COLOUR VISION AND TESTS FOR COLOUR BLINDNESS.

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THERE is scarcely any subject in the domain of medicine and surgery which has been more misrepresented than that of the facts of colour blindness, nor is there any in which such lack of discrimination has been shown with regard to the selection of appropriate tests for its detection.

Many of us know from experience how the methods advocated by Edridge-Green have won all along the line, and that those who have not been so blinded by prejudice as to refuse to examine the facts have been led by the overwhelming weight of evidence to admit that his theory explains the facts, and that his methods are efficient and reliable for the detection of errors of the colour sense. Lately, however, it has been freely stated that many, if not most, scientific men have failed to be convinced and have rejected his ideas as untenable. Such statements have been made without a shadow of proof that such is the case, and in order to show how far it is from the truth I wish to review briefly what some of the most eminent men have said regarding his work. I should like also to point out that what follows represents only a very small fraction of similar evidence, but I have made selections from the writings of those whose names are so well known in science that any statement they make cannot but carry weight, and must be respected by those who are in any way conversant with the position they occupy in the scientific world. It is also hoped that this may serve to stop the dissemination of reports which are so freely banded about and which are so foreign to the facts of the case.

Dr. E. H. Starling, F.R.S., Professor of Physiology in University College, London, writes in his *Principles of Human Physiology* (1912): "It is very difficult, however, to harmonize the facts of colour blindness with either this" (Helmholtz's) "or Hering's hypothesis. It is better to abandon hypotheses altogether and to adopt a purely empirical classification of colour vision as has been done by Edridge-Green. This observer points out truly," etc., and this is followed by a page and a half of the facts pointed out by Edridge-Green.

Dr. Halliburton, F.R.S., Professor of Physiology in King's College, in his *Handbook of Physiology* (1913), writes: "The Edridge-Green lantern is one of the best to employ; in it the intensity and colour of the light, and the order in which the colours are shown can be easily varied. If the colour-blind person is made to examine and report on the colours of a spectrum" (Edridge-Green's method) "or in portions of the spectrum exposed to view, the results obtained are more accurate, but this is not so simple as the lantern test."

Sir Edward Schäfer, F.R.S., Professor of Physiology, University of Edinburgh, in *Experimental Physiology* (1912), writes:

Testing for colour vision. Edridge-Green's lamp and spectroscope. . . . The best practical method for testing colour vision is by the use of a lamp provided with glasses of different colour, the subject being expected to name the colour which is exhibited. A more accurate method of obtaining spectral colours for testing purposes is the employment of a spectroscope so arranged that only a definite part of the spectrum with a pure spectral colour is visible at one time. (This is the method of using the Edridge-Green spectrometer.)

Professor Burch, F.R.S., in his *Physiological Optics* (1912), describes Edridge-Green's monochromatic colour patch method, and concludes thus: "The most powerful grating spectroscope may be used in the way described by Edridge-Green and the preceding statements verified." Edridge-Green's signal lantern is then described.

Professor Alcock and Dr. Ellison, in their *Experimental Physiology*, write: "Colour Blindness. Examine portions of the spectrum by the method of Edridge-Green." Details are given, and they add: "Examine Holmgren's set of coloured wools and let the student test his neighbour for colour blindness. This test succeeds best if both experimenter and subject are slightly thick-headed."

Professor D. J. Hamilton, F.R.S., of Aberdeen, wrote as follows in his *Textbook of Pathology*:

Edridge-Green's Theory: All these theories, however, presuppose that the essential defect is in the retina. From what we now know of the visual centre in the brain, it seems quite as likely, if not more so, that the vice is located in the apprehensive centre—that, in fact, colour blindness is essentially a disease of interpretation, not one which is bound up with the mechanism placing the visual centre in communication with the periphery; that it is, in fact, simply a form, and probably a very pure one, of congenital psychical blindness. . . . Edridge-Green in his fascinating work on the subject of colour blindness has taken this view of the matter. His explanation of the colour sense is as follows.

(Then he gives nearly three pages of details).

Lord Rayleigh, in a letter to Dr. Edridge-Green, wrote as follows:

I think you are entitled to claim credit for having advocated the "lantern" tests at a time when they did not seem necessary to others, and if you like you may quote me as saying so.

