

**On cases of accident to shipping and on railways due to defects of sight /
by E. Nettleship.**

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ON CASES OF
ACCIDENT TO SHIPPING AND
ON RAILWAYS DUE TO
DEFECTS OF SIGHT

BY

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ON CASES OF ACCIDENT TO SHIPPING AND ON RAILWAYS DUE TO DEFECTS OF SIGHT.

INTRODUCTION.

THOSE who are interested in the practical aspects of either colour-blindness or deficient acuteness of sight know that in spite of all that has been written on the dangers of such defects, relatively few instances are known in which they have been proved to have caused accidents to shipping or to railroad trains. So far as I know Dr. A. Favre (1), medical officer to the Paris-Lyons railroad, was the first to mention any actual cases in a paper read at Lyons on August 28th, 1873; such details as he gives will be found at page 26 below, and I have not been able to discover anything more. In 1876, Dr. F  ris (2 and 3), a medical officer in the French maritime service, took up the subject and recorded the examples given below as Cases 2, 3 and 4. In 1879 Joy Jeffries (4) brought out the first edition of his work and referred to some of the few cases then known; and a few years later (1886) Dr. Prinz (5) in Germany gave some others. In the following year, 1887, and onwards for several years, Mr. T. H. Bickerton (6), of Liverpool, made important contributions to the subject, both in the form of cases and criticisms. Dr. Edridge-Green's treatise appeared in 1891 (7) and contained several fresh examples. In 1907 the late Professor W. Nagel (8), of Berlin, gave a short list of cases, one or two of which I have not seen quoted elsewhere. In the most recent paper

on this subject by Stargardt and Oloff (9) several of the old cases are repeated but no new ones added. The present writer had (20), as long ago as 1887, spoken of the importance of collecting cases in which accidents had been actually traced to defects of sight.

Attention to the subject, as shown by published records, has fluctuated. During the last two or three years there has been a marked revival of interest. This has been owing largely to criticism of the methods of examination and standards of visual efficiency actually required by the Board of Trade; and to opposition, especially by the shipping communities,* to the higher standard about to be required by the Board in the near future, as recommended in the report published in 1912 of the Departmental Committee on Sight Tests (12). Indeed it is obvious that the ship owners and railway companies must look with misgiving at any proposals that may tend to restrict the supply of men wishing to enter their service.

Such disinclination or active opposition to higher standards of vision is the more intelligible in regard to colour-blindness when we remember that it is little more than a century since colour-blindness was first recognised, whilst attention to its importance as a possible cause of accidents was first suggested scarcely sixty years since, when Dr. George Wilson (10) of Edinburgh expressed his suspicion that fatal disasters had resulted to merchant ships and railway trains from mistakes made by colour-blind men in the interpretation of the coloured signals. Wilson was instrumental in inducing the Great Northern Railway to test the candidates for admission to its service before they were chosen. Again, all our fundamental and accurate knowledge of the phenomena of colour-blindness has been due to the work of men of science—physicists

* An opposition not confined to this country. Writing in 1907, Prof. W. Nagel (since dead) referred to corresponding hostility in Hamburg. The vehemently hostile attitude of some of the railroad people in the United States of America in former years has been spoken of by Joy Jeffries.

and physiologists—or of medical men who have paid attention to the subject. Even now the ordinary and most conspicuous phenomena of this common defect are known to comparatively few persons.

Especially difficult is it for those who know nothing of the subject to understand why a markedly colour-blind person should be able, as we know he so often is, to distinguish coloured signals correctly on one occasion and not on another (see, for example, Cases 18, Bickerton 6 *f*, and 19, *ibid.* 6 *c*). Again, of the many tests for colour-blindness, some are advocated by one authority, others by another. Further, only a few of the experts in this subject have known enough of practical seamanship or of the conditions of railway traffic to convince the marine and railroad officials that a scientific knowledge of colour-blindness makes its possessor a safe guide in matters relating to practical service. Lastly, very often in earlier years, and at times even quite recently, lads or men who, sometimes unknown to themselves, were colour-blind in a dangerous degree, have managed to slip through their examinations and pass as having good colour-vision. Once admitted to the marine or railway service such men have every motive for concealing their defect, and attributing any difficulties they may have with signals to some other cause.

For reasons such as the above defects of sight are *in fact* regarded, by those who have to inquire into accidents, as of such little importance that in the official investigations the question of defects of sight in the men who were on look-out or corresponding duty is scarcely ever raised. Naturally, therefore, no accidents are discovered to have had visual defects for their cause. Continuing to reason in a circle the conclusion is that defects of sight do not cause accidents!

It would be ludicrous, if the matter were not so grave, to find that though precautions of greater or less efficacy are taken to exclude men with conspicuous defects of sight from entering the sea or railroad services, because

such defects are admittedly dangerous, yet when an accident happens no trouble is taken to find out whether the man responsible for it actually now has efficient sight or not. Every other possible cause for the casualty is sought out, but the possibility that his vision either was defective when he entered the service, or has become so since, is never even considered.

Over and over again, both at home and abroad, attention has been forcibly drawn to this extraordinary state of things,* particularly by the Committee on Colour-blindness of the Royal Society (11), which gives as its final recommendation (paragraph 12, p. 2, of its Report)—“That in case of judicial inquiries as to collisions or accidents, witnesses giving evidence as to the nature or position of coloured signals or lights should be themselves tested for colour- and form-vision”; by Bickerton (6*h*); and most recently of all we find the following paragraph at page 6 of the Report of the Departmental Committee of the Board of Trade (12), of which Committee the present writer was a member: “There appears to be no evidence showing conclusively that defective vision has caused any appreciable number of accidents at sea, although we do not think that it necessarily follows from this that the present method, even where it has been employed, has been successful in excluding all dangerous persons from the mercantile marine, or that no accidents have been caused in this way, since it has not been the practice in conducting inquiries into the causes of casualties to test the vision of persons implicated. We think it regrettable that effect has not been given to the recommendation as to the testing of witnesses, contained in the Report of the Committee of the Royal Society in 1894,† and we desire to repeat that recommendation that, in case of judicial inquiries as to collisions or accidents, witnesses giving evidence as to the nature or position of coloured signals

* Of foreign references, see especially Nagel's energetic protest in 1907 (38).

† This date should be 1892.

or lights should be themselves tested for colour and form vision." Some even of those representing the railroad interest have from time to time written in favour of the examination of witnesses after an accident (Case 28). Again in favour of collecting cases we find the following in a leading article headed "Railway Servants' Eyesight" in *Invention* (14) in 1889; "We think it would be highly instructive if an investigation could be made to ascertain if any, and how many, collisions at sea and on railways have been due to colour-blindness and defective sight, and we understand that some such proposition is to be brought forward in the House of Commons." I am not aware that any such official investigation was ever proposed; certainly it was never carried out.

I understand quite well that, even when the man or men whose visual defects may have been to blame survive the disaster, it may not always be easy to produce them promptly as witnesses at the official inquiry, and that this difficulty is apt to be greater in the case of shipping than of railway disasters. *But it ought to be obligatory for these men, and any others who give evidence as to signals, to have their sight tested by expert examiners, after every maritime or railroad accident in which the nature of the signals that are in question has to be inquired into.*

I cannot help hoping that just now a full presentation of all the cases that can be collected up to the present date, those already given by previous writers and such others as are available, may help towards the formation of a correct and temperate view of the reality and seriousness of the danger. It is very necessary to avoid any suspicion that we are overstating the case. But we must at the same time take the opportunity afforded by the display of all the evidence we can collect to draw the attention of the Board of Trade, the Government and the public as forcibly as possible to the defect in the existing law, which blocks investigation into one of the very important causes of these disasters.

I believe that the small number of accidents recorded as

having been caused by defects of sight represents only a portion, probably a small portion, of those that have happened; how many others there have been we shall never know, but in support of my opinion the following considerations are some of those that may be urged.

