

Question—With regard to shipping Lascars, you say they do not take look-out duty?—They are a sort of assistant look-outs; they have no responsibility, as that always rests with a European. There are generally two on the look-out together, one European and one Lascar. As a rule they pick up a certain quantity of English, and they have very good eyesight, though I do not know as to their colour-vision; they do not go through any examination. Between the two, that is to say the European who has picked up a certain amount of Hindustani, and the Lascar a certain amount of English, there is an understanding between them.

Question—Do you think the precautions taken by the Board of Trade with regard to seamen are sufficient?—I would not say they are stringent enough. They examine by means of coloured lights in a narrow passage, and the man has to call the colours. The naming of colours I consider to be a right test, as well as matching colours, on account of cases of colour-ignorance. Seamen might not know the names of all colours possibly; but as long as they name red and green without mistakes, that would be sufficient.

Question—Have you ever met anybody who called a light a black light?—No.

Question—Do you consider that the coaching for the Board of Trade certificate, which is known to be practised, might be the cause of the comparative ease with which defective colour-vision men get the certificate?—I do not think the coaching is sufficient to account for it.

Question—Does your examination include coloured lights?—No, coloured wools only; the Board of Trade use the coloured lights.

Question—We may take it that you examine all the officers, and you accept the Board of Trade shilling certificate for the men?—Yes, we always insist upon that. All officers, from the first to the fifth, go through our tests.

Question—Have you any suggestions you would like to make with regard to the tests?—I think not, except that the Board of Trade cannot be too severe with their examinations, and a little strong pressure might be brought to bear upon them in this direction. We should be glad to have the examinations made sufficiently reliable to relieve us of the necessity of doing what they ought to do.

LETTERS RECEIVED BY THE COMMITTEE BEARING ON
THE ENQUIRY.

"No. $\frac{7680}{1602}$

"Pall Mall,
"27th May, 1890.

"SIR,—I am directed by the Secretary of State for War to acknowledge the receipt of your letter of 20th instant, and to acquaint you in reply, that tests for Colour Vision are invariably used in the case of all candidates presenting themselves for Commissions in Her Majesty's Service.

"Holmgren's wools being the most convenient, are employed in a systematic manner to detect any defect.

"The plan consists in making the candidate match certain test colours from the heap of wools.

"I am to add that recruits are not tested for Colour Vision.

"I have the honour to be, Sir,
"Your obedient Servant,
"RALPH THOMPSON.

"The Secretary to the Committee,
"Science and Art Department,
"South Kensington."

