foot: ten months later very limited ankle movement; treated at Croydon General Hospital for three weeks; plaster-of-Paris splint (? time); forty-five weeks half wages and lump sum; not a good result; bad fracture; not likely to do own work again.

23. G. C., aged 43. Fracture of left ankle (? tarsal bones); swelling of foot; no bony deformity noted; treated at St. Thomas's Hospital; plaster-of-Paris splint seven or eight weeks; twenty-six weeks' half wages, and lump sum equal to more than that.

24. A. R., aged 56. Fractured tibia just above left ankle; slight concavity just above ankle; good ankle movement; in Guy's Hospital eleven days; out-patient about five months; fifty-five weeks half wages, and settlement by lump sum; would not try.

25. H. A. P., aged 39. Fracture of right ankle, good position; six weeks after accident there was pain on moving the joint; treated at St. Thomas's Hospital; sent home in splints; splints three weeks; lump sum paid under employer's liability; lost sight of.

26. M. Pott's fracture; not fit for work fifteen months after accident; position good; ankle stiff; examined in court under employer's liability.

27. C. O., aged 40. Compound fracture right tibia and fibula just above ankle; left leg at ankle (? Dupuytren); right: deformity above ankle; left: inward displacement of foot; malleoli widened, very little movement; treated at St. Bartholomew's Hospital; plaster-of-Paris splints removed about three months after accident; seventeen months after accident using two sticks; left foot not likely to get good enough for work.

28. J. S., aged 35. Fractured tibia and fibula, just above ankle, fairly good position; treated at London Hospital, in bed twenty-four days; plaster-of-Paris splint forty days; twenty-six weeks' half wages.

29. A. H., aged 34. Fracture of left leg above ankle; position good; could not feel fracture site; treated at Royal Free Hospital three weeks; plaster-of-Paris splint on a month; fifteen months after the accident still on half wages; nine months after leg fit at any rate for ground work, but patient neurasthenic.

30. R. W., aged 49. Fracture right fibula about ankle; position good; eleven months after good movement, some pain; should do ground work; in St. Bartholomew's Hospital fourteen to twenty-one days; plaster-of-Paris splint six weeks; eighteen months after accident still on half wages.

31. G. F., aged 40. Fractured patella; good result; treated at Hampstead General Hospital; wired; twenty-eight weeks' half wages and lump sum.

32. J. B., aged 46. Fracture of right ankle (? compound); position good; limping badly and using stick sixteen months later; treated at St. Mary's Hospital; splints (anaesthetic); in bed five weeks and three days; plaster-of-Paris splint six weeks; sixteen months after accident on half wages, and likely to be some long time.

33. A. E. H., aged 30. Fracture of right ankle; thirteen months later wasted leg and thigh muscles; both feet flat; treated at St. Bartholomew's Hospital; fracture (?) diagnosed by x rays eleven months after accident; ? tubercle in ankle and tarsal joints; using crutch and stick thirteen months afterwards and foot very painful.

34. Constable P. Fracture of right tibia and fibula just above ankle; treated at St. Bartholomew's Hospital; plaster-of-Paris splint at once and then police hospital; two days later plaster-of-Paris splint removed and back and side splints applied; off duty eight weeks and two days.

35. Constable S. Fractured tibia and fibula half way down shaft; ankle joint not involved; wrestling accident; treated at police hospital, back and side splints; off duty sixteen weeks and three days.

36. Constable F., aged 29. Fractured tibia and fibula 2 to 3 in. above ankle; tibia oblique sharp point under skin on inner side above ankle; treated at the police hospital; off duty thirteen weeks, then went to full duty, but allowed to sit down for a few minutes occasionally for first two months.

37. Constable B. Fractured fibula, external malleolus; wrestling accident; treated at police hospital; massage from second day, passive movement from fifth; plaster-of-Paris splint from fourteenth day for three weeks; off duty eleven weeks.

38. Constable P. Fracture of upper third of fibula; wrestling accident; treated at police hospital; back and side splints; off duty nine weeks and four days.

39. Constable T. Fractured tibia and fibula, lower fifth; first treated at Guy's Hospital, then police hospital four days, then convalescent home, and again police hospital fourteen days; off duty twelve weeks and six days.

40. Constable M., aged 44. Compound fracture of tibia and fibula, lower third; wound just behind tibia; run over by cab; treated at the police hospital; off duty thirteen weeks but not doing quite full ordinary duty till eleven months after accident.