Besides the actual shipping casualties that are known to have been due to defects of sight, we have a number of other instances in which it is practically certain that either a collision or a stranding would have occurred but for the prompt intervention of a normal-sighted colleague. These cases, so far as they are known to me, are given in detail below, and perusal will show that in several of them the disaster was only just averted. Although few people hear of these "potential accidents," they are from my present point of view quite as important as the actual casualties. Indeed, they are in some respects more valuable, because although the information concerning them is usually confidential, it is given willingly and with no desire either to conceal or overstate anything. It may be surmised with confidence that for one such case that we get knowledge of, more than one—probably several—others occur but never go further than the two or three men who were personally concerned. Various medical men, scientists, and others, themselves colour-blind in various degrees, have narrated their own experiences with the signal-lights and buoys. I may refer especially to the evidence given by Dr. F. W. Mott, who has slightly defective colour-vision, before the committee on sight tests (13), questions 1649 to 1658, and to the detailed account given of his own case by another colour-defective medical man, Dr. A. Guttmann of Berlin (40). Dr. Guttmann's very instructive narrative derives special importance from the facts that he has paid much attention to the subject of defective colour-perception, and is himself a practical seaman and master of his own motor-boat. He has put the efficiency of his colour sense to practical proof with great exactness on numerous voyages, and describes his motor-boat experiences both with lights and buoys, and likewise his observations, compared with

those of the normal-sighted officers, on the bridge of one of the North-German Lloyd liners at night both in clear weather and in fog. His general conclusion is that men with weak colour-sense are unsafe, and, like those who are badly colour-blind, ought to be excluded from service at sea. Captain Craig, M.P., a colour-blind yachtsman, gave similar evidence before the committee on sight tests (13), questions 1290-1306.

It is evident that in respect to both actual and potential casualties, a seaman or railwayman who suffers either from colour-blindness or defective form-vision is strongly tempted to conceal his defect. Some men so affected are not aware that their sight is different from that of their fellows. Many others who know or suspect their defect also know that in one way or another they have managed, for years it may be, to keep clear of disaster, and one can easily understand, that both they, and their employers, find it difficult to believe that a defect always present should be operative only on rare occasions. Hence, I have no doubt, has arisen the tendency that we see so strongly and so constantly displayed, when there is a question of personal default, to blame other, less constant, less personal, more avoidable and more remediable shortcomings in the man to whom an accident has been due.

Then in connection with the apparent, but unproved, rarity of shipping accidents caused by defects of vision, we are told that the vast majority of shipping casualties are due to causes in which visual faults cannot possibly take any share, and that the proportion of the whole that might have been caused in that way must be extremely small. Thus in Appendix B to the Report of the Departmental Committee (13, pp. 141-142), showing the number and causes of collisions and strandings, *Table I* shows a total of 1092 accidents on or near the coasts of the United Kingdom, or of the coasts of British possessions abroad, during the fourteen years 1894-1908. The 1092 cases are divided into fourteen groups according to cause. From what I have said above it may be safely assumed that

defects of vision were not inquired for in the official investigations. If this assumption be valid, as I am convinced that it is, we may, I think, suppose that visual defects might have operated in some of the cases headed "Bad Look-out" (100 accidents), "Error of Pilot" (34 cases), "Error in Judgment" (138 cases) and "Cause Unknown" (180 cases), total 452, or roughly 40 per cent. of the whole. It is possible that those better acquainted with the technical definition of the groups referred to may decline to admit some of them into what, for brevity, may be called the "*Possible Sight-defect Class*"; but even if we take only "Bad Look-out" and "Cause Unknown," the total (280) gives a percentage of 26. *Table II* shows the strandings everywhere of vessels registered in the United Kingdom and British possessions abroad during the same fourteen years. Apparently only strandings, not collisions, are counted. Further, this table is divided into only six groups instead of fourteen, so that no exact comparison can be made with *Table I*. The total is 1540, of which 98 are due to "unknown causes," 429 to "navigation and seamanship," 322 to "miscellaneous causes." The two last-named groups might, and probably do, contain some cases due to visual defects, but as no trustworthy numerical statement can be made, I omit them. The 98 due to "Unknown Causes" form between 6 and 7 per cent. of the whole. *Consideration of these two tables appears to me to show that an appreciable proportion of shipping accidents due to defects of sight may have been included, but not identified, in certain of the groups.* According to Dr. Féris (2) Romberg classified the causes of 2408 accidents to shipping that occurred between the years 1859 and 1866. Of this total Romberg considered that 846 (35 per cent.) were of a kind that might have included cases caused by colour-blindness, *viz.*, "Erreur du pilote ou du capitaine, 215; Inobservation ou interpretation des règles de route, 537; Causes indéterminées, 94."

As a partial set-off to the above considerations, it must be fully recognised that the institution of tests of sight by

the Board of Trade, by the important ship owners and by the railway companies has resulted not only in the detection and consequent exclusion of many candidates found to have disqualifying visual defects, but that the knowledge that such tests had to be passed has also often prevented those who knew themselves to be defective from applying for admission. Many myopic lads have myopic relatives, and such families, knowing that short-sightedness often increases in degree and therefore becomes more disqualifying with age, will tend to choose occupations for which long sight is not essential. A very large number of colour-blind lads have one or more colour-blind brothers, a fact that sometimes deters them, although if one member of such a family succeeds in passing the examination we not infrequently find that the others apply too. I know of cases in which pairs of colour-blind brothers hold marine certificates or have passed for commissions in the Army.

It should also be added that, so far as we know at present, colour-blindness appears to have caused more accidents than defective form-vision,* *but no conclusion of any value can be reached as to this point or as to the total frequency of accidents from visual defects of all kinds, until examination of the sight is made compulsory after accidents.* It appears to be the case that in the accidents hitherto proved to have been caused by bad form-vision the pilot has been the one to blame (Cases 12, 13 and 17, and probably Case 11); and in this connection I may say that I have quite recently seen an elderly pilot with considerable myopia and form-vision quite below the standard, who was referred for special examination to the Board of Trade. As to the kind of signal that has been mistaken, it has almost always been a lamp at night, but in Case 9 the accident occurred by daylight with a buoy, and in Case 20 mention is made of difficulties in the interpretation of buoys.

* See also a letter from Mr. John Glynn in *The Times* for May 7th, 1913, in which the writer states that "no single accident can be traced to faulty form-vision on the part of an officer." [A pilot is not, technically, an "officer."—E.N.]

The contention that lowered acuity of sight (defective form-vision) has not been proved to have caused accidents loses much of its force when we remember, as was first pointed out by Sir William Abney, that even when colour-perception is normal defect of vision for form may, and often does, lead to tardiness, hesitation and even positive errors in the interpretation of the colour of a distant signal. The fault in the eye, whatever it may be, that causes all objects at a long distance, whether white or coloured, to be seen out of focus and therefore imperfectly, also lowers the brightness of the colour of such image. This part of the subject has not yet received sufficient attention. In this connection the memorandum on "Dark Adaptation," by Professor Gotch (13), p. 151, should be consulted.

I do not propose to consider what standard of vision should be set up, but may say that the degree of form-vision recommended by the Committee on Sight-tests, and generally spoken of by those whom it concerns as "the new standard," does not appear to me to be too high. Nor is this the occasion for discussing the question of an international standardisation of signal-lights, such as was advocated at the Seventh International Medical Congress held in London in 1881 (15), and by Dr. W. H. R. Rivers in the memorandum he supplied to the Departmental Committee in December, 1910 (13). It is clear that there would be very great difficulties in reaching any such agreement.

The Committee on Sight-tests (12) was able to deal only with British shipping. I go further afield, my object being to show the ever-present risk of allowing any men whose sight is defective, either for colour or form, to interpret coloured signals, and the serious danger that would again arise if a high standard of visual efficiency were not to be maintained in both the shipping and railroad services. I have therefore collected cases from both home and foreign mercantile and naval marine sources and from the railroad services.

The majority of the cases given below have been already published in more or less detail, others are new. In the published cases I have done what I could to get to, or as nearly as possible to, the original sources. The published accounts, however, are scattered and not always accessible, and although I have received much help from various quarters the search for early records has not always been successful. The Marine Department of the Board of Trade has given me much assistance by supplying or obtaining for me several original reports, making inquiries and allowing me the use of the library, and my acknowledgments are due especially to the late Sir Walter Howell and Mr. T. Lodge. I am particularly indebted to Mr. Lodge, who was one of the secretaries to the Sight-tests Committee, for his courtesy and invaluable aid.

I have divided the cases into three classes, (I) shipping cases, (II) railway cases, and have subdivided the former into the two groups, (A) actual casualties, (B) potential casualties. Only one of the railway cases is grouped as "potential." In class III are placed miscellaneous cases, in some of which defects of sight were proved, although their relation to the accident was doubtful; whilst in others, though no visual defect was demonstrated, or even sought for, the circumstances pointed to such defect as the most likely cause of the disaster. The whole collection is numbered consecutively for convenience of reference, and in each class or group the cases are placed as nearly in chronological order as possible; when the date of happening is not known the date of the earliest available reference is given instead.

CLASS I.—SHIPPING CASES.

GROUP A. ACTUAL CASUALTIES ; CASES 1 TO 14 AND CASE 36.

CASE 1.—Dr. Prinz (5). On January 18th, 1860, the captain of the Spanish ship "San Miguel" lost his vessel on the reef of Juan Claro by taking a white harbour light of Cadiz for a side light of another vessel.