Sir William Ramsay, K.C.B., F.R.S., Professor of Chemistry in University College, London, has written to me as follows:

Very many years ago I came in touch with Dr. Edridge-Green. I have certain peculiarities of vision which he classes as "three-colour." I was, and am, convinced that he is right. Since then I have followed his work more or less; my son and I were examined in Professor Starling's laboratory some years ago, and his tests confirmed our impressions as to our vision. I cannot say that I agree with all that he has published, because I have not followed it all minutely; but I am sure that he is correct in the broad lines on which he interprets colour vision, and that he has got very scant justice from others who have held the field with their preconceived notions; they have, in many cases, come round to his views, which they have adopted without acknowledgement.

Professor A. W. Porter, F.R.S., Assistant Professor of Physics in University College, London, in a letter to the *Lancet*, dated September 27th, 1912, wrote:

I was present along with Professor Trouton at the test of the case made by Dr. F. W. Edridge-Green, which is described in the *Lancet* of June 22nd, 1912. The examinee passed successfully the official wool test of the Board of Trade, but failed completely when tested with Dr. Edridge-Green's lantern. There is no doubt whatever that the examinee was a very dangerous case, in spite of passing the wool test. This case alone would make it clear that a lantern test is a necessity. But there are lanterns and lanterns, and in my opinion it is exceedingly doubtful whether the new lantern suggested by the recent Departmental Committee has the requisites for effecting a correct discrimination between candidates. To mention one point only—it lacks any possibility of adjusting the luminosity so as to imitate the effects of atmospheric changes. This is the requisite which every lantern must have if it is to discriminate between the safe and the unsafe colour defectives. It is possible to imitate service conditions in this respect with Dr. Edridge-Green's lantern. A lantern which lacks this provision is as useless as the fine weather tests which were made in the open by the Departmental Committee.

At the International Medical Congress at Budapest in 1909 Dr. Edridge-Green read a paper on the theory of vision, by special request, in the two Sections of Ophthalmology and Physiology. Not one word of adverse criticism in either Section was made. (See the remarks in the *Lancet* for 1909, page 1005, and the *BRITISH MEDICAL JOURNAL* at the time.) The strongest approval of his ideas and methods was expressed. Professor Von Tschermak, Professor of Physiology in Vienna and one of the leading authorities in the world on vision, afterwards wrote to the *Lancet* and supported the theory, pointing out how Edridge-Green's work fitted in with that of other authorities on vision. This letter, which is too long to quote, was written on October 25th, 1909, and published directly afterwards.

Professor C. Timiriazeff of Moscow wrote in 1913 thus: "The chemical hypothesis concerning the functions of the visual purple seems to gain ground. Professor Edridge-Green has succeeded in removing the most formidable obstacle in its way."

It may be remembered that a resolution was passed in the Ophthalmic Section at the Annual Meeting of the British Medical Association held at Brighton last year, condemning the tests at present in use by the Board of Trade. This resolution was passed with one dissentient only, and that gentleman happened to be one of those who was a member of the Departmental Committee who recommended the tests at present in use. It may also be

[2817]

pointed out that this vote was taken in the middle of the morning, and before an unusually full meeting which was about as representative as any special meeting could be.

Most people will remember the long articles and discussion published in the *Morning Post* early in the present year. A vast amount of evidence was put in supporting the claims made by Edridge-Green, and methods and tests still in use were very freely criticized. None of the facts were disproved, and in fact no one came forward to criticize what was written. Why do not the adherents of the other side appear, and show where the majority are wrong? The answer can be given by any one who will give it a moment's consideration. It is certainly a fact that one unbiassed opinion in favour of a statement is worth twenty of jealous rivals who refuse to give reasons.

Can any one who was present at the meeting of the International Medical Congress in London last year have any doubt as to the favourable reception which Dr. Edridge-Green's paper had? I wonder if any demonstrator at that large meeting got a more enthusiastic reception than did he when he showed some of the most convincing experiments that were ever demonstrated before a large and highly scientific assembly, in which it is perhaps no exaggeration to say that every civilized country in the world was represented.

Only a few months ago a letter was sent to the press, signed by thirty-one of the leading ophthalmic surgeons of the United Kingdom, in which they condemned the method at present in use at the Board of Trade for form vision; they stated that "The wool test for colour blindness is not an efficient test"; and also that "Any lantern used for testing colour blindness should have means for regulating the luminosity of the lights shown." The lantern used by the Board of Trade has no means of regulating the luminosity, simply a means for increasing or diminishing the size of the aperture.

