REMARKS ON THE HOLMGREN WOOL TEST: IS IT ADEQUATE FOR THE DETECTION OF COLOUR BLINDNESS?

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THE official test employed by the British Board of Trade for the elimination of colour-blinds from the ranks of British mercantile marine officers is that of Holmgren's wools. One is almost fearful of venturing to breathe anything approaching a suggestion of incompleteness or imperfection against this test, for the struggle which had to be waged against the Board of Trade before they could be induced to abandon their guessing competition style of testing for colour blindness was of such an arduous and protracted character that I for one would almost feel disposed to abandon the fight did it become necessary to urge some other method of testing upon the officials of that slow-moving department. The great superiority of the test which requires a candidate to do something over that which invited a candidate to name (guess at) the colours of lights and cards exhibited to him is of course apparent, but for some time past it has struck me that Holmgren's wools do not answer to that superlative degree of infallibility which has been claimed for them. Is it possible for persons whose perception of colour is far from normal—in fact so abnormal as to render the individual altogether unable to discriminate between the lights carried by vessels at sea—to pass the test? The following illustration from life, which came under my own observation, answers the question in no uncertain tone.

In February, 1897, the 4,000-ton steamer *D*—, belonging to Liverpool owners, was in the North Sea. The time was night, and the second officer, who had passed for second mate in 1894 and first mate in 1895, was on the bridge. By accident the captain came on deck, and was horrified to find his vessel making straight for an approaching sailing ship. The second officer had seen the approaching craft's green light, and, mistaking it for a white one, supposing it to be exhibited on some stationary craft, kept his course. A minute or two more and it would have been too late to avert a disaster, and probably the resulting collision would have sent one, if not both, vessels to the bottom. As it was, however, the captain grasped the situation at once, and, promptly starboarding, averted the danger of collision, but not until the two vessels were less than a length apart.

The officer concerned was discharged at B—, and early in March he received the following letter from the Board of Trade official there:

Board of Trade.

"Certificates." Mercantile Marine Office, March, 1897.
Sir,—With reference to report made at time of your discharge from ss. *D*— on the —th ult. that you suffered from defective eyesight, I am requested by the Board of Trade to ask if you would be willing to have your sight tested under the conditions laid down in Rule 7 of Examination 1. Awaiting your reply, I am, Sir, yours obediently,
—, Supt.

Needless to say the officer had no objection. He had passed the Holmgren wool test before, and had no need to fear its reapplication. Accordingly he was retested, and passed as possessed of normal vision. Later I tested him myself with the wools, and he neither by wrong matches, hesitancy, or nervousness showed the least sign that his colour perception was not perfectly normal. I then submitted the case to Professor Oliver Lodge, F.R.S., of Liverpool University College, of whose researches in the field of physics I have no need to speak. After testing the officer with the spectrum, etc., Professor Lodge wrote as follows:

Your patient has the very slightest touch of ordinary colour blindness of the usual kind—namely, what we assume to be and call a slight defect of red sensation. He matches an orange mixture with a pure yellow, and calls a true yellow match "too green." Quite the usual thing, but very slight. All ordinary wrong matches with pigments that a colour-blind person makes, he is quite clear about. I should hardly have thought it sufficient to disable him. But it's there.

Now, here was a person who could not distinguish between the masthead light (white) and the starboard light (green). His mistake on the *D*— was no accident, for he freely con-

fessed to me that he never was certain about these two lights. Yet in spite of this visual and regular inability to discriminate between white and green lights, he could and can escape detection by the Holmgren wool test. This hardly makes for the infallibility of the test. I ought, perhaps, to say that this gentleman's object in consulting me was one of conscience. What was he to do? Shore berths in which his training would be of value were not to be had, even if vacant, by one with little or no interest, and he might as soon look to the heavens to rain gold as expect the Board of Trade—though aware of the case—to find a shore berth for him. No; he might starve so far as they were concerned. He did not want to risk his own or other people's lives, but he had been freely permitted to pursue the sea life—nay, more, he was a certificated officer. The sea was his livelihood. If the conscience of this great Government, whose privilege it is to safeguard the lives of its citizens, permitted him to spend many years of his life in training for a profession for which he was physically unfitted, why should he presume to set up a higher standard of morality? This reasoning it has been my lot to hear times without number. Some months later I wrote to this gentleman, asking for some further information, and I quote the reply received: "Mr. — went to sea as mate about two months ago in the — bound for —. I expect him home in about four months." Whether Mr. — did safely return I know not. If so he is quite at liberty to bring about a calamity of the character which the captain of the *D*— so narrowly averted.