Dr Féris (2), writing in 1876, quotes the following cases :

CASE 2.—Féris's first case. On May 14th, 1869, at half-past four in the morning, the French lugger "Japhet" stranded two kilometres east of Pontusval, on the north coast of Finisterre, Brittany, having mistaken the light of the island of the Île de Bas (which shows in each minute a white flash lasting eight seconds followed by an eclipse, and no red light at all) for that of the Île de Vierge (which shows, first, a white light followed by a short eclipse, then, second, a red flash followed again by a short eclipse, then third, white again, the total duration of the cycle being four minutes). This description of the two lights has been supplied to me from the Board of Trade ; Féris's account is not so precise.

CASE 3.—Féris's second case. On October 19th of the same year (1869) the Swedish schooner "Vesta" stranded some kilometres from the port of Gravelines (between Calais and Dunkirk) having mistaken the light of Gravelines or that of the English North Foreland. Now the Gravelines light is a fixed white light, that of the North Foreland is a fixed white and red light.

CASE 4.—Féris's third case. The following case is

copied by Féris (2), "Textuellement comme je le trouve indiqué, *les Annales du Sauvetage maritime*, tome viii, année 1873" (3). I translate Féris's copy as follows:

"On January 26th, 1871, the English steamer 'Malvina' stranded on the reefs of Sourdava* in the roadstead of Marseilles, having mistaken the green light of la Joliette for the larboard light of a ship coming towards her.

"Here we have a captain who mistook the green light of a pier for the red light of a ship. . . . It is certain that if this captain had been examined as to his colour-vision before he obtained command of his ship, this accident would not have occurred."

CASE 5.—The Supervising Inspector-General of Steam-Vessels (for the United States), in his annual report (16) for 1880, writes as follows:

"On the night of July 5th, 1875, there was a collision near Norfolk,† Va., between the steam-tug 'Lumberman' and the steamship 'Isaac Bell,' the former vessel bound to, and the latter from, Norfolk. The accident occurred at about 9 o'clock p.m. on an ordinarily clear night, under circumstances which until recently seemed more or less mysterious. The master of the steamer and all his officers made oath that at the time signals were made to the tug the latter was from one to two points‡ on the steamer's starboard bow, and consequently the steamer's green light only was visible to the approaching vessel. Yet the master of the tug, whose statement was unsupported by any other testimony, asserted that the steamer's red light was exhibited, and he signalled accordingly. The discrepancy in the statements was so great that many persons uncharitably charged the master of the tug with being intoxicated, although no evidence was ever offered in support of the charge. By this accident ten (10) persons lost their lives. Upon a visual examination of this officer

* Apparently a misprint for Sourdaras.

† Norfolk, close to Portsmouth, Virginia, the two towns standing upon opposite sides of the same harbour.

‡ A "point" is a fraction more than 11 degrees.

under the rules during the past summer by the surgeon of the Marine Hospital at Norfolk, he was found to be colour-blind, two examinations having been accorded him with an interval of ten days between them."

The long interval (five years) between the accident (July, 1875) and the examination of this tug-master for colour-blindness (summer, 1880) is doubtless explained by the fact that the compulsory examinations of pilots and would-be pilots on steam vessels in the United States was only instituted in February, 1880 (see pp. 4 and 5 of the same report, where we read that "The Supervising Surgeon-General reports that up to June 30th, 1880, 2870 pilots were examined, and sixty-four of this number were found to be colour-blind").

CASE 6.—Prinz (5). On February 8th, 1877, the schooner "Teneriffe" on putting into the roadstead of Bata Cano* was run down by the Spanish gun-boat "Marinero" in consequence of the captain of the latter vessel having mistaken the position lights of the schooner for the white harbour lights.

CASE 7.—Prinz (5). In 1879 the schooner "Teresa" was lost in the harbour of Gibora,† owing to confusion between the white light of the Governor's house there and the red harbour light at the end of the quay.

CASE 8.—T. H. Bickerton (6 c) quotes the following from a letter written to him by Messrs. Macintyre & Co., Liverpool, Shipowners:

"Our ship 'Carbet Castle' collided in the South Channel, bound from Dundee to Cardiff, in 1879, with the 'T. H. Ramien,' due, as far as we can now make out, to the colour-blindness or short-sightedness of the chief officer."

CASE 9.—Stranding of "City of Austin." Quoted verbatim by Joy Jeffries (4) (second edition, p. 176).

* Perhaps a misprint for Bata Bano on the south coast of Cuba, almost due south of Havana.

† Perhaps misprint for Tibara, on the north coast of Cuba, near the eastern end of the island.

The Surgeon-General* of Marine Hospital Service says "The following report to the supervising Inspector-General of steam vessels †, relative to the loss of the steamer 'City of Austin' on the Florida coast, shows colour-blindness of the pilot to have been the cause of the accident.

'Office of U.S. Local Inspectors of Steam-Vessels,
'Savannah, Ga. ;

'June 6th, 1881.

'Sir,—In accordance with your letter of instructions of May 7th, 1881, requesting the local inspectors at Savannah to inquire into the cause of the loss of the steamer "City of Austin" at Fernandina, ‡ April 24th, 1881, at 4.15 p.m., we have to report : It appears from the statement of J. W. Howell, Collector of Customs at Fernandina, that the steamer "City of Austin" was sailing under register, and was in charge of State Pilot George Cribb, licensed at St. Mary's, Ga., on the twenty-sixth day of March, 1879.

'The loss of the steamer was caused by the pilot mistaking the colour of the buoys that mark out the channel.

'Dr. J. H. Pope of Fernandina was consulted by Mr. Cribb some months ago on account of his sight, and advised him to consult Dr. Chisholm of Baltimore, which he did. The doctors are of opinion that his eyes are affected from excessive use of tobacco. We examined him for colour-blindness in presence of the Chairman and Secretary of the Board of Pilot Commissioners at St. Mary's and find that, at a distance of six feet, he is not able to distinguish one colour from another.

* Probably Dr. John B. Hamilton, who wrote the corresponding report for year ending June 30th, 1880. See Joy Jeffries—"Colour-Blindness and Visual Power," in *Annual Report of the Railroad Commissioners for the State of Connecticut for 1881*. Reprint in Ophthalmological Society's Library ("F. 33"), p. 4.—E.N.

† This report of the Supervising Inspector-General is for 1881.—E.N.

‡ Fernandina is on the east coast of Florida between Savannah and Jacksonville.

‘The master, E. C. Sterns, estimates the loss of the steamer at one hundred thousand dollars, and the cargo at the same amount. The vessel will prove a total loss.

‘Very respectfully,

‘JONES AND HEADMAN,

‘Local Inspectors.

‘Hon. James A. Dumont.

‘Supervising Inspector-General, Washington, D.C.’”

CASE 10.—Dr. S. T. Armstrong (17), Passed Assistant Surgeon, United States Marine Hospital Service, reports in 1888 that—“The master and owner of a steamboat, on the Mississippi river, brought a man to me for examination for colour-sense. The man proved to be colour-blind, and on looking over the records his rejection several years previous was found; the man said he had not expected to pass, and stated that his steamboat had once collided with, and sank, a steamboat on account of his inability to distinguish the signal lights. His would-be employer was aware of these facts.”

N.B.—It seems just possible that this colour-blind man was the same person as the colour-blind tugmaster (or pilot?) of the “Lumberman” in Case 5.—*E.N.*

CASE 11.—Bickerton (6*bb*). A case of valuable time lost owing, as the captain alleged, to the pilot’s bad vision. No names and no date, but captain’s narrative taken down from him by Bickerton was: “Time, midnight. My steamer was bound to London with a valuable and perishable cargo, and every hour was therefore of great importance. The Trinity pilot came on board off Dover and took charge in the usual course. There was a spring flood tide, with a violent gale from the north-west, with rain squalls, but the atmosphere was clear. At the Gull Lightship the pilot, to my great annoyance, slowed down. On arriving at the Tongue Light-vessel the pilot said that he could not see the next light—the Princess Channel Lightship—and that the weather and tide made

it too risky to enter the river. The North Sand Head, the North Foreland, the Tongue, and the Princess Channel Light were perfectly visible to me, but the pilot declined to go on. I then called the mate on to the bridge and asked him if he could see the Princess Channel Light. He immediately answered, 'Yes, sir,' and at the same time pointed it out. The pilot now proceeded, but anchored off the Chapman, and would not go any further. The ship lost twelve hours in time and over £100 in money by this delay, and I am of opinion that had the pilot's eyesight been equal to his duties this would not have occurred."