The British Association met in 1912 in Dundee, and a committee was formed to inquire into the subject of colour vision and colour blindness. This committee consisted of the following gentlemen: Professor E. H. Starling (Chairman), Dr. Edridge-Green (Secretary), Professor Leonard Hill, Professor A. W. Porter, Dr. A. D. Waller, and Professor Gotch. The report they drew up stated:

The inadequacy of the wool test even with additional colours as an efficient test for colour blindness is now established.

They then show from the published statements of the Board of Trade examinations the shocking results of the wool test thus: Out of "105 failures, 55 failed in both wool and lantern test, and 50 in the lantern only. None failed in the wool test only." In a daylight test "the bead test of Edridge-Green is preferable." "The chief difficulty from a practical point of view is the line at which rejection should take place, as there is every grade of transition between total colour blindness and the normal colour sense. If a large number of persons be examined with the Edridge-Green lantern, about 25 per cent. show defects of colour perception. In the majority of cases the defects are slight." Those who know anything about the subject will see how entirely this report backs up the ideas of Edridge-Green, and how thoroughly opposed it is to the theory of Helmholtz on which the wool test is based.

I have heard it stated in the usual loose manner taken by the opposition that Professor Gotch, who unfortunately can no longer be reckoned among the living, was opposed to the ideas of Dr. Edridge-Green. As a matter of fact, he was one of his strong supporters, and although he never published much, there is abundant evidence in existence in his private correspondence to prove this, but I hesitate to quote from this in the circumstances. Unfortunately for the world of science, he died before the report just quoted was brought out, but I have ample proof from some of his colleagues on the committee that had he lived he would have signed it with the others.

Professor von Kries was shown by Dr. Edridge-Green how readily certain colour-blind people were able to do matching tests. He subsequently wrote agreeing with Dr. Edridge-Green's view of this case.

At a meeting of the Paris Ophthalmological Society, held during the present year, Edridge-Green's tests were specially shown by Dr. Sulzer, when not a single adverse criticism was expressed.

Mr. W. M. Beaumont writes in the *BRITISH MEDICAL JOURNAL* of January 13th, 1912, page 69: "Modern methods of colour vision testing are due to the work of Edridge-Green, and the present-day use of his lantern increases *pari passu* with the disuse of Holmgren's wools."

I am entirely unacquainted with a single person who has been convinced of the truth of the Edridge-Green facts having subsequently changed his opinion and adopted an attitude hostile to his theory and his tests.

At one time it was impossible for him to get a hearing at any scientific meeting, because he brought forward ideas which were altogether hostile to those which were held. Since, however, he has obtained a hearing, the papers which he has communicated to the Royal Society, the Physiological Society, various English and foreign ophthalmological societies, the British Medical Association, the Society of Arts, and many others too numerous to mention, would take up several pages, if only to name their titles. To the mass of this evidence it is impossible to find a single criticism that will hold good. He has challenged the world over and over again to bring forward anything which will disprove his facts or theory, and the result has been that no one has had the power to do so. One has often heard people state that he is wrong. One naturally asks, "In what way?" The answer has never amounted to more than this, though perhaps not expressed in the identical words, "You are wrong because we say you are." "Look at my cases and let me show them to you," says Dr. Edridge-Green. They reply, "We will neither look at your facts nor allow you to show us your cases. You are wrong because we say you are." No better argument than this has ever been adduced against him, and to show that I am not exaggerating let me point out that this very action was taken by the Royal Society Committee and the Departmental Committee appointed by the Board of Trade to investigate the whole subject. On each occasion they refused to allow him to show them a single case or to demonstrate a fact before them. Could a more partial attitude be adopted?

It would not be so bad if the opposition would only act fairly towards him, but this they do not do. Take, for instance, the latest book by Sir William Abney on *Colour Vision* and compare it with his former writings. We find that whereas he was formerly an opponent of Edridge-Green's methods, and a strong supporter of the methods used by the Board of Trade, yet now he recommends almost everything that Edridge-Green has for many years been advocating, and yet never mentions his name from the beginning to the end of the work. Methods which he condemned with the greatest energy a few years ago are now given in such a way that it leaves the impression that he has always advocated them, if not that they were actually introduced by himself. Is this a way which recommends itself to fair dealing with an opponent? The fact of the matter is this: Every one who has looked into the subject has been convinced of the truth and practicality of the methods advocated by Dr. Edridge-Green; his methods have been advocated all over the world; no one has ever arisen who has been able to prove that any fact he has stated is wrong, though there still are those who do not hesitate to use methods to prejudice those unlearned in the matter which are grossly unfair. If they have any criticism to offer why do not they come out in the open and make it, and then give the other side the opportunity of answering? They have scores of times been accused of failing to do so because they know that they could not maintain their position, and this view must be still held until some one can come forward and disprove the facts that are so strongly held and so readily demonstrated to any one who will take the trouble to see such demonstrations. If they will not do this then judgement goes by default, and it must be because they have no answer to give better than they have so often used, namely, that your ideas are wrong because we say they are.