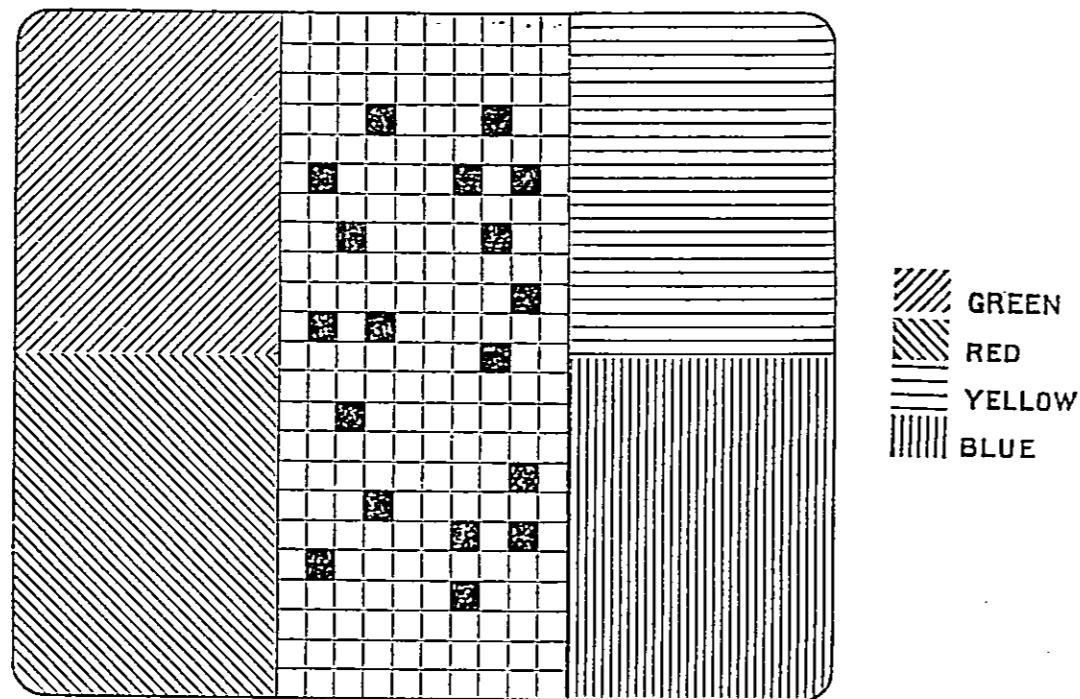
"No. $\frac{7680}{1604}$

"Pall Mall,
"5th June, 1890.

"SIR,—I am directed by the Secretary of State for War to acknowledge your letter of 2nd instant, and in reply to acquaint you that there are no statistics regarding Colour Blindness compiled in this Department.

"I have the honour to be, Sir,
"Your obedient Servant,
"RALPH THOMPSON.

"The Secretary to the Committee,
"The Royal Society,
"Burlington House, W.



"Description and Instructions.

"(Modified after the Regulations issued from the Horse Guards, by Prof. Longmore, in 1868.)

"Each test dot on this card is one-fifth of an inch square, and corresponds, at a distance of 15 feet, with the bull's-eye, 2 feet square, at 600 yards, required by order to be distinctly seen by every acceptable recruit.

"Men.—With perfectly acute vision these test dots ought to be clearly visible in full daylight at 19 yards.

"1. Expose the card in full daylight at a distance of 15 feet from the candidate.

"2. Examine each eye separately, taking care that the unused eye be merely covered, not pressed upon or closed.

"3. Vary the number and position of the dots by covering some of them and moving the card.

"4. Test each eye as to recognition of colour."

"Civil Service Commission,
"Westminster,
"28th May, 1890.

"SIR,—In reply to your letter of the 20th instant, I am directed by the Civil Service Commissioners to inform you that in the medical examinations conducted by them no tests of Colour Vision are employed, except in the case of the examination for the India Civil Service, where the tests used are of the simplest character.

"Under the circumstances the Commissioners regret that they are not in a position to assist your Committee.

"I have the honour to be, Sir,
"Your obedient Servant,
"J. E. LOCKHART.

"Capt. Abney, R.E."

"M. 4624.

"India Office,
"Whitehall, S.W.,
"29th May, 1890.

"SIR,—I am directed by the Secretary of State for India in Council to acknowledge the receipt of your letter of 20th May, and to acquaint you in reply that the tests for Colour Blindness used by the Medical Board at this Office, in the examination of candidates for the Indian Service, are Holmgren's coloured wools. First a pale grass-green skein of wool is selected, and the candidate is requested to pick out from the heap of coloured wools others of the same type of colour, irrespective of shade; if he readily selects the greens he is considered to be free from Colour Blindness, though the further tests are usually applied; if he picks out any of the confusion coloured greens, drabs, pinks, yellows, &c., he is Colour Blind.

"The second test used is a light purple or rose colour; if he matches this with blues or violets he is pronounced red blind, if with greens or greys he is pronounced green blind; if he passes the second but fails in the first test his colour sense is weak.

"The third and confirmatory test is a bright red; if he is red blind he chooses dark greens and dark browns; if green blind, bright greens and bright browns.

"I am, Sir,
"Your obedient Servant,
"O. N. NEWMARCH,
"Maj.-Gen.,
"Military Secretary.

"Capt. W. Abney, R.E.,
"Science and Art Department,
"South Kensington."

"Admiralty,
"27th May, 1890.