I quite realise that this criticism of the generally accepted method of testing for colour blindness may come as a surprise to some of those who have watched the development of the colour-blind question. Indeed, by many, ability to pass the Holmgren wool test is regarded "confirmation strong as proof of Holy Writ" of a normal colour perception.

To be perfectly candid, I was, up to a comparatively recent date, a firm believer in the all-sufficiency of the test. In fact, I informed the Royal Society Commission which investigated the Seamen's Eyesight question, that I was prepared to pin my faith to the Holmgren wool test. Some little of this confidence has, I need hardly say, been shaken by the discovery of the phenomena to which I have alluded. Nor is it by any means an unusual occurrence for theories to be upset, or to require modification through the discovery of fresh data. There is no such thing as finality in scientific research, and history furnishes us with many examples of the accepted theories of to-day becoming the fallacies of to-morrow. I do not wish to be understood as prophesying a wholesale upset of existing beliefs and tests concerning this question, but I wish to make it thoroughly clear that the case I have quoted proves conclusively that the Holmgren wool test is by no means a certain discoverer of the lesser marked forms of colour blindness. That there should be such a phase of physical infirmity argues pretty strongly in favour of that opinion that colour and luminosity are in some way or other intimately associated. A person who loses the power to discriminate between colours at a distance, but regains it at close quarters, is clearly possessed of a type of abnormal colour perception which the Holmgren wool test can never discover. The disquieting character of this phase of colour-blindness is well expressed in the following letter written to me by Dr. Hubert Seager:

I do not remember to have yet seen any discussion on the peculiar form of colour blindness to which I myself—and no doubt other people as well—am subject: Inability to distinguish at night between a red and a green light at a distance exceeding half a mile, though I can pass any test for colour or long sight in the daytime, and can distinguish coloured lamps perfectly at night within half a mile's distance. I tested this condition of my eyesight again last year when I was at sea for a week or two, and found it unaltered. . . . Naturally, such a state of colour blindness might lead to very serious accidents at night, and the Board of Trade tests should be adapted to such defects.

Then, too, there are that numerous class who, while they can distinguish between the colours of the spectrum, are yet, so to speak, weak-sighted for colours, the difference between one section of the spectrum and others being, especially under weak illumination, by no means decidedly marked. Captain Abney states his experience of such cases as follows:

Besides cases of complete blindness due to the absence of one or two sensations, on the Young theory we have other cases in which one or even two sensations are more or less deadened. It has often been said that

such cases are difficult to class as red or green deficient. As far as my own observations go, I have never found this difficulty. In numerous experiments which Lord Rayleigh has made in matching orange by means of a mixture of red and green he has come across several who have apparently normal vision, as they see colours correctly in every part of the spectrum and yet some require much less red mixed with green to make a match with the orange than do others. The limits of the visible spectrum to those persons, as far as my examination of their cases goes, are the very same as my own.

Now, neither the person who is shortsighted for colours nor he who is weak-sighted for colours will be detected as possessed of anything but a normal colour perception by the Holmgren wool test. I am not alone in asserting that the Holmgren wool test is far from being the be-all and end-all of a colour-blind discriminative. Dr. George Mackay, of Edinburgh, writes on the subject as follows:

It seems to be scarcely appreciated as it ought that there exist persons whose perception of colour appears to be correct in quality, but is congenitally defective in quantity or intensity. The subjects of this affection can pass successfully such a test as Holmgren's applied in the orthodox way, since they inspect the skeins at close quarters. They appear to see colours much or quite as the normal-eyed, provided the stimulus of colour rays applied to their retina is sufficiently strong, but if it be weakened by dilution with white light or removal of the source of colour to a distance, their defect is made manifest.