41. Constable M. Fracture of middle shaft of tibia; horse fell on him, fibula not broken; treated at police hospital, back and side splints; off duty thirteen weeks.

42. A. H., aged 51. Fracture of neck of humerus; no deformity noticed; full passive movements painful three months after accident; treated at Guy's Hospital for two months, then massage; thirty-two weeks' half wages.

43. F. J., aged 49. Fracture of "cup of right shoulder"; no deformity; two months later wasting of muscles; full passive, but little active movement; treated at St. Bartholomew's Hospital; passive movement commenced at five weeks; twenty-six weeks' half wages.

44. C. P., aged 48. Compound fracture of right arm; callus felt middle of forearm; slight concavity forwards; treated at Middlesex Hospital; splints six to seven weeks; surgeon told him to do light work at the end of three months; twenty-three weeks' half wages and lump sum.

45. G. M. Fracture internal condyle humerus and at wrist; tendons cut; left arm; some outward displacement of the hand; treated at Middlesex Hospital; gas twice for elbow movement; twenty-five weeks' half wages and lump sum; fit for light work.

46. E. M., 40. Fracture of left wrist "bone cracked," x rays; no bony deformity, but severe injury to soft parts; lot of swelling and pain; treated at St. Mary's Hospital; six months after wrist rigid; no pronation and supination; looked hopeless; fifty weeks' half wages and big lump sum.

47. H. W., aged 36. Fracture of part of head of radius; x rays; only capable of being diagnosed by radiography; treated at St. Thomas's Hospital; mobilization and massage; seen eleven days after accident; hospital people thought five or six weeks; employer's liability settlement.

48. C. D., aged 64. Fracture of neck of humerus; union good; some grating in the shoulder sixteen months after the accident; no deformity; could not use it; treated at Westminster Hospital, then the London; eight months' massage and a machine and movement; last three months, letting it go when seen by me; seventy-nine weeks' half wages and a good lump sum.

49. J. K., aged 38. Fracture of scapula; seven weeks after accident very poor shoulder movement; treated at Great Northern Central Hospital; eleven weeks' half wages, and lump sum equal to ten more.

50. B. H., aged 39. Fracture of lower end of right forearm by direct violence; fairly good position; three months after, some swelling about wrist, and wasting of forearm muscles; treated at St. Bartholomew's Hospital; Carr's splint four weeks, massage afterwards; seventeen weeks' half wages and lump sum equal to thirty more; work involves using heavy hammer for breaking concrete.

51. F. W., aged 43. Fracture of lower end of left radius; position good; five months later pronation and supination good; flexion and extension limited by pain in tendons; treated at West London Hospital; back and front splints; twenty-two weeks' half wages.

52. T. L., aged 48. Fracture of left humerus; ten months later no deformity; muscles good; limited shoulder movement; no treatment last six weeks; treated at Great Northern Central Hospital; forty-four weeks' half wages, and lump sum equal to at least twenty more.

53. W. G., aged 40. Colles's fracture; typical displacement; treated at St. George's Hospital; ether for setting; Carr's and back splints; mobilization and massage after third day; seven months later still on half wages; probably some permanent weakening.

54. Constable J. Fracture of forearm; both bones broken; treated at police hospital; went first to (?) St. Bartholomew's; seven weeks off duty.

REFERENCE.

¹ *Clinical Journal*, November 10th, 1909, p. 65.

ON THE FUTILITY OF THE OFFICIAL TESTS FOR COLOUR BLINDNESS.

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FOR the past twenty years or more Edridge-Green has pointed out the utter inadequacy of the official tests for colour blindness, and his efforts have been seconded by many other ophthalmic surgeons both in this country and on the Continent and in America. In Germany, Nagel, who was colour blind, repeatedly stated that from his own personal experience he knew how easy it is for an intelligent man to defeat many of the tests which to the lay mind appear to afford conclusive evidence of the presence or absence of defective colour vision.

The result of these efforts is so far very disappointing. Holmgren's wools are still scheduled as the official test both by the Board of Trade and by railway companies, and the examinations are practically always conducted by men who have no special knowledge of the physiology and pathology of colour vision. It is true that if a seaman is rejected he can appeal to a special court of examiners which includes a physicist possessing expert knowledge of colour vision, but what if he passes the tests conducted by laymen by inefficient methods?