"MY LORD,—With reference to letter of the 16th inst., requesting, on behalf of a Committee appointed by the Royal Society to enquire into the subject of Colour Vision, information as to the methods employed by the Admiralty for testing Colour Blindness, I am commanded by my Lords Commissioners of the Admiralty to acquaint you that candidates who are examined for entry into

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the Naval Service are required to recognise without hesitation the primary colours, as well as green, the tests employed being those of coloured flags or coloured cards held at varying distances from the candidate.

"Cases of hesitation, or suspected defective colour-perception, are tested by Holmgren's wools and samples of coloured buntings used in Her Majesty's Navy.

"A special form of apparatus, in the shape of a lamp with coloured slides, for testing colour-perception at night, is under trial.

"I am, my Lord,
"Your obedient Servant,
"EVAN MACGREGOR.

"The Lord Rayleigh,
"Royal Society,
"Burlington House, W."

"London, Brighton, and South Coast Railway,
"Secretary and General Manager's Office,
"London Bridge,
"June 26th, 1890.

"TESTS FOR COLOUR VISION.

"Sir,—Referring to your letter of the 16th instant, relative to the tests used on this Railway for Colour Vision, I have the pleasure to hand you herewith some small samples of the different coloured glasses used for signals, and also a couple of pieces of red and green bunting, which are portions of flags used for hand signals by our Guards and Permanent-way men. The white bunting is made of the same material.

"The memorandum overleaf describes the pigments used for signal colours, and the labels on the glasses enclosed describe the colours and the uses the glasses are put to.

"With regard to the tests employed, I may state that the Company's Medical Officer examines, on their appointment to the service, the men in the Traffic Department, and for this purpose skeins of coloured wools are used, as well as coloured discs.

"In the Locomotive Department the Drivers and Firemen first commence as Engine Cleaners, when their eyesight is tested by the Inspectors, the colours shown being red, green, and white, at short distances. On being promoted to Firemen it is again tested at a distance of about 420 yards with red, green, and white boards, of about half the size of semaphore signals, and this test is again repeated when they are promoted to Drivers.

"In addition to this, the Foremen examine them at distances varying from 400 to 700 yards, both by night and day, the Surgeon of the district finally giving a certificate.

"I am, Sir,
"Your obedient Servant,
"A. SARLE,
"Secretary and General Manager."

"London and North Western Railway,
"Secretary's Office, Euston Station,
"London, N.W.,
"June 27th, 1890.

"Sir,—I beg to acknowledge the receipt of your letter of the 16th current, and in reply to your enquiry am instructed to inform you that the Company purchase the coloured glasses used for signal lamps from—

Messrs. Chance Brothers & Co., Glass Works, Birmingham.

„ Defries & Sons, 147, Houndsditch, E.C.

„ Gammon & Co., Belmont Glass Works, Birmingham.

And that they obtain the material for signal flags from Messrs. W. Bancroft & Sons, Halifax.

"I am, Sir,
"Faithfully yours,
"F. HARLEY,
"Secretary.

"Capt. W. de W. Abney, C.B.,
"The Royal Society, Burlington House, Piccadilly, W."

"Metropolitan Railway,
"General Manager's Office,
"32, Westbourne Terrace, London, W.,
"June 28th, 1890.

"COLOUR VISION.

"Sir,—In response to your letter of the 16th inst., I may advise you that we have no appointed examiner to test the Colour Vision of our men, nor do we adopt the principle of colour glasses.

"Our test is that known as the wool test, adopted by several of the Railway Companies, and it is made either by our Locomotive Superintendent personally, or by his immediate representative.

"In compliance with your request, I have pleasure in sending the following samples:—

"1 red flag.

"1 green flag.

"1 piece each of red and green glass.

"1 small bottle containing vermilion enamel, with which we paint the Signal Arms.

"I am, Sir,
"Your obedient Servant,
"J. BELL.

"Captain Abney, R.E., C.B."
(7731)

" South Eastern Railway,
 " General Manager's Office,
 " London Bridge Station, S.E.,
 " June 27th, 1890.

" COLOUR BLINDNESS.