CASES 12 and 13.—CASE 12.—Barrett and Orr's case (18) of the wreck of the Peninsular and Oriental Company's steamer, "Australia," on the Corsair Rock at Port Philip, Victoria. This took place about 1.30 a.m. on the night of June 19th–20th, 1904. The night was moonless. Rain had been falling and there was a high wind, but the sea was calm. The vessel's own speed was about 14 knots plus a strong tidal current from the S.E. of probably 6 knots. The usual practice in entering Port Philip is to keep the white light (which is 130 ft. high) and the lower level red light (90 ft. high) in line until well past the Corsair Rock and then to turn to starboard and go up the channel of the harbour. In the present case, however, the pilot in charge turned to port to allow for the strong current from the S.E. He appears to have given three orders to port, and shortly after they were given, barely half an hour after he had come aboard, the vessel struck the Corsair Rock. If he had seen the white light and the red one clearly enough to tell when they were out of line he would not have taken the course he did.

The ship struck when she was about 4000 yards from these lights, at which distance the images of the two lights would, in eyes with this pilot's degree of short sight (myopia), be not only diffused and proportionately enfeebled in brightness, but would probably overlap more or less.

At the inquiry the pilot said he had not been aware

that his sight was defective, but he also said that the lights had not seemed to him as clear as usual. He used his binoculars at any rate at first, but they were left on the wreck and there was therefore no opportunity of seeing whether they were faulty or not. His eyes were examined by Dr. Barrett several times within a few days of the accident and found to be myopic to the extent of about 3 dioptries; vision without glasses varied from $\frac{6}{36}$ ($\frac{1}{6}$) to $\frac{6}{24}$ ($\frac{1}{4}$) and with the appropriate glasses was raised to nearly $\frac{6}{6}$ (1); colour vision normal; no disease of the fundus of either eye. His age was 50. His heart, arteries and kidneys were unsound, but these conditions do not appear to have been factors in causing the casualty. He was temperate, and neither brought any alcohol on board with him nor received any whilst there.

CASE 13.—On inquiry it appeared that the same pilot had had a previous accident. He was in charge of the S.S. "Indraghiri" when she ran aground at night on March 10th, 1904, *i.e.*, about three months before the wreck of the "Australia." The night on that occasion was dark, but clear, and the lights were visible. The accident was caused by his failing to see the occulting light of a certain buoy. He said he thought the light was obscured by a flight of birds.

It is practically certain that if this pilot's form-vision for long distance had been full, or approximately so, neither of the two accidents for which he was responsible would have occurred.

CASE 14.—According to Nagel (38), a shipping collision of special interest in relation to our present subject took place in the autumn of 1906 near Trelleborg, a place on the extreme south coast of Sweden, about fifty miles from Copenhagen. During a clear night the Danish steamer "Heimdal" ran across the bows of the Finnish barque "Onni" and was rammed by her. The "Heimdal" did not sink, but the ramming vessel, "Onni," sank some time after. The blame fell upon the steersman of the "Heimdal," who said at the inquiry that the "Onni" had

shown a light, which, just before the collision, changed to another colour, indicating a change in the direction taken by the sailing vessel, but too late for him to alter his course. But several other witnesses denied that any such change in the direction of the barque had taken place. The steersman was injured at the collision, and lay for some time unconscious in hospital. When well enough, he was examined by medical men at Copenhagen, and his colour-sense found to be decidedly abnormal, though not deficient in a high degree. Examined later by a Copenhagen ophthalmologist, he made only slight mistakes. The suggestion is that before the collision this steersman's sight had failed, so as to cause serious lowering of colour-perception, "as is not unusual, especially from abuse of alcohol," but that during his stay in the Copenhagen hospital his eyes recovered, so that at the last examination only a trace of the defect remained. Such an order of events is what we should expect in a case of toxic amblyopia. *See Postscript, p. 53.*

Case 36 (p. 41) ought to have been placed here. It was incomplete when the MS. was first arranged, and, by an oversight, was not afterwards transferred.

CLASS I.—GROUP B: POTENTIAL CASUALTIES; CASES 15 TO 23.

CASE 15.—Féris (2) quotes the following graphic anecdote related to Dr. Favre by a young pilot who had recently returned from Mexico in the Norwegian merchant ship "Adelheim": "The second officer could not recognise the coloured signals, and constantly had to ask a sailor to tell him the colours of the side-lights of vessels that the 'Adelheim' met in the English Channel; he confessed that he could not tell the difference between the green and the red light."

CASE 16.—T. H. Bickerton (6 a). "A captain of a large Atlantic steamer, in answer to my inquiry whether

he had ever come across a colour-blind man, gave me the following information. One night, while lying in his berth under the bridge, he heard the officer on watch sing out 'Hard-a-port.' He at once rushed on deck, and asking the officer what was the matter was answered 'Red light ahead, sir.' He looked, and seeing on the starboard bow a green light at once had the helm starboarded. Collision only just avoided.

"He could not understand how such a mistake could be made as the officer was considered an experienced one. On a subsequent occasion a somewhat similar occurrence took place. The order 'Hard-a-port' was given, and on the captain hurrying on deck he found that the man had mistaken the pyrotechnic light* with which the vessels at night signal the name of the line to which they belong, and which was being shown on the starboard side of the advancing vessel, for its port light. On each occasion a probable collision was only averted by the prompt intervention of the captain. On the owners of the vessel being informed the man was examined, found to be colour-blind, and dismissed."

CASE 17.—Bickerton (6 *bb*). Case of an apparently nearly blind pilot narrated and signed by Captain Henry F. Watt, of Liverpool.

Captain Watt took a pilot on board his steamer "Charles Morand" at Patras at 8 p.m. to conduct the vessel to Vostitza, both ports upon the north coast of Morea. Captain Watt "took her clear of the shipping in the harbour, and then handed her over to the charge of the pilot. For the first hour a labourer was on the bridge assisting the pilot to make out the lights, but, getting tired, he went below. Finding the pilot was keeping close to the shore and noticing that he never looked at the compass I became suspicious of his eyesight, and during the next hour myself hauled the ship

* Nothing is said about the colour of this pyrotechnic light, and I am told that the colour displayed by these lights is not the same for all vessels.

off the shore several times. About midnight, the atmosphere being fairly clear, the pilot announced that he had arrived off Vostitza, and could see the light. I could see no light and stopped to sound, and then hauled in for what the pilot said was the harbour. The ship was just moving when the look-out man sang out that she was within a stone's throw of the beach, and just as I got the telegraph full speed astern she ran ashore. But for my suspicions she would have gone full speed on to the rocks."

CASE 18.—T. H. Bickerton (6*f*) gives the following case communicated to him in writing by Captain Coburn who was for many years in the service of Messrs. Leach, Harrison and Forwood at Liverpool. "The steamer 'Neera' was on a voyage from Liverpool to Alexandria. One night, shortly after passing Gibraltar, at about 10.30 p.m., I went on the bridge, which was then in the charge of the Third Officer, Mr. ———, a man of about 45 years of age, and who up to that time I had supposed to be a trustworthy officer and competent in every way. I walked up and down the bridge until about 11 p.m., when the third officer and I almost simultaneously saw a light about two points on the starboard bow. I at once saw it was a green light, and knew that no action was called for. To my surprise, the third officer called out to the man at the wheel, 'Port,' which he was about to do, when I countermanded the order, and told him to steady his helm, which he did, and we passed the other steamer safely about half a mile apart. I at once asked the third officer why he had ported his helm to a green light on the starboard bow, but he insisted that it was a red light which he had first seen. I tried him repeatedly after this, and although he sometimes gave a correct description of the colour of the light, he was as often incorrect, and it was evidently all guesswork. On my return I applied to have him removed from the ship, as he was, in my opinion, quite unfit to have charge of the deck at night, and this application was granted. . . . I cannot imagine

anything more dangerous or more likely to lead to fatal accidents than a colour-blind man on a steamer's bridge."

CASE 19.—T. H. Bickerton (6 c) gives a case related, presumably to himself, by Captain Heasley of Liverpool. The Captain states that "after passing through the Straits of Gibraltar, the second officer, who had charge of the deck, gave the order to 'port,' much to my astonishment, for the lights to be seen about a point on the starboard bow were a mast-head and a green light, but maintained that it was a mast-head and a red light, and not until both ships were nearly abreast would he acknowledge his mistake. I may add that during the rest of the voyage I never saw him make the same mistake. As a practical seaman," he adds, "I consider a great many accidents at sea arise from colour-blindness."