The practical working of the system is a matter of common knowledge to all who have had opportunities of investigating the question. Signals are frequently over-run by engine drivers, and it is well known that the

majority of railway accidents are caused by misinterpretation of signals. It is highly probable that some at least of these mistakes are due to the fact that individual drivers are colour blind, either because the tests were insufficient to exclude them when they joined the service or because they have subsequently acquired defective colour vision. To show that these fears are not imaginary, I shall shortly describe cases which have come under my notice during the past month. All are dangerously colour blind, and they would all easily pass the colour tests carried out by the company's inspector with the wools. One of them is still a locomotive engine driver, and is therefore an active danger to the travelling public.

CASE I.—Engine Driver: Colour Defect Congenital.

An engine driver consulted me about his vision. He wished for reading glasses, and at the end of his examination confessed that he had difficulty in distinguishing the lamps, more especially if they were being swung. He had no difficulty in distinguishing a red light, or a green light when at rest, but he had great difficulty with the white lights, which sometimes looked red, at others green. He was uncertain about some of the purple lights which are used on the points and are lighted by an oil lamp, which often gives a feeble illumination.

He was found to be emmetropic, with some presbyopia corresponding to his age. When shown a red, green, blue, or purple hank of wool he immediately named it correctly. When asked to pick out reds he did so easily, and did the same with definite blues and purples. He picked out a large number of greens without a mistake, but eventually included some greys.

It is quite obvious that he might quite easily pass such an inadequate wool test as this, and he had in fact been able to get admitted into the railway company, and had quite easily passed the yearly colour tests carried out by the inspectors.

He was then asked to sort out and grade all the wools in the box. All manifest reds and browns were grouped together, but browns and greys were mixed with the green, dark blue with browns and greys, light blue with mauve, light pink and blue, and pink with light brown. Sage green was placed with yellow, yellowish-green with yellow, pink with grey, and yellow-green with grey. So that in the case of this man a careful examination with the wools would have certainly discovered his defect, and yet he had passed the railway test regularly.

The man was now confronted with the Edridge-Green colour perception lamp, with the following results. All reds, however much obscured by neutral tinted glass, were at once correctly named as red. Signal green was always called green, but pure green was almost always called red. Violet was invariably correctly named. Orange was called red, pale blue green, and white light was called red or green. If shown green and then white, the white was called red, and if white followed red it was named green. It is quite obvious, then, that this engine driver is a *dichromic* who only possesses red and violet in his spectrum separated by a band of various shades of grey. He is a man who, if driving a locomotive on a misty night, might easily make a fatal mistake, although he is hardly likely to miss a red light, for his spectrum is not shortened at the red end.

CASE II.—Acquired Colour Blindness: Partial Optic Atrophy.

This man, a painter by trade, has always been able to match his colours correctly till recently, when he began to make slight mistakes. When first seen he was found to be suffering from partial optic atrophy, the result of lead poisoning. His vision was then $\frac{2}{3}$ and $\frac{1}{2}$. When last seen, he had given up painting for four months, and his sight had improved to $\frac{3}{4}$ and $\frac{2}{3}$.

His colour sense was carefully tested, as when first seen it had been found to be defective. The wools were named and matched in a way which was truly marvellous, when the real state of his colour vision is known. He, however, mixed greens and blues and purples and greys. Light green, grey, and mauve are confused. But, probably because of his long training in colour values as a painter, he could easily pass the colour tests imposed by a lay examiner. When examined with the lamp, with the diaphragm fully open, and using both eyes, he utterly failed to name correctly a single colour! Bright red was green, green red, purple red, and blue green. The lamp proved conclusively that he would be a most dangerous man as an engine driver or a seaman.

This was a case of acquired colour blindness due to optic atrophy, but similar conditions are found in many other diseases, especially in diabetes, which is a disease to which engine drivers are especially liable. No central scotomata could be detected with Bardsley's scotometer, nor were the other symptoms comparable to those found in tobacco amblyopia.

CASE III.—Partial Optic Atrophy and Retrobulbar Neuritis.