" SIR,—With reference to your circular of the 16th instant on this subject, I beg to state, so far as concerns the practice of this Company in this matter, in connection with those entering their service, it is as follows:—Candidates for employment as Porters, &c., are required to match colours from a collection of coloured objects or wools of various tints, and the medical man also uses the tests known as Snellen's tests.

" Applicants for employment as Engine Drivers enter the service as Engine Cleaners, and as a preliminary, a collection of coloured wools is placed before the candidate, and he is requested to pick out various colours as directed, and unless he is able to distinguish the colours readily and correctly, he is not considered eligible.

" In time an Engine Cleaner is promoted to a Fireman, and on this taking place, the colour test is again applied, supplemented with tests with hand flags at various distances.

" I am, Sir,

" Your obedient Servant,
 " M. FENTON,
 " General Manager.

" W. de W. Abney, Esq.,
 " The Royal Society, Burlington House, W."

" The Great Northern Railway,
 " General Manager's Office,
 " King's Cross Station,
 " London, N.,
 " July 15th, 1890.

" DEAR SIR,—In reply to your letter of the 16th ult., addressed to the Secretary, on the subject of the tests applied to men admitted to the Great Northern service for Colour Blindness, I have the pleasure to enclose for your information a copy of a Report which I have called for from the Medical Officer, giving full particulars of the tests for the traffic staff.

" I also enclose copy of a Report from the Locomotive Superintendent, with reference to the tests applied to Enginemen.

" I can only add to the information contained in these, the statement that I do not know of any cases where an accident has resulted from Colour Blindness on the part of any of the Company's servants.

" The test applied to the Enginemen is a practical one, not only for colour but for distance, which is a very necessary element.

" Yours truly,

" W. W. Abney,
 " The Royal Society, S.W."
 " H. OAKLEY.

ENCLOSURE.

" The Great Northern Railway,
 " Locomotive Department,
 " Engineer's Office, Doncaster,
 " February, 4th, 1890.

" DEAR SIR,—Drivers' eyesight. Yours of the 13th ult., and Mr. Clement E. Stretton's inquiry.

" When Enginemen are first appointed they are subjected to a rigid test, both with respect to distance and colours.

" For distance, the ordinary signals in the yards are used, and to ascertain their faculty for distinguishing colours a painted board is mostly employed.

" Men are again examined when age, infirmity, or any other cause leads us to suspect that their eyesight is in any way defective.

" I may tell you that in my long experience and that of my oldest assistant, no single case of Colour Blindness has occurred, and it should also be borne in mind that there are always two pairs of eyes on the footplate.

" Yours truly,
 (Signed) " P. STIRLING.

" H. Oakley, Esq.,
 " King's Cross."

" Belvedere House,
 " Barnet,
 " June 28th, 1890.

" DEAR SIR,—In reply to your letter of the 25th inst., requesting me to inform you as to the mode of testing the sight of the men. Each man is placed with his back to the light at a distance of 15 feet, and made to count the dots on a test dot card, first with both eyes and then with each separately. I also made them read the names of stations which are printed on cards at the same distance. If satisfied with the examination on this point, I then test for Colour Blindness by the use of Holmgren's coloured wools. They consist of a collection of small skeins of coloured Berlin wool, each of which is loosely twisted up. In this bundle is included wools of red, orange, yellow, yellow-green, pure green, blue-green, blue, violet-purple, pink, brown, grey, several shades of each colour. These worsteds being placed in a pile on the table, I lay aside a skein of a special colour desired for the examination, I then require the man to select from the wools other skeins which most closely resemble the colour of the sample, and to place them by its side. The Colour Sight is decided by the manner in which he performs his task. I hold up the different colours to him at a distance of 15 feet. Test 3 is a confirmatory test, and specially useful in examining the Colour Sight of those employed in reading signals. Select a

vivid red skein, like the red flag used for signals on railways, a bright yellowish-red, a scarlet. The red blind will match the sample with a dark green or dark brown with shades which to the normal eye are darker than scarlet. The green blind will select light green or light brown to match the scarlet shades which are lighter than the sample.

"Yours faithfully,
(Signed) "W. J. HARNETT.

"W. Latta, Esq."