The Royal Society must be held entirely responsible for this state of affairs. It appointed a special committee to do the work which Edridge-Green had been asked to do by the Board of Trade, and after three years' deliberations it recommended the wool test, which even in its improved form allows 50 per cent. of dangerous cases to pass (vide above). The subject is undoubtedly difficult, but if Edridge-Green were able to find out facts which a committee containing such men as Lord Rayleigh, Lord

Kelvin, and Sir George Stokes failed to ascertain, or even recognize when they had been pointed out, the Royal Society should have made some acknowledgement of his work, especially as it utterly discredited him and ruined his career. As I have shown, many have heard of his discredit, but are unaware of the complete change of opinion. I have written this article to show these people exactly how matters stand.

COLECTOMY FOR INTESTINAL STASIS.

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I HAVE done four cases of colectomy for intestinal stasis—one in a man and three in women. Three cases recovered and one died.

History, Symptoms, and Progress after Operation.

CASE I.—W. C., a mason, who had not worked for three months and had done only light and intermittent work for eight years, complained of abdominal pain one hour after meals. He was very constipated, had often gone a week without bowels acting, and was constantly taking castor oil or salts. He had had sickness after nearly every meal, but not lately; he sometimes made himself sick; he had vomited blood (a teacupful) on six or seven occasions. He suffered from distension, flatulence, had got thinner, and was very miserable, said life was not worth living, and felt inclined to finish himself off. He had taken much medicine, and was treated medically in hospital four years ago without relief. He was a thin man, with sallow complexion and dark rings round his eyes; the tongue was coated, the right kidney was movable. There was pain, tenderness, and gurgling over the caecum, tenderness beneath the upper part of the right rectus, and pain in the epigastrium. The urine contained creatin and creatinin in large quantities. A test meal gave total acidity 0.1606 per cent. X-ray photographs of bismuth meals showed great delay, and dropping of the transverse colon so that its centre reached the bottom of the pelvis. After operation, on November 6th, the parietal wound suppurated slightly. The patient got up on November 25th, and on December 11th, five weeks after operation, went home.

CASE II.—A. L., housewife, had been "ailing" many years; suffered from indigestion, and was very constipated. Eight years ago she was fitted with a supporting ring for "womb trouble." The symptoms had been worse for the last four months, and for three months she had passed blood frequently from the bowel, and had grown much thinner. She was a thin, anaemic woman, with lemon-yellow complexion, dark rings beneath the eyes, cold extremities, and a miserable appearance. The lower abdomen was distended, and there was much gurgling of gas; tenderness was most marked in the left iliac region, but was present also over the caecum and pylorus. X-ray photographs of bismuth meals showed, after half an hour, the stomach dropped, so that the greater curvature reached the pelvis, and, after twenty-four hours, large masses in the caecum, with distension of colon and sigmoid. Examination with the sigmoidoscope revealed nothing abnormal. After operation (January 22nd) she at first went on well, but later developed progressive asthenia and cardiac weakness without active symptoms; there was no parietal infection. She died on January 31st, nine days after operation. An examination *post mortem* through the operation wound only showed thin pus in the pelvis and lower abdomen; the bowel wounds were intact.

CASE III.—A. M. S., a married woman, complained that for four or five years she had had pain in the left side of the abdomen, particularly in the lower part. It was worse directly after food; she sometimes vomited, and was only able to take "baby's food." She was very constipated, and passed a quantity of whitish material and "strings" with the motions and at other times. She had had an enema once daily for two years. She was very thin, with a yellow-brown complexion and darkish red areas on the cheeks. There was much tenderness all over the course of the colon, and mucus and shreds in the motions. The sigmoidoscope showed the bowel to be very red. An x-ray photograph of a bismuth meal showed that the transverse colon reached to the pubes. Operation was postponed because after a preparatory enema the patient became dizzy, lost consciousness for two hours, and had great cardiac weakness. It was eventually performed on March 2nd. She did well; no parietal infection occurred, and she left the hospital one month after operation.