CASE 20.—Nettleship (19). A gentleman who had had many years' experience in one of the European navies gave the following account of the difficulties his defective sight had caused him. He had been colour-blind and had moderately defective form-vision all his life, but had managed to pass whatever tests of vision had been required when he entered the service. On first going to sea he was very slow in picking up small objects, such as buoys, although when once found they were plain enough so long as he kept his eyes upon them. He was inaccurate in taking observations with the sextant. He always had difficulty with the coloured lights, and unless quite close he could not tell whether the light was white, red or green. However, he managed to keep the rule of the road as, except on a very dark night, he was able, with night glasses, to see the form of the hull of a vessel which had other lights on board; also the fact that merchant steamers usually carry their side-lights well abaft the mast-head light enabled him to judge how such a ship was steering; he also admitted that he used to get help from brother officers or men when necessary. On one occasion, when he was æt. about 20 years, he was in charge of a torpedo boat that formed one, about the



central one, of a chain of several passing in single file up an estuary at night. The signal to stop engines and anchor was on this occasion to be a certain arrangement of the white, red and green lights displayed by the leading vessel; when this signal was given he could not interpret it and had to steer his vessel off to one side to avoid a collision with the one next in front.

CASE 21.—T. H. Bickerton (6 *e*). The case of a man, who, having passed as second mate in 1894 and first mate in 1895, was second officer on the bridge of the steamer "D——," 4000 tons, in the North Sea in February 1897. "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. . . . 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. The next month (March, 1897) he underwent another examination at the Board of Trade in the wool test and passed again as he had done before. He was then examined, at Mr. Bickerton's request, by Professor (now Sir) Oliver Lodge by spectral and other tests and was found to be slightly red blind, matching an orange mixture with a pure yellow and calling a true yellow match 'too green.'" He afterwards freely admitted to Mr. Bickerton that he was never certain about the white and green lights.

CASE 22.—Two colour-blind men on duty on the same ship at the same time.

Dr. Joy Jeffries (21), in two letters dated January 12th (to Mr. Brudenell Carter) and February 11th (to E. Nettleship), 1913, tells of the following striking case (unpublished).

Lieutenant —— was an officer commanding the United

States sailing vessel (frigate) —— (the name is mentioned by Dr. Joy Jeffries) on a passage through the Long Island Sound bound to the Boston Navy Yard. It being night and the weather doubtful and there being no hurry he turned the ship round to head back to the harbour he had come from. He knew himself to be colour-blind. A look-out forward who, as the event showed, was also colour-blind, called out "Green light ahead," and the lieutenant, being no judge, had to "take the report." A brother officer who was sitting in a chair under a large open hatch below and knew of the lieutenant's defect, hearing the call, rushed up, and looking ahead saw the light was red and hailed the lieutenant commanding, so that the ship's course was altered just in time to clear a large schooner, carrying at least a thousand tons of coal, that in a collision would have gone through and over the frigate and drowned the 250 men asleep below. The lieutenant was "quite broken up" by the shock of the occurrence and resigned. Yet the Secretary of the Navy offered to put him back in office if he wished it! He was afterwards given work of a kind he could safely accept during the Spanish-American war.

CASE 23.—Sir Walter Howell in his reply to question 19 (Departmental Committee, Evidence, p. 2) (13) quotes the following from a letter addressed to the Board of Trade by the master of the barque "Peru" in 1894. "The time was about 11.30 p.m. and the weather was quite clear with a starry sky. One of the men on the look-out reported a light on the port bow. I asked the mate, 'What kind of light is it?' and he replied, 'A red light, sir.' I went for my glasses, and on looking through them found the light to be a green one. I cried out 'That be damned. It's a green light.' I gave orders to about ship, and this order was carried out, and as we passed on the starboard side of the steamer, I could easily have thrown a stone on the deck of such steamer." Sir Walter Howell adds that the officer who made the above mistake was examined by the Board of Trade on his return to England, found to be

colour-blind, and his certificate cancelled by the London Local Marine Board.

In *The Morning Post* of October 1st, 1912, at p. 5, Dr. Jas. W. Barrett, of Melbourne, recounting the cases of the "Australia" and the "Indraghiri" (Cases 12 and 13 above), makes the following statement: "Other occurrences of a similar nature are known in Australia, although for obvious reasons minute details have not been published. A steamer was run ashore but not seriously injured. The two officers responsible were subsequently found to possess respectively defective form and colour-vision. This fact was accidentally ascertained. Another accident, rendered probable by the colour-blindness of an officer, was prevented by the recognition of the nature of the mistake by a brother officer. . . . The interest of the matter largely centres in the fact that in all these cases detection was accidental."

CLASS II.—RAILWAY CASES.

GROUP A : ACTUAL CASUALTIES. CASES 24 TO 31.

[Favre (1), writing in 1873, states that a railway accident is said to have been caused by colour-blindness in England several years before, but that he had no exact particulars. He does not mention the source of his information. This case is so meagre that, although I mention it in its chronological order, I do not propose to count it in the series. It might possibly be the same as Case 26 below.]

CASE 24.—In the same paper Favre states that three years earlier (*i. e.*, in or about 1870.—E. N.) a railway accident had been caused by the colour-blindness of a pointsman at Bucke,* in Westphalia, twenty persons being injured. Source of information not mentioned.

CASE 25.—Gintle (22). In the summer of 1876 a collision occurred on the Finnish Railway between Helsingfors and Tawastehus, which was caused by a colour-blind pointsman who had held up the green instead of the red lantern to the approaching train. I have tried to obtain original information about this case, but without success.

CASE 26.—Haynes Walton (23) gives the following case in a letter headed "Colour-blindness," on p. 8 of *The Times* for January 3rd, 1877: "Colour-blindness may be acquired. This is very rare compared to its existence as a congenital defect, and not generally known. A few years ago I was investigating colour appreciation, and the first instance of the acquired defect that came to my knowledge was in the person of an engine-driver. This man confessed, after an

* Perhaps a misprint for Bückeburg, not far from Minden.—E. N.

accident through his not distinguishing the red signal, that he had gradually lost his colour-power, which had been perfect, and so sensible was he of his loss and its disadvantages that before the accident he had determined to give up the situation. The manager of the company, who told me the circumstances, assured me that this driver had been carefully examined but a few years back and passed as possessing perfect sight." It seems just possible, though not likely, that this case and Case 28 are the same.

CASE 27.—Minder (24) narrated in 1878 the following example of the difficulties in which a congenitally colour-blind railway engine-driver found himself: "A young man, not aware that he was red-green blind, was made, first stoker, then engine-driver on a Swiss railway. He very soon found difficulty in deciding upon the colours of the signals, and left this part of his duty to his normal-sighted companion. After a time the latter was replaced by another man, who appears to have also been colour-blind, and then matters again became difficult for our original colour-blind engine-driver. No serious accident occurred, but he made a series of mistakes with the coloured signals in manœuvring at stations which led to his being fined and undergoing other unpleasantness. We are not told whether he continued in the service. The red lamp gave him the most difficulty, the colour being undistinguishable until he was too near to it to stop his engine. As a rule, he managed to distinguish the green from the white by the greater brightness of the latter; and he said he could imitate all the three signal colours by turning the wick of the lamp more or less up or down."

CASE 28.—Railway collision attributed to the colour-blindness of an engine-driver. In 1889 Mr. Clement E. Stretton (25), C.E., of the Associated Society of Drivers and Firemen, wrote that—"Some years ago a collision occurred on a railway in consequence of a train over-running a signal; the driver was firm in his statement that the light was 'green,' whereas all the other men

said it was 'red.' The driver was fined, and afterwards continued to work as usual. He then made some other mistakes, which would have ended in collisions had not the fireman said, 'Stop, mate.'

"Without any cause being stated, the driver decided to give up railway work, and take to another occupation. He some time afterwards informed me that he found that when he had been on duty for seventeen hours, and especially in some states of the weather, 'he was not certain about red and green,' and he believed his sight was the cause of the collision."

The writer adds: "In all cases in which collisions occur in consequence of mistakes of signals, it would be a great advantage if the Board of Trade inspectors would have the men's sight tested before they come to the conclusion that one or other man is not speaking the truth." The rest of the letter refers to a previous communication from Dr. Edridge-Green about Holmgren's test and other points.

CASE 29.—A correspondent signing himself "Thirty Years Railway Man" (26), published the following statement in 1889, on the question of the colour-vision of railway employes, which was then under discussion, in *Invention*, vol. xi, p. 1153 (December 28th, 1889). The writer was a member of the General Railway Workers' Union. He states that in his opinion the card tests and the wool tests as he knew them were not efficacious in excluding men with defective colour-vision, and in confirmation adds the following: "Why, Sir, I had a mate that passed them all; but we had a pitch into another train over it; he couldn't tell a red from a green light at night in a bit of a fog." He does not give either the year or the particulars of the accident.