"Metropolitan District Railway,
"Manager's Office,
"Parliament Mansions, Victoria Street,
"London, S.W.,
"July 17th, 1890.

"SIR,—Your letter of the 16th ultimo, addressed to the Secretary, respecting the various tests for Colour Vision, has been handed to me, and I beg to reply to your several questions as follows:—

"The tests are applied by the Company's Medical Officer, Dr. R. Bligh Wall, of 72, Bishop's Road, Bayswater. His test is by means of coloured wools, the person under examination having to name a given colour, and in some cases he is required to match colours.

"Any application to attend one of your meetings to explain the methods in detail, if addressed to Dr. Wall, will, I have no doubt, receive his best attention.

"I send herewith samples of the different coloured glass in use for the different signals, viz., red and green, as well as sample pieces of bunting used for hand signals. With respect to the fixed day signals, in the case of those known as ground discs which depend on colour, the pigment used is known as Bennett's Enamel White Paint, and Bennett's Vermilion Fluid Enamel, two specimens of which I enclose.

"I am, Sir,
"Your obedient Servant,
"ALFRED POWELL,
"Manager.

"Capt. W. de W. Abney,
"The Royal Society."

"London, Chatham and Dover Railway,
"Secretary's Office,
"Victoria Station, Pimlico, S.W.,
"July 14th, 1890.

"SIR,—In reply to your letter of the 16th ult. as to the steps taken in this Company to test the Colour Vision of the employes, I beg to inform you that the test used in our Locomotive Department is the same as that in the Army. It is a test in colours and dots on a card. I enclose a copy of the card, as well as the

description and instructions printed at the back. The card was obtained at the Horse Guards some time ago. As regards the test adopted in the Superintendent's Department for Signalmen and others under the control of the Traffic Superintendent, I cannot do better than send you a copy of a report from our Medical Officer with reference to the means which he adopts to test the Colour Vision of the men in that Department.

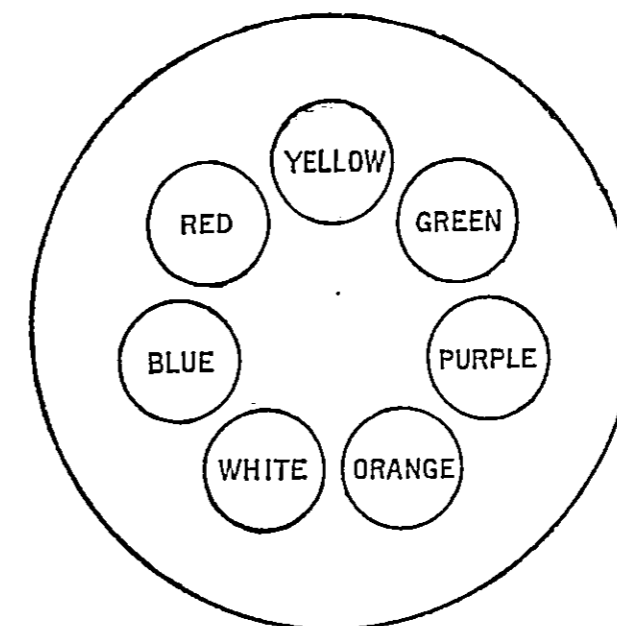
"Yours faithfully,
"JOHN MORGAN,
"Secretary.

"The Secretary, Colour Vision Committee,
"Royal Society, Piccadilly, W."

"The Avenue,
"Brixton Hill,
"July 9, 1890.

"DEAR SIR,—In accordance with your instructions of July 5th to report on the means employed to test the railway servants on L.C. & D.R. as to their ability to detect colours, the following apparatus is in use.

"It consists of a hollow tube about 12 inches square and 22 inches long. At one end of it is a revolving disc having let into it as near as possible the seven primary colours, great care being taken that the red, green, and purple are of the same hue as the actual signals:—



"The disc is illuminated at the back, thus giving the colours much the appearance they have on the signals.

"This appliance meets with all necessary requirements, and is a fair test as to the men's capabilities of detecting colour.

