, with or without glasses.	Not less than 20/50 with both eyes open, with or without glasses.

CERTIFICATES.—In case glasses are necessary to bring the acuteness of vision up to the above standards, the Examiner will report the facts to his General Superintendent, through the Division Superintendent, on form T 523, with the full record of the examination, and the certificate will be withheld until he receives the approval of the General Superintendent. This will not apply to Towermen, Telegraph Operators, Station Agents, Section Foremen, or Crossing Flagmen.

The Examiner will give a certificate, form 1523, to each person passing a satisfactory examination. This certificate will be dated and signed by the Examiner, and will also be signed in his presence by the person examined.

The above instructions will apply to all tests of vision, color perception and hearing, made after May 1st, 1901.

As soon as practicable all employees who are required to pass such tests, and who have not been examined by one of the Company's Examiners since April 1st, 1899, must be examined in accordance with the above instructions.

W. E. CHAMBERLAIN,
General Manager.

BOSTON, May 1st, 1901.

FORM 1523.

The New York, New Haven and Hartford Railroad Company.

This certifies that I have this day carefully tested the Acuteness of Vision and Color Perception of.....
whose signature is attached hereto, and find that he is not disqualified by color blindness or other defective sight from employment where he is required to distinguish form and color of signals.

..... Examiner.

..... 1.....

.....
Signature of party examined.

THE NEW YORK, NEW HAVEN AND HARTFORD RAILROAD COMPANY.

.....DIVISION.

Record of Examination of Sight, Color Sense, and Hearing.

NAME. ..... OCCUPATION. ..... DATE. .....

SIGHT.

Acuteness of Vision, without Glasses.	Right Eye.	Left Eye.	Both Eyes Open.	Reading Test, both Eyes Open,	Without Glasses.	With Glasses.
Distance in feet, at which standard test-type are read,				Size of reading test-type read correctly,		
Smallest line of standard test-type read correctly.				Written train orders read correctly (Yes or No).		

Position Signal Test, without glasses.	Right Eye.	Left Eye.	Both Eyes Open.
Distance in feet at which card with semaphore arms can be read correctly,			

COLOR SENSE.

Test-Skein Submitted.	Numbers on the Skeins in Standard Holmgren Color Set, selected as similar to Test-Skeins.													
A Green.														
B Rose.														
Testing Lantern, two lights.	Size of Opening.	Number shown.	1	3	2	4	3	5	4	6	5	7	6	8	7	9
		Name given.														
		Number shown.	8	10	9	11	10	12	11	13	12	1	13	2	1	3
		Name given.														

Testing Lantern, one light.	Size of Opening.	Number shown.	1	2	3	4	5	6	7
		Name given.							
		Number shown.	8	9	10	11	12	13	1
		Name given.							

HEARING.

Number of feet at which numbers or words can be repeated correctly when spoken in a conversational tone.	Right Ear,	Left Ear,
Number of feet at which ratchet acoumeter can be heard.	Right Ear,	Left Ear,

REMARKS:

.....
Examiner.