CASE 30.—Mr. Brudenell Carter (27) published the following case in 1890, and obtained recently for me some further particulars from Dr. Joy Jeffries, who had originally mentioned it to him. Dr. Joy Jeffries writes that—"This railway accident occurred in Ohio where a law

existed. An engineer " (equivalent to our engine-driver—E. N.) "lost his leg by an accident and he proved his fireman to be colour-blind, against which there was then a State law. As I understood it the engineer was busy and the fireman failed to recognise a danger-signal, from which an accident happened which caused the loss of the engineer's leg." The engineer got heavy damages from the Company. The occurrence "prevented the repeal of the law as to colour-blindness which was being attempted."

CASE 31 is a *potential* railway case. Nuel (41) published a case in 1879 showing the danger that may sometimes be caused by the onset of colour-blindness from disease of the optic nerves in a man who was supposed to have had good colour-vision until then. A railway excavator, when 19 or 20 years old, rapidly lost the sight of his right eye from retro-bulbar optic neuritis; after a month's treatment in hospital the sight of this eye improved to two-thirds of the normal; he returned to work and kept at it for nearly a year without inconvenience. (It is to be noted that the left eye was supposed to be good all the time and does not seem to have been examined.) Then one day he was obliged to act as gate-keeper (presumably at a level crossing); at the proper time in the evening he put up what he considered to be a red signal lamp and went to his home or cabin near by. About ten minutes later, having to go out for some reason and to pass close to the signal lamp, he suddenly found himself in doubt as to the colour of that face of the lamp that he had set as red. He now examined it at quite close quarters with his left (the supposed good eye), and found that he had put up the green face of the lantern instead of the red, whilst with the right eye he confused both the red and green lights with the white. The doctor to whom he first went in his alarm told him he must have been drunk; but Nuel, whom the man consulted next, found the colour-perception very bad in the right eye and decidedly lowered in the left; visual acuity of right $\frac{6}{9}$, of left "normal," so that he had amply sufficient form-vision for any duty. Right

optic disc showed the appearances of partial atrophy, left appeared normal. During the succeeding months the left became worse and the right failed again and finally both optic nerves became atrophic. Later still he developed symptoms of serious disease of the central nervous system.

CASE 31A.—Nagel (38), writing in 1907, gives the following account of the Oberkottzau accident case, although he does not mention the name. A few years ago at a south German station an express ran past the entrance signal and ran into a goods train. The engine-driver had seen the green signal warning him to be cautious and go slowly, but thought it was white. He did recognise the red "stop" signal at the station, but it was too late to prevent the collision. The medical men who examined him pronounced unanimously that he was colour-blind.

P.S.—Since writing the above I have received from Dr. Zeitlmann (45) further particulars. The Oberkottzau accident occurred in the night of August 29th, 1900. There was a very thick fog. The engine-driver mistook the green "caution" signal light for a white light at two carriage lengths' distance, although his stoker saw that it was green at 30 metres. This engine-driver had been examined with wools four times previously and passed (Status of the examiners not mentioned.—E.N.). After the accident he was examined by two ophthalmic surgeons of high repute; he made many mistakes with wools, and also with the tests of Pflüger, Stilling and Nagel. Visual acuity $\frac{6}{6}$, refraction normal, fundus normal in each eye. He was removed from the service.

CLASS III.—MISCELLANEOUS.

CASUALTIES TO SHIPPING OR TO RAILWAY TRAINS IN WHICH
(a) VISUAL DEFECTS, ALTHOUGH, PRESENT, WERE NOT
PROVED TO HAVE CAUSED THE ACCIDENT; OR (b) SUCH
DEFECTS IF PRESENT WOULD HAVE EXPLAINED THE
ACCIDENT, BUT THEIR PRESENCE WAS NEITHER PROVED NOR
DISPROVED. CASES 32 to 42.

CASE 32.—The Lagerlunda case. The railway collision near Lagerlunda in Sweden in the year 1875, in which nine persons were killed, has gained some notoriety amongst those who are interested in the practical aspects of colour-blindness, because the late Professor Holmgren of Upsala stated in 1878, in his well-known monograph (28), that he had reason for supposing colour-blindness to have been one of the principal causes of the accident. Holmgren used distinctly guarded language, but unfortunately gave no indication as to either the source or the nature of the data that had led him to this conclusion—an omission upon which Geissler (22) commented in 1881. Geissler adds that he had seen a report of this accident, published more than a year after its occurrence, in the *Statens Jernvågstrafik för år 1875*, and that nothing was there said as to the cause of the collision. Joy Jeffries in his widely read book published in 1879 (4) quoted Holmgren's statement, and I am not aware that anyone since Geissler has tried either to verify or refute the position that the Lagerlunda accident was caused, partly

or entirely, by colour-blindness. W. Nagel, however, writing in 1907 (8), states definitely that the accident was caused by the colour-blindness of the engine-driver; and this is even further emphasised by Stargardt and Oloff (9), who, writing in 1912, say—"It is well known that in the year 1875 the Swedish physiologist Holmgren proved beyond doubt that the railway accident at Lagerlunda in Sweden, in which nine persons lost their lives, was caused by the colour-blindness of the engine-driver." From the account given below it will be seen that this confident attitude cannot be justified, and that Holmgren, writing within a few months of the accident and with all the facts before him, was only able to surmise that colour-blindness had probably been a factor in causing it, a conclusion to which perusal of Allander's recent pamphlet (32), dealing from an entirely different point of view with this case and another, had led me, before I had seen either the extracts from the report of the official enquiry, or the newspaper correspondence published by Holmgren and others shortly after the accident, that have come to hand since. In Allander's pamphlet, compiled from contemporary official sources, colour-blindness is not mentioned. The judge ruled that the station-master had not done all that he could and ought to have done to bring the train that was in fault to a standstill in the station, and that this negligence was a contributory cause of the accident, but that the chief cause was a want of the signals for standing still in the station, for moving on ("departure" signal) and for actually leaving ("exit" signal), which at that date were not sufficiently defined in the regulations.

Holmgren had been engaged in investigations upon the subject of colour-perception for some time before the Lagerlunda affair, and it was owing to his efforts that the public interest in this accident was directed towards colour-blindness as a possible cause of this and other disasters. The result was that a proper method of testing for this defect was introduced upon the Swedish State railway soon afterwards.

Holmgren's view of the Lagerlunda disaster some months after it happened is given in the course of a long letter dated September 25th, 1876, upon the prevalence and importance of colour-blindness, sent to the Royal Committee for the State Railways, and published in *Aftonbladet* (29). In this he writes: "In connection with the more general points of view I take the liberty of drawing your attention to one in particular which shows the necessity for controlling the state of the colour-sense of the railway employees, namely, the accident that took place on the southern line on November 15th, 1875, which resulted in the so-called 'Lagerlunda incident.' Whether or not colour-blindness in any way at the last minute was one of the causes of the accident will in all probability never be ascertained, as both S. F. Anderson, the engine-driver on the up train, and the extra carriage oiler, C. F. Larson, were killed; but it is difficult to entirely free one's mind from the supposition that at any rate the oiler Larson was colour-blind." He goes on to remark upon the contradictory character of much of the evidence given at the inquiry as to the colour of the signals shown at Bankeberg Station, and suggests to the Committee the advisability of having the colour-vision tested in all those survivors of the accident who were concerned, namely, the station-master, the extra station-man, two conductors, the line-man and the wife of the overseer all mentioned by name, and offers to conduct the examination himself. In a letter a fortnight later, October 8th, 1876, Holmgren expresses regret that the Committee in their reply of October 2nd have "entirely passed over his suggestion to make an examination of the colour-sense of the survivors of the Lagerlunda accident." And there it would seem the matter ended. The passage in his book (28) published in 1878 already referred to is as follows: "Il ne peut être tout à fait sans intérêt de jeter aussi un coup d'œil sur le développement de la question et son état actuel en Suède. Dans ce qu'on appelle la cause de Lagerlunda, ou ce procès qui a été intenté à la suite d'un accident de

chemin de fer dont Lagerlunda en Ostrogothie fut le théâtre le 15 Novembre, 1875, et qui a excité vivement l'attention publique alors, il se présenta des témoignages qui me firent supposer que la cécité des couleurs avait été l'une des causes principales de ce sinistre. Cela m'inspire la pensée qu'un contrôle devrait être exercé sur le sens des couleurs parmi les employés des chemins de fer." Mr. Dahlgren, Librarian of the Royal Library, Stockholm, writes to me (May, 1913) that the original Swedish edition of the book contains nothing more.

It is clear, therefore, that Holmgren himself considered it as no more than probable that colour-blindness was one of the causes of the Lagerlunda railway accident, and that, as he fully recognised, the point could not be cleared up because the men whose colour-vision was most in question were killed.

The following short account of the accident is derived from Allander's pamphlet (32), and from extracts from the proceedings of the legal investigation sent to me by Mr. Dahlgren (49).