Again, Dr. Angus McGillivray, of Dundee, in commenting upon a case which came under his own observation, remarks as follows:—

Now a candidate may arrange the Holmgren tests with perfect accuracy, and recognise and name promptly the colours used in signalling, yet, though possessing perfect distant vision, he may be quite unable to tell the difference between a red and a green signal at the distance of a few yards, even in a clear atmosphere.

He then proceeds to mention some of the peculiarities of this type of colour blindness, as instanced in a patient of his, who, although an effective colourist, and who could pass the Holmgren wool test with ease, practically lost the sense for colour when the coloured object was removed to a distance. In conclusion, Dr. McGillivray states that the recommendations of the Royal Society Committee mention no tests that would detect such a case as he has recorded. Thus it is evident that the official test used by the British Board of Trade, even if it were properly applied, is ineffectual in eliminating from the mercantile marine all persons who by their visual infirmities are totally unfitted to assist in the navigation of vessels. To ensure, therefore, certain discovery of all colour defects, a quantitative test for colour is in addition required.

THE PRACTICAL APPLICATIONS OF LARGIN IN DISEASES OF THE EYE.

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MODERN pharmacy has provided us with several substitutes for nitrate of silver, such as protargol, argentamin, actol, itrol, and argonin. Largin, the latest of these synthetic compounds, occurs in the form of a stone-coloured, granular powder. It is stated by Merck¹ to contain 11.10 per cent. of silver combined with protalbin, so that it is richer in the percentage of metal than any of the other compounds. Its watery solution has a brownish colour and an alkaline reaction, and keeps well in suitable phials. It is precipitated neither by albumen nor by chlorides. Largin is claimed to be a non-irritating bactericide possessing some astringent properties. It has been employed by Pezzoli and Finger² in gonorrhoea. Dr. Marcel Falta³ appears to be the only writer who has yet published anything with regard to its action in ophthalmic disorders. By dropping a 1 per cent. watery solution into the eye several times a day Falta claims to have obtained "surprising results" in conjunctival inflammations and in catarrhal ulceration of the cornea. In diseases of the tear passages he used a 10 per cent. solution. Falta never observed any staining of the conjunctiva follow its application.

For several months I have employed largin rather extensively in the treatment of superficial eye disorders, especially in the various forms of ophthalmia. The preliminary trials were made with a 3 per cent. watery solution, but that was soon replaced by a 5 per cent., and eventually by a saturated 10 per cent. solution; the remedy was also used as a powder in some cases, such as phlyctenulæ of the conjunctiva. For the

most part the remedy was painted over the exposed palpebral conjunctiva once or twice a day. In these various ways largin has up to now been employed by me in upwards of 100 cases of eye disease. In some kinds of ophthalmia the results have been in nowise inferior to those obtained with silver nitrate, over which largin has one obvious practical advantage in the fact that its application neither causes pain nor is it followed by any appreciable reaction. Largin is, however, much more expensive than lunar caustic, but that drawback will doubtless be lessened as the advantages of the new agent become better known. It is to be especially noted that if used for more than a few weeks, largin certainly does stain the conjunctiva.

In gonococcal ophthalmia my results with largin have, upon the whole, been of a somewhat disappointing character. It has appeared to me in such cases distinctly inferior as a curative agent both to protargol and to silver nitrate. The following is a case in point:

CASE I.—A thin and ill-nourished baby, aged 14 days, was brought to me on October 9th, 1899, suffering from severe ophthalmia, noticed on the third day after birth. A non-infiltrated ulcer, with rounded edges, existed in the lower part of the left cornea. The pus, when examined with the microscope, was found to include cocci and diplococci, mainly grouped in the protoplasm of the cells; the organisms did not stain by Gram's method. Two agar tubes inoculated with pus from the conjunctiva remained sterile after three days in the incubator, thus excluding the organism that above all others is likely to be confused with the gonococcus—namely, the diplococcus intercellularis meningitidis. The treatment comprised—(a) largin, 5 per cent. to lids daily; (b) sublimate lotion, 1 in 5,000, frequently; and (c) drops of physostigmine and cocaine to left eye. One week later the conjunctival secretion included many gonococci. After fourteen days' treatment with largin the eyelids were still swollen, gonococci were present in the abundant discharge, while the ulcer of the left cornea had become vascular. The strength of the largin was accordingly increased to 10 per cent.; but the discharge remained thick and profuse, so that three days later (October 21st) it was replaced by a 2 per cent. silver nitrate solution. Under that treatment the ulcer soon healed and the discharge quickly subsided. Indeed, the good effects of the silver were most marked. The patient was discharged on November 14th with a smooth and pale palpebral conjunctiva and an insignificant nebula in the lower-inner quadrant of the left cornea.

So much for the superiority of silver nitrate. The next case goes to show that protargol is better than largin in the treatment of gonorrhoeal ophthalmia:

CASE II.—R. B., aged 19 days, was first seen on November 29th, 1899. She was born at term, after a labour lasting about forty-eight hours. Her mother was affected with a greenish genital discharge before and after parturition. The baby's left eye became inflamed on the third day and the right eye on the sixth. Pus from the eyes contained numerous gonococci, mostly grouped within the cell elements of the specimen. The corneæ were clear, and there were no joint or other complications. The eyes were cleansed frequently with sublimate lotion (1 to 5,000) and the exposed conjunctiva painted daily with largin (10 per cent.). Three applications of largin having failed to make any appreciable impression on the purulent secretion, that agent was, on December 2nd, replaced by protargol (50 per cent.). Four days later the pus was less, although specimens still included many gonococci. On December 20th, after eighteen applications, there was still some secretion from the conjunctiva. Gonococci were present, especially in specimens from the right eye (thirty-fourth day of the inflammation), where they formed many intracellular groups. On December 27th a fair number of gonococci were found in the scanty secretion from the right eye (forty-first day) and a few scattered gonococci in specimens from the left eye (forty-fourth day); xerosis bacilli were present in each case. On January 3rd, 1900, the conjunctiva of the eyelids was smooth, thickened, and pallid; the corneæ were clear and the eyes free from inflammation. Nothing beyond xerosis bacilli could be demonstrated in the extremely scanty conjunctival discharge. The protargol was stopped and the patient dismissed.

In the common acute contagious ophthalmia, due to the tiny Koch-Weeks bacillus, largin has yielded very different results. In 20 such cases, some of a severe nature, a rapid cure has followed the daily application to the conjunctiva of a 10 per cent. solution. Indeed, in that particular affection, my experience leads me to believe that a 10 per cent. largin is every whit as effectual as a 2 per cent. silver nitrate solution. In acute trachoma (also often associated with the Koch-Weeks bacillus) largin has given good results.

CASE III.—G. E., 9 years, was admitted to the Ophthalmic School with acute trachoma. The lids were red and puffy, the eyeball was congested; the palpebral conjunctiva was thick, red, and granular; and a coherent pellicle was present upon the mucous membrane of the upper lids. In the profuse conjunctival discharges, the Koch-Weeks and the xerosis bacilli were found. After three applications of 10 per cent. largin, the swelling, redness, and membrane had disappeared; while after five applications no bacilli could be demonstrated, and the general improvement was most striking. The remedy was then changed for bluestone in order to attack more efficiently the residual chronic trachoma.

CASE IV.—M. A. T., aged 9 years, admitted November 16th, 1899, with subacute trachoma. In the discharges from the eyes Weeks and the xerosis bacilli were found both by cover-glass preparations and by cultures. Vision $\frac{1}{2}$. Sublimate lotion, 1 in 5,000, frequently, and the daily application to the everted conjunctiva of largin, 10 per cent. After forty-three applications of largin, sight was equal to $\frac{1}{2}$; little discharge was present, and the conjunctiva was much less red and granular.