

STANDARD TESTS FOR COLOR BLINDNESS

In a report presented at the last annual meeting of the American Medical Association, Section on Ophthalmology, three prominent railroad physicians, acting as a committee of the association, have given the results of their studies in the latest practices, throughout Europe and America, in the examination of railroad employees and others for color vision and in the most advanced requirements in this matter. The report is to be found in a pamphlet printed by the American Medical Association, 535 North Dearborn street, Chicago. It is by Doctors Charles H. Williams, of Boston; Nelson M. Black, of Milwaukee, and J. Ellis Jennings, of St. Louis. The report contains descriptions of the latest model of Williams' lantern, of the anomaloscope (recently noticed in the *Railway Age Gazette*) and other apparatus used in tests.

To obviate some of the objections found in using Holmgren's worsted test, Dr. Jennings has devised a scheme for testing with yarns without handling them, and the colors are arranged in a box or frame in such a way that a person who is tested makes a permanent record of his color sense. This arrangement consists of a square box divided into an upper and a lower half, each half having a lid—virtually two shallow boxes with bottoms joined together. The upper side of the box is marked "Test No. I Green," and contains a color-board made up of all the different colors, shades and tints likely to be mistaken by the color-blind for green. The lower side of the box is marked "Test No. II Rose," and contains a color-board made up of all the different colors likely to be mistaken by the color-blind for rose. The color-boards, like the box, are absolutely square and each contains 64 patches of worsteds $\frac{1}{4}$ and $\frac{1}{2}$ in. in size, of various colors and shades, making a total of 128 colors used in the test.

In close proximity to each patch of colored worsted is a circular opening in the color-board which is for the purpose of registering the particular patch of color chosen by the candidate. This he does by inserting a pointed pencil of wood or metal through the opening and punching a hole in the record sheet which had previously been placed beneath the color-board. The position of the patches of color and the circular openings have been arranged in an absolutely symmetrical design, so that when the box is turned in any one of four positions the same appearance is presented and it is impossible to say which is top or which is bottom. The openings in the boards are so arranged that the records of both the green and rose tests are made on a single sheet.

Method of Testing.—The cover marked No. 1 is removed, the color-board lifted out, a record blank inserted and the color-board replaced. Care must be taken to see that the mark "top" in the box, "top" on the back of the color-board and the top of the record blank all correspond. The box is now turned around several times until all sense of direction is lost.

The green test skein fastened to the inside of the box cover is placed at a distance of 2 ft. and the candidate is given the pointed pencil and requested to look along each row of colored patches and when he sees the test color or one of its lighter or darker shades, he is to place the point of the pencil in the opening opposite and punch a hole in the paper beneath. Having completed Test No. I, the cover is replaced and the box turned over, exposing Test No. II, the Rose. The corresponding record blank having been inserted and the Rose skein displayed, the test proceeds as before.

It will be seen that the subject is obliged to decide by color alone. There are no odd and even numbers to give a clue. The patches of color are small enough so that cases of color scotoma may be discovered.

RECOMMENDATIONS

The results of the studies of this committee are summarized in the recommendations which they present at the end of the report, which are as follows:

1. In every case the color-sense should be examined by

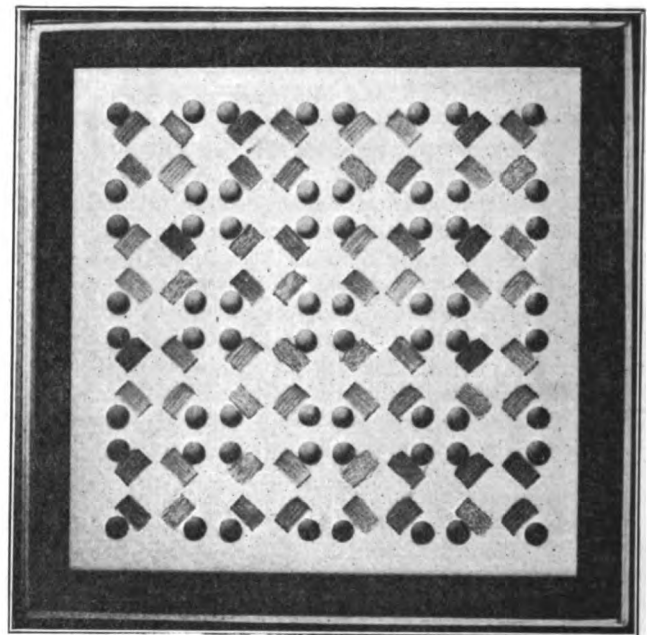
the Holmgren worsteds exactly according to the directions given. As some cases of defective color-sense may occasionally pass the Holmgren test it is necessary that another test with a lantern should be used in every case to determine the color-sense of the macula region where the colors of signal-lights must be quickly recognized.