Two express trains, No. 1 from the north (down train) and No. 2 from the south (up train), were timed to meet and stop at *Linköping* station soon after midnight (12.28 and 12.27 o'clock respectively) on November 15th, 1875. Train No. 1 was punctual, but half an hour before No. 2 was due, notice was received that it would be about an hour late. Arrangements were then made from *Linköping* for No. 1 to go on to *Bankeberg*, the next station, and for No. 2 to stop short at *Bankeberg*, and wait there until No. 1 had arrived. In the ordinary course these two trains would have passed each other at *Bankeberg* without stopping. The railway was a single-line road with a loop at and beyond each station to allow of two trains stopping or passing. No. 1 left *Linköping* at 1.1 a.m., and on reaching *Bankeberg* was to be switched on to the loop; No. 2, which, in fact, reached *Bankeberg* before No. 1, was to stay on the main line. The north switch was set correctly for No. 1 to turn on to the loop line, but No. 2,

having arrived at Bankeberg station before No. 1 had reached the loop-line, both trains were on the main line at the same time. We are not told how fast No. 1 was going, but No. 2, going at full speed, received a semaphore signal to slow down just after it had passed the other or south switch. This order was not obeyed to the station-master's satisfaction, and consequently when the train (No. 2) had reached the south end of the platform "he showed the signal for stopping the train by means of the green light from the lamp in his hand," and when the engine-driver had answered this by whistling, he (station-master) changed his light to red. The train was travelling at "unusual speed" but the engine-driver did his best to stop it, and by the time he reached the north switch the train had nearly, but not quite, come to rest; he then increased his speed forwards, without the station-master's order; this was at about 1.10 a.m. Two or three minutes after this the collision occurred on the incline towards the bridge over the Lagerlund river.

It seems that the driver of No. 2 paid little or no attention to the green "caution" signal at the south semaphore; but he recognised the green signal first shown by the station-master's hand lamp in the station, and whistled in reply; whether he recognised the colour of the red light that the station-master then substituted for the green is uncertain as he seems not to have slowed down promptly enough. Although No. 2 train slowed down very much at or about the north switch, we do not know why it started again instead of either standing still or backing. When it (No. 2) was about to increase speed again at the north end of the station, a line-man ran along waving a red lamp and doing his best to stop the train. A carriage oiler who was with the luggage guard in the front van of the train is reported to have seen this signal carried by the line-man, but to have taken it for a "line clear" signal, and it is said that this carriage oiler calling out to the engine-driver that he saw the "line clear" signal caused the

driver to speed up his train again. There is no doubt, from the testimony of two witnesses, one of them the wife of the overseer, that this line-man's signal was red. But it is equally certain that another man (not the station-master) was, during the same period, showing on the platform a green light, which he kept stationary, not moving. Both these lights are said to have been visible at the same time, but the red one was moved vehemently, and its carrier ran with it in front of the train until the latter overtook him, whilst the green one was, as just stated, stationary. Although the green one evidently ought not to have been there, no confusion between them ought to have been possible. It seems to me that if either the engine-driver (C. F. Anderson) of No. 2 train or his carriage oiler (C. F. Larson) were colour-blind, this defect might explain either the initial lack of attention to the "caution" signal of the semaphore, or the failure to notice the change of the station-master's hand lamp from green to red; and that in the hurry and confusion such colour-blindness would certainly much increase the risks of a wrong reading of the moving red lamp carried by the running line-man (Johansson) and the stationary green light held by the extra station man (Jakobson). As both this engine-driver (Anderson) and the oiler (Larson) were killed nothing could be proved as to their colour-vision.

CASE 33.—Board of Trade Report, No. 3484, February 1st to 16th, 1888 (50). "Toronto," British steamer about 3300 tons, and "Freidis," Norwegian sailing vessel about 630 tons. On the night of January 17th, 1888, at about 11.37, the vessels collided, the starboard side of the "Freidis" striking the port side of the "Toronto" and rubbing all along the latter. Of the fourteen men on board the "Freidis" only one, the captain, was saved, and as he had been below off duty until just before the accident he could say nothing as to how the vessels came together. On the "Toronto," the second officer and the fourth officer, both in charge on the upper bridge, and

the captain, who came up, saw the red light of a vessel about 2 points on their starboard bow at about 11.30; the quartermaster, at the wheel on the upper bridge, also saw the same red light about the same time. The look-out man, however, stated, "apparently without animus," that he saw a green light about 2 points on the starboard bow, that he reported it to the bridge three times between his first sighting it and the time of the collision, and that he never saw a red light at all. He appears to have been pressed on the point by the fourth officer a couple of days after the accident and before the official inquiry, and to have declared, when told that all the four officers saw the red, "that he saw the green only and that he would say so." It need hardly be added that no examination of his colour-vision was made in connection with the inquiry! But it is difficult to believe that he was not colour-blind. The collision, however, was not caused by any confusion between the red and green lights, and if the look-out man was, as I believe, colour-blind, his defect would not, in the circumstances, have added materially to the risk of accident. The accident was caused by the "Toronto" going at too high a speed "on a dark night in a frequented channel," and not slacking speed in sufficient time when another vessel was approaching, and for this the captain alone was adjudged to be in default.

CASE 34.—Stranding of the "Violet" (50). The steamer "Violet" carrying 1550 tons of coal from Newcastle to London ran aground on the *Long Sand* sandbank at the mouth of the Thames about 6 a.m. on January 10th, 1892. Weather fine, but hazy, sea smooth. Four fixed lights were factors in the case. The first, *i.e.*, most easterly, of these, the *Shipwash* light, was passed normally, at 3.45 a.m. from a quarter to half a mile off on the vessel's port-beam. The next was the *Sunk Light*, which ought to have been passed on the steamer's starboard side, but owing to the master having set the vessel's course, soon after passing the *Shipwash*, too much south and too little west, was actually passed on

the port side. This course seems to have been set by the master by inadvertence or by a slip of the tongue, but having given it to the mate just after 4 o'clock the master went below, and although he came on deck more than once during the next hour and a half he seems to have taken the mate's word as to the light then in view being the Sunk Light. Both officers admitted at the inquiry that they made no attempt to verify this opinion. The light they took for the Sunk was, as afterwards found out, the *Long Sand* light. This error led to the master altering the course about 5 to 5.30 o'clock, and this alteration took the vessel on to the Long Sand sands. Had the right course been set after the Shipwash, the corresponding change of direction would have led to the "East Swin" channel, where the fourth light, the *Gun-fleet*, would have been passed. As a matter of fact the Sunk light was probably taken for the Gun-fleet, as the Long Sand was undoubted taken for the Sunk.

The Court found that "The casualty was caused by the unsafe and improper courses set and steered after passing the Shipwash light, and by the total disregard on the part of the master and mate of the character of the light subsequently seen."

After the close of the inquiry the Court discovered that the mate's certificate (certificate qualifying him for master) bore the memorandum in red ink—"This officer has failed to pass the examination in colours. (Signed) J. Clark Hall, Registrar-General." They comment in strong terms on the danger of granting a master's certificate and entrusting the command of a vessel to such a man, but come to no other conclusion, as to this particular case, than that the mate's defect "under certain circumstances might have had an important bearing upon the subject of the investigation."

The certificate is dated December 9th, 1890, and the colour-test was presumably that of 1885, naming the colours of certain glasses in a lantern, and sorting according to their colour a number (40) of coloured cards previously

mixed up together.* We may fairly assume that he was in fact quite markedly colour-blind.

Of the two lights, the Sunk and the Long Sand, that were mistaken, the former is a revolving red and white, period forty-five seconds, the latter a group flashing white light, flash two seconds, eclipse six seconds, flash two seconds, eclipse twenty seconds, in every half minute. Clearly a colour-blind would be more likely than a normally sighted man to fail in distinguishing with promptitude between them. As according to my reading of the evidence the master took a good deal for granted from the mate between about 4.30 and 5.30 o'clock, it seems to me that the mate's colour-blindness may easily have caused the accident considering the disadvantage he was under from the wrong course originally set by the master shortly before 4 o'clock, and the hazy atmosphere.

One can readily understand that the mate might at the inquiry rather admit a negligence that was shared by the master than own to his own colour-blindness.

This master and mate had made six previous voyages together between March, 1891, and the present one, January, 1892, and two of these had involved navigation of the estuary of the Thames. Whether these circumstances led the master to leave him more than usual responsibility on the accident voyage cannot be either affirmed or denied, but it is perhaps not unlikely. We do not know whether the previous voyages through the Thames estuary were made by night or daylight.