CASE IV.—C. A. had been operated on three years earlier for "ulcerated stomach," and had been better until five months ago, when vomiting and pain commenced after food. She had been very constipated for years, and had had three slight attacks of haematemesis. She was a thin woman with a coated tongue and earthy complexion. She vomited frequently after admission, sometimes a little blood. There was tenderness over the caecum and duodenum, a vertical median scar in the epigastrium, and slight oedema of legs. Test meal: Total acidity 0.1752 per cent.; urine, trace of creatin. Mobile right kidney. The case was transferred from a medical ward after prolonged

treatment, including morphine frequently. After operation (April 30th) she did well except for slight parietal infection and obstinate cystitis. She left hospital seven weeks after operation.

Details of Operation.

The conditions found in the abdomen and the operative details were substantially the same in all four cases. The preparation, which commenced three days before operation, consisted of enemata, castor oil, clear soup, albumin water, tea, brandy. Case 3 had kerol gr. v thrice daily for a fortnight before operation. Anaesthesia was by scopolamine and open ether. A continuous submammary saline injection was given throughout the operation. The patient was placed in a partial Trendelenburg position, with the legs over the end of the table. A long vertical incision was made through the inner part of the left rectus. In each case external adhesions were found between colon and parietes and kinking at hepatic and splenic flexures, particularly the hepatic, where the transverse and ascending colon were bound together, ileal kink, dilated duodenum, prolapsed stomach, and transverse colon. In Case 4 (previously operated on) the stomach was adherent to the anterior parietes and the duodenum was most markedly dilated. There were various omental, gall bladder, duodenal, and other adhesions and varying degrees of membrane overspreading the caecum and ascending colon. After separating external and other adhesions, so as to render the colon freely mobile and permit of its being lifted out of the abdomen, it was removed from 8 in. to 9 in. proximal to the ileo-caecal valve to the middle of the pelvic colon; the distal end of the colon was closed and the ileum joined to the colon by an end-to-side anastomosis, taking care that the ileum was not twisted. The hole in the mesentery was carefully closed and an oesophageal tube passed up the rectum and through and about a foot beyond the anastomosis, the operator manipulating the tube and an assistant pumping paraffin in to help its progress. This tube was tied to the anal margin. The parietal wound was closed in layers without drainage, except in Case 3, in which a tube was kept in the abdomen for forty-eight hours.

The dressing throughout was sterilized, frequently changed, hot boracic fomentations. The patient was placed in a marked Fowler's position. The rectal tube drained well in all cases, a few ounces of paraffin being pumped up it every twenty-four hours. It was taken out in seven or eight days. All cases showed some shock after the operation, but it was only marked in Case 2, where the pulse was very weak and rapid from the first.

End Results.

The three cases which recovered were all seen and examined by me on October 5th, 1914, when their condition was as follows:

CASE I (eleven months after operation).—Says he is much better than before the operation, that he can eat practically anything, and that he never vomits. He still feels a weakness in his abdomen and has loose motions, the bowels acting two or four times a day. He has tried two or three times to do his ordinary work, but cannot manage it. He has not got fatter or thinner. On examination he is pale, his eyes are clear, with no dark rings round them. He wears a belt; the recti are slightly separated. There is epigastric tenderness.

CASE III (eight and a half months after operation).—Says she is much better and much fatter; can eat anything now. All her people say how very different she looks. She sometimes has a pain in the back and in the lower abdomen when she walks, and she suffers from palpitation. She takes a tablespoonful of paraffin every morning, and this keeps the bowels regular. She is never sick. On examination she is a fat, healthy looking woman with a good complexion and clear, bright eyes. There is a sound abdominal scar; some tenderness over sigmoid region. She is emphatic in saying that she is better than she has been for many years.

CASE IV (five months after operation).—Much better. Put on a stone in weight after she went home. Her friends say she looks quite different. She is sick at her periods, which are profuse. She takes syrup of figs occasionally for the bowels. She is a healthy looking, well-nourished woman, with bright eyes and clear complexion. There is a strong abdominal scar, with no tenderness.

The operation is a serious one. It requires careful preparation of the patient and careful technique. It should be reserved for cases with marked signs and symptoms of stasis. It contrasts, in my experience, with many cases in which various lesser measures have brought about cure. In all these abdominal cases—which can be grouped under