This was a man who some twenty years ago suffered from syphilis. He now has V.R. = $\frac{1}{3}$, V.L. = $\frac{1}{8}$ —that is to say, he can get about well, and had been a seaman or a railway man he could for some time have performed his duties before his defective vision was detected. The examination of his colour vision was highly instructive. He sorted, named, and matched all the wools without the slightest error or mistake. The lamp test showed that his colour sense was dangerously

defective. The right eye, examined with a fully opened diaphragm and no tinted glasses, saw no colour at all except red, and when the diaphragm was narrowed he even failed to see the red. The left eye saw red, violet, and purple, but could not appreciate green at all. White was seen as red.

Bardsley's scotometer showed on the right side a central scotoma for all colours of very irregular shape, and in addition several detached islets where colour was not perceived. The left eye showed a central scotoma for green. There was no contraction of the white fields. The condition is one of partial optic atrophy and retrobulbar neuritis. The right disc shows intense temporal pallor; the left is hyperaemic.

This individual would be a very deadly man in charge of a steamer, and yet his defect could easily have arisen after he had obtained all his certificates. The case shows the absolute necessity for a yearly examination of all mariners holding certificates.

CASE IV.—Partial Optic Atrophy.

A well-educated man, aged 44; V.R. = $\frac{1}{3}$, V.L. = $\frac{1}{8}$; has one diopter of hypermetropia, but no glass improved the vision of the right eye. There was temporal pallor of the right disc; the left was normal. Tested with Bardsley's scotometer there was no central scotoma, but a small paracentral one, and the perimeter showed slight nasal contraction of the field on the right side. The left was normal. There is some slight nyctalopia; he is a little dazzled by bright light, and sees well in twilight. He neither smokes nor drinks. An examination of the nose showed a deviation of the septum to the right, giving rise to much obstruction in the upper part of the nose and to retention of secretion. This deformity was probably the result of a fall from a tree when a lad, when he pitched upon his nose.

The condition is one in which certain of the tracts in the optic nerve have been temporarily or permanently put out of action, probably on account of pressure upon the optic nerve by a distended sphenoidal sinus or inflamed posterior ethmoidal cells, a defect from which any engine driver might suffer.

Tested with wools he picked out reds and greens correctly, and when asked to match wools made no glaring or obvious mistake. Tested with the lamp he utterly failed to distinguish red from green with the right eye. He called bright red red or green alternately, and signal green was similarly treated. He was able with the left eye to name all the colours correctly, but when shown yellow or orange after green he called it red, after red he called it green. When the red light was diminished in intensity he did not see it at all. Obviously he would not be a safe man to drive an express train, for he could easily mistake a white light for a green one, and a dim red light he would not see at all, for he has shortening of the red end of the spectrum.

CASE V.—Retrobulbar Neuritis due to Alcohol and Tobacco.

This case is the most important of all. He suffers from retrobulbar neuritis, the result of excessive indulgence in alcohol and tobacco. His vision has sunk to $\frac{2}{3}$ and $\frac{1}{2}$ within the past few months.

He picked out and matched the coloured wools with ease and certainty because his peripheral vision was good, but when tested with the lamp he could see neither red nor green at all, although he had good vision for blue and violet. The scotometer showed a large central scotoma for red and green.

Such cases must be very common at sea where men have plenty of time to smoke excessively, and also drink heavily as well. They cannot be unknown on the railway, and may explain many of the cases in which red signals are overrun. The mystery shrouding the Shrewsbury accident could be elucidated upon the theory that the driver had central scotomata for red and green, and so never even saw the red lights arrayed against him. If he had these scotomata he would easily pass the railway tests, but the lamp would at once have unmasked him.

These five cases are simply adduced to show that in a large class of defects of the colour sense the ordinary official tests can be evaded, but that the Edridge-Green colour perception lamp at once detects them.

I do not suggest that the wool tests applied correctly would not have been sufficient in the first two cases to unmask the abnormality in question, in fact they clearly did so, yet one of these men, an engine driver, at work to day on the railway, had passed several times, and yet he is a dangerous dichromic.

The conclusion is that the Board of Trade should be compelled by public opinion to insist that the obsolete wool test be abandoned and that the examinations be made with the Edridge-Green lamp, which could be made up for railway use at a cost of about £1. This lamp is simple to use and it gives results which for all practical purposes are accurate. If a man passes the lamp test he is safe on the railway. All seamen and railway men should be examined at least once a year by an expert.

The Society of the Lying-in Hospital of New York has received from Mrs. Helen Hartley Jenkins the sum of £5,000 to enable the hospital to make a special study of puerperal fever.