2. (a) Those who pass the test with the worsteds and with the lantern, without making a mistake, should be classed for signal purposes, as normal.

- (b) Those who make the characteristic mistakes in selecting colors which look like the green, or the rose test skein, of the Holmgren worsteds, or, who make mistakes in naming the colors of the lantern, should be classed as abnormal.

- (c) Of the abnormal cases: Those who select with the green test skein some greens and also some grays, browns, rarely a red, or, who select with the rose test skein some rose or red colors, and also blues, purples, grays or greens, or with the lantern test call a red light green or white, a green light red or white, or a white light red or green, should be classed as dangerously defective in their color-sense.

Those who make other mistakes than the foregoing, or who are very hesitating in their selection or naming of colors, should be classed as having a weak color-sense. If these



Jennings' Self-Recording Worsteds Test

persons wish to work where they will use colored signals, they should be re-examined under medical supervision by repeating the tests with the Holmgren worsteds, and the lantern; and in addition with Stilling's plates (Fourteenth edition, 1913), and also with some form of spectroscope test to determine the extent of the visible red end of the spectrum, and, if possible, with Jennings' self-recording worsteds test, and with the Nagel anomaloscope.

3. Cases of appeal from the original examination should be re-examined as provided in the foregoing paragraph.

4. Some plan should be adopted to ensure a proper and uniform standard in the colors of the worsteds, especially the green and the rose test skeins, and in the colors of the lantern.

5. On large railway systems, and in the marine service, there should be some central point where a complete equipment can be maintained in charge of a competent medical examiner, for the re-examination of doubtful or appealed cases. There should also be a periodic examination by such examiner of all the equipment used in these tests over the whole system, to be sure that it is kept in proper condition and renewed when necessary.

6. Reports of the examinations should be kept on file at some central point and should be supervised by some competent medical authority to see that the tests are made according to the instructions.

7. The Section on Ophthalmology should adopt some standard form of instruction and record blanks which may serve as a guide for those who make the tests.

It will be noted that in the foregoing recommendations no mention is made of red-blind, or green-blind, or blue-blind. The border-lines between the various forms of defective color-sense are not sharply marked, and with the means at the disposal of the examiner in making the routine tests of large numbers of men, it is not possible for him to determine with certainty the exact quality of the defective color-sense, nor is it essential. It is sufficient if he can pick out those who are dangerously defective in their color-vision, or who need a further special examination, and the committee believes that a careful study of its report, and a strict compliance with the methods and standards there explained, will enable the examiner to make these tests for color-vision fairly and accurately.

THE WAR AND PENDING RAILWAY FINANCE

By GEORGE A. CLARK

The railroads of the United States, Canada and Mexico have approximately three-quarters of a billion dollars of bonds and notes now outstanding, which mature during the next five years, 1915 to 1919, inclusive. Approximately \$450,000,000 will fall due during 1915. In these totals no account is taken of equipment trust obligations, of the new capital which must be raised to perfect pending reorganizations of a large amount of mileage now in receivers' hands, nor of the new capital expenditures which are absolutely necessary during this period. A most conservative estimate would place the requirements for these purposes at not less than \$250,000,000.

The task of raising a billion dollars even in normal times for an industry which has largely passed the period when the inducement of large profits may be held out to investors, is a fairly sizable one. The fact that a large part of the total amount required during the period is already invested, and that in the process of refunding the actual amount of new capital brought into the industry is relatively small, does not lessen the seriousness of the situation. Because of the abnormal conditions prevailing as a result of the war a considerable part of the money represented by the maturing obligations will be diverted to other classes of security. The wide extent of the war and the consequent enormous waste of capital with resultant influence on interest rates has brought about a situation more serious than the railroad industry has ever faced before.

Those companies which are under the necessity of refunding maturing obligations in 1915 and to a slightly less extent during the subsequent three or four years are confronted with a situation more pressing than the problems which they have been struggling with during the past few years. For the time being the necessity of raising new capital upon such terms as will permit a continuance of the corporate existence of the companies involved overshadows problems of increased operating efficiency, higher rates and combatting labor demands. The money to refund these obligations must be raised or the inevitable receivership faced. Fortunately, the obligations maturing in 1916, 1917, 1918 and 1919 are relatively small in amount, both for the individual companies and in the aggregate, for the several years.

The statement in the accompanying table sets forth the principal obligations matured and maturing during 1915, including equipment trust obligations, arranged in order of maturity.