"On examination they are instructed to look down the tube, and by means of a handle any one of the colours can be shown at will, so that no two men coming up need have the same series of colours. This is very important, as when a number of candi-

dates come up together, they immediately communicate to the other what has taken place.

"The actual cases of Colour Blindness are very scarce, but it is not at all an unfrequent occurrence to find men coming up, more particularly from the rural districts, quite unable to name the colours correctly, purely from want of education. These men are always rejected.

"Yours faithfully,
(Signed) "J. H. PARKER WILSON, F.R.C.S.

"To the Superintendent L.C. & D.R."

"The Cunard Steam-ship Company, Limited,
"Secretary's Office,
"Liverpool,
9th July, 1891.

"SIR,—Referring to your letter of the 23rd ult., I beg to annex particulars of the tests required to be passed by seamen before they are admitted to the Cunard service.

"I enclose also skeins of wool similar to those used on each occasion.

"The officers undergo a special examination for colour by the Board of Trade in passing each grade.

"The Cunard Company had the whole of their officers examined some two or three years ago by a qualified medical man, which examination is to be repeated this year, and every three years in future. A special examination by a medical man is also to be made in respect of each new officer entering the service.

"As a representative of the Company, if he were to attend a meeting of the Committee, could only repeat the particulars here given, my Directors think that you will probably consider such attendance unnecessary.

"I am, Sir,

"Your obedient Servant.

A. W. MONHOUSE,

"Secretary.

"Captain W. de W. Abney, C.B., R.E.,
"Science and Art Department,
"South Kensington, London, S.W."

COLOUR BLINDNESS.

Tests.

First.—A lamp fitted with slides in which a red, white, or green glass can be placed. When the crew are about to sign articles the lamp is lighted, and if a sailor unknown to the officers wishes to ship, if his qualifications are satisfactory, he is told to name the colour of the light as the different coloured glasses are put in the slides and shown to him.

Second.—Several skeins of coloured wool are placed on a table, and if a stranger to the officers wishes to ship, he is told to pick

out a colour named to him. Afterwards the surgeon or an officer takes up one skein after another, and asks the man to name the colour.

If the man's answers to either of the above are satisfactory, he is entered.

"Peninsular and Oriental Steam Navigation Company,
"Offices, 122, Leadenhall Street,
"London, E.C.,
"July 6, 1891.

"SIR,—We regret we have not been able to reply earlier to your letter of the 23rd ult., which was duly received, but we are pleased now to give you the information you desire.

"Every navigating officer who enters our service has his sight specially tested, and he is not accepted unless he possesses good normal vision in both eyes.

"The method by which the vision is tested is as follows:—One of Pickard and Curry's (of Great Portland Street) large sheets of test types is enclosed in a frame and hung on the wall of a room. The prescribed distance has been measured and marked, and the candidate is placed with his toes to this line. First one eye is covered up and he is asked to read all the lines, beginning with the very large type at the bottom line. If the eye first examined proves satisfactory, it is covered up and the other eye is examined in a similar way. Should the candidate prove to have good long sight in both eyes, his short sight is tested by his being asked to read a list of proper names printed in small type, the sheet on which the names are printed being gradually brought closer to his eyes until the words cease to be distinct. This distance is noted, and if shown to be the normal distance, his sight is considered good. We attach importance to good short sight as well as good long sight on account of the necessity of reading, marking on charts, &c.

"The candidate having shown himself to possess good long and good short sight, is tested as to colour-sight by being asked to name the colours of an assortment of the usual coloured wools, obtained for the purpose from Pickard and Curry.

"Preliminary to this examination, the candidate's power of long sight is usually roughly tested by his being asked to read letters on sign-boards, &c. at various distances in the street, but it is on the accurate tests above described, which are never omitted, that we place reliance, and on the results which they give we base our decision regarding the acceptance of the candidate so far as his vision is concerned. All seamen have to produce Board of Trade Colour Certificates before being shipped by this Company's vessels.

"We are, dear Sir,

"Yours faithfully,

"J. D. JAMES,

"For the Managing Directors.

"Captain W. de W. Abney, C.B., R.E.,
"Science and Art Department."