It is generally conceded that, as a result of the war, higher

interest rates will be the general rule for some time to come. It is possible that long-term money will cost more than it has at any time since the Civil War. During the progress of the war, not only have the processes of production been stopped, but an enormous sum is being consumed by the operation of the hostile armies and navies. Modern warfare is so costly that the European conflict may deplete the world's surplus of capital almost to the point of exhaustion. Possibly during the progress of the war, and certainly following its conclusion, the principal governments involved will endeavor to float loans. It is conceivable that the necessity for money will be so pressing on the part of the combatants that interest rates unknown in modern times will prevail. Such a development could have but one result upon the market for railroad securities. The income return of-

Company	Obligation	Interest Rate	Due, Date	Amount
Ashley River	1st currency	6s	Jan. 1	\$33,500
N. Y. C. & H. R.	1 yr. Notes	5s	Jan. 1	30,000,000
St. Louis & San Francisco	Rec. Cer.	6s	Jan. 2	3,000,000
N. Y. C. & H. R.	S. P. & O. 1st	6s	Feb. 1	175,000
Chicago & North Western	Cons. currency	7s	Feb. 1	12,832,000
A. T. & S. F.	Chic. & St. Louis 1st	6s	Mar. 1	1,500,000
Boston & Lowell R. R. Corp.	Plain	4s	Mar. 1	500,000
Michigan Central	Notes	4½s	Mar. 1	6,000,000
Boston & Maine	1 yr. Notes Ext.	6s	Mar. 2	27,000,000
Erie Railroad	Coll. Trust Notes	5s	Apr. 1	10,000,000
A. C. L.	Richmond & Petersburg	6s 7s	May 1	340,500
Missouri, K. & T.	2 yr. Notes	5s	May 1	19,000,000
N. Y. C. & H. R.	3 yr. Notes	4½s	May 1	20,000,000
N. Y. C. & H. R.	Oswego & Rome 1st & 2d	5s & 7s	May 1	750,000
N. Y. N. H. & H.	Harlem Rv. & Port Chester	5s	May 1	10,000,000
N. Y. N. H. & H.	Notes	5s	May 1	20,000,000
Missouri & No. Arkansas	Rec.	5s	May 1	1,250,000
Lake Shore & Michigan Central	1 yr. Notes	20,000,000
Discounted May 15
Baltimore & Ohio	Notes	4½s	June 1	35,000,000
D. L. & W.	Morris & Essex Cons.	7s	June 1	11,677,000
Missouri Pacific	Extended	6s	June 1	24,942,000
Nat'l Rys. of Mexico	2 yr. Notes	6s	June 1	26,730,000
Pere Marquette	Rec.	5s	June 1	1,892,000
Cumberland Corporation	Conv.	5s	June 1	5,000,000
Canadian Northern	Notes	6s	July 1	3,500,000
Canadian Pacific	1st	5s	July 1	13,147,633
Western Maryland	Coll. Notes	5s	July 1	10,000,000
Western Maryland	Coll. Notes	6s	July 1	3,000,000
Hampden R. R. Corp.	Notes	6s	July 1	2,000,000
Chicago & Eastern Illinois	Re. Cert.	6s	July 6	6,000,000
Pittsburgh, Shawmut & Northern	Rec.	5s	Aug. 1	1,500,000
Wabash R. R. Co.	Re. Cert. Ex.	6s	Aug. 1	16,000,000
Chicago & Western Indiana	Notes	5s	Sept. 1	10,000,000
C. & O.	Kineon Coal 1st	5s	Oct. 1	200,000
Penn. R. R.	Conv.	3½s	Oct. 1	86,827,000
Vicksburg, Shreveport & Pac.	Prior Lien	6s	Nov. 1	1,323,000
C. St. P. M. & O. S. Ste. M. & S. W.	1st Cur.	5s	Nov. 1	350,000
Erie Railroad	Tioga 1st Ext.	5s	Nov. 1	239,000
New Orleans & North Eastern	Prior Lien	6s	Nov. 1	1,320,000
Total				\$443,028,633

ferred and the safety of the investment must be comparable with the investment features offered in the obligations of foreign governments.

Although the aggregate amount of capital which must be raised for refunding purposes bulks large in a situation like the present, there is cause for congratulation that such a large amount of permanent financing was successfully completed during the first half of 1914. During this period a number of the leading companies have been successful in substituting on a favorable basis long-term obligations for short-term notes. In addition the capital requirements of these companies were anticipated sufficiently to provide for pressing immediate needs. The Southern Pacific, the Northern Pacific, the Chicago, Milwaukee & St. Paul and the New York Central & Hudson River Railroad raised \$165,000,000 for this purpose. A number of companies, including the Southern Railway, the Maine Central and the Chesapeake & Ohio, raised large sums by means of three and five year note issues. Two important companies, the Erie and the Baltimore & Ohio, both of which, according to reports, have been working on a general and refunding mortgage, refunded their maturing obligations through the sale of one year notes. The latter company has \$35,000,000 maturing June 1, 1915.

Generally speaking, the situation is as sound, if not better, than at any time since 1907. Many extensive programs of improvements have been largely completed. A part of the