CASE 35.—“Cambrian Princess” and “Alma” (35). About 2.15 a.m. on April 1st, 1902, the British sailing ship “Cambrian Princess,” gross tonnage 1394 tons, coming from Peru to Antwerp with guano at a speed of $3\frac{1}{2}$ knots, was run into almost at right angles on her port side about 13 feet from her stern by the overtaking British steamer “Alma,” 1145 tons, bound from Southampton to Havre, going at 17 knots. The collision occurred in the English

* Appendix 4 to *Minutes of Evidence of Report of Departmental Committee* (13), 1912, p. 133.

Channel, eight miles from the Owers Lightship. The "Cambrian Princess" sank in three or four minutes and 11 of her total 22 hands were lost. All lights were distinctly visible a mile or more off though there was fog nearer the land. It appears that very shortly before the collision, perhaps fifteen minutes, the second officer of the "Alma," who was in charge, sighted a bright light, that was afterwards proved to have been the stern-light of the "Cambrian Princess," nearly ahead, that he then looked at it through his glasses, "and although uncertain of its true character and the direction in which it was proceeding, came to the conclusion that it was either a pilot boat or a fishing vessel." When his vessel had approached nearer he suddenly saw the sails and hull of the "Cambrian Princess," but too late for anything effectual to be done to avoid collision. The Court found that the accident was caused by the second officer of the "Alma" mistaking the character of the bright light and the direction in which it was proceeding, when first sighted, and then approaching so close before discovering his error that nothing could be done. He was found guilty of an error of judgment only.

Needless to add this officer was not required to have his sight tested after the accident! although the difficulty he had in interpreting the character of the stern-light of the vessel he was overtaking was just such a difficulty as an ordinary colour-blind would be likely to have. He passed the sight tests of the Board of Trade on June 19th, 1893 (coloured cards and glasses); January 14th, 1895, and May 3rd, 1897 (the wool test.) It seems that no question as to his visual competency was raised at any of these examinations.

It is to be added that the position of the two vessels was such that the "Alma" could not at any time see either the red or the green light of the "Cambrian Princess," although the latter vessel had seen both the green light and the bright (mast-head.—E.N.) light of the "Alma" a few minutes before the collision. The second

officer of the "Alma" therefore had to decide the colour of only the bright (*i.e.*, "white") stern-light of the "Cambrian Princess."

CASE 36.—In the year 1902 a collision occurred on the lower Elbe at Nienstodten between the steam tug "Hansa" and the passenger steamer "Primus" (7 and 31), in which 107 lives were lost. At the time of the legal proceedings the possibility of the accident having been caused by colour-blindness was often discussed in the press. No steps appear to have been taken to find out whether the captain of the "Primus" was colour-blind or not until the spring of 1907, when, in consequence of an article by the late Professor W. Nagel (42) in the *Hamburgischen Korrespondenten*, the man was examined and found to be colour-blind, and, according to Guttman (40), had confused the red with the green side light of the other vessel. Dr. Sannemann of Hamburg (44), who has kindly made further inquiries for me from the doctor who carried out this examination, writes (on April 26th, 1913) confirming the above statement, and adds that the examining doctor is now not quite sure whether there was or was not defect of form-vision also. He states that the visual efficiency of this captain, all in all, was found not to fulfil the requirements for service at sea, but for the officers of small passenger steamers, such as the "Primus" was, plying only between places on the Elbe, no definite standard of vision is required.

CASE 37.—Galloway (37) records a case of a trawler that went ashore in a snow-storm when in charge of a mate whose form-vision was very defective, R. being only $\frac{6}{36}$, not improvable; L. $\frac{6}{18}$ partly, raised to $\frac{6}{6}$ partly by — 1.D; traces of old keratitis; colour vision normal. It does not appear certain that this casualty could have been avoided if the mate's sight had been perfect.

CASE 38.—The running down of the iron-clad "Vanguard" by the iron-clad "Iron Duke" on September 1st, 1875, has been held to have been due to the defective form-vision of one of the look-out men. The vessels were in line

distant from each other two and a half to three cable-lengths (say 650 to 700 yards), speed 8 knots, the "Vanguard" leading. The weather was clear till about 12.45 p.m. (midday), when the "Vanguard" ran into a wall of fog so dense as to hide objects more than a ship's length away, and the "Iron Duke" thus became invisible. The captain of the "Vanguard" stated that as soon as his ship entered the fog he ordered her speed to be reduced from 8 knots to 6 and then to 5, and was just about to signal to the "Iron Duke" when the look-out on the starboard cathead, a seamen named Michael Murphy, reported a sail right ahead crossing the bows of the "Vanguard" from port to starboard. Murphy himself, in his evidence, said he saw what he took to be the hull of the vessel in the "loom upwards from a lull in the fog." It is not clear whether the captain saw Murphy's ship or not, but at any rate she was not seen by any one of four other officers or men who were on look-out duty on various parts of the "Vanguard," although some of them were in a position to see her. The "Iron Duke" ran into the "Vanguard" within apparently from two to three minutes after Murphy's report of the vessel, the "Vanguard's" speed being 6 knots at the time. Some days later a Swedish or Norwegian sailing vessel ("bark") with timber reported having escaped being run down by a man-of-war on the day when the disaster to the "Vanguard" occurred and at about the same place. Murphy, the man who saw what he thought was the ship ahead, had imperfect sight, though we do not know how imperfect, and it has been suggested that the ship he saw was a "phantom" ship due to his bad sight; he had at various times been under treatment for his eyes at the naval sick quarters at Yokohama and elsewhere; his eyes were examined by two medical men during the progress of the court-martial, and they reported that "he has fair average sight and can see distinctly objects from 300 to 500 yards distant." We may take it, therefore, that he probably had sight enough to see an object like the hull

of a ship such as he reported at comparatively close quarters even in some degree of fog.

The real question is whether the captain of the "Vanguard" slowed his vessel down because of the fog into which he had run, or in order to avoid running down a ship reported to be crossing his bows. If the latter were the case then the collision might fairly be set down to the impaired vision of the look-out Murphy, who reported a vessel that none of the other look-out men saw. As I read the report of the court-martial given in *The Times*, however, the order to slow was given because of the fog, and before Murphy reported his so-called "phantom" ship ahead; and if this be correct we cannot hold Murphy's visual defect to have had any share in what happened, whether what he said he saw was a real ship or not. As the whole affair occupied only a very few minutes the order in which the various events took place must have been very difficult to decide in retrospect, and it may be that the slowing down was due partly to one of the above possible causes and partly to the other.

CASE 39.—The railroad accident at Arlesey Station (50) on the Great Northern line, four miles north of Hitchin, has been cited as another instance of the unaccountable casualties that would be readily explicable by colour-blindness or other defect of sight, but as both the driver and stoker of the blameworthy train were killed the point could not have been settled even if it had been customary to include questions relating to vision in the official inquiries.

This accident took place at 4 p.m. on December 23rd, 1876. Whilst a luggage train was being shunted two of its trucks left the rails and prevented it from clearing the down line. The signals had been set at "danger" half an hour before these trucks fouled the line, in order to give time for the luggage train to get across and clear, and they remained so until the collision occurred.

At 4 p.m. an express from London going at nearly full speed dashed into the luggage train, the driver, stoker

and three other persons being killed and thirty injured. At the inquiry the head guard of the express stated that he could not see the signals very well, not further than 200–300 yards, “on account of the dulness of the weather,” and he presumed that the driver could not see them much further off; it is to be noted that snow came on soon after the accident.

The case is just one of those that, in the absence of gross carelessness on the part of the engine-driver, might readily be explained if he were somewhat colour-blind or had defective form-vision.

CASE 40.—“Nereid” and “Killochan” (*The Times*, February 5th, 1889, p. 7). There is no mention of any doubt as to the colour of any of the signals in this case, but, as usual, no testing of the sight of the implicated survivors appears to have been made.

The sailing ship “Killochan” was going up the Channel for London, and after passing Beachy Head was accompanied by a tug, which, having offered to tow and been refused, followed at a short distance behind on the “Killochan’s” port side. The “Killochan’s” speed was about 6 knots, the “Nereid’s” speed much higher, and increased by a tide of $3\frac{1}{2}$ knots in her favour, the weather heavy but clear and fine and all the lights clearly seen.

The collision occurred two miles from Dungeness between 8 and 9 o’clock on Sunday night, February 3rd, 1889, the steamer “Nereid” striking the sailing vessel “Killochan” almost at right angles in the forepart of her starboard rigging according to the evidence of the master of the tug, who was about 100 yards astern of the “Killochan” at the time, but the captain of the steamer “Nereid” said the “Killochan” struck the “Nereid” on her port bow. Both vessels sank within five minutes of colliding; twenty-three men drowned, including the captain of the “Killochan.” Each vessel accused the other of altering course. The master of the tug said the “Nereid” altered her course when well on starboard side of the “Killochan,” and the second mate of the “Killochan” confirmed this by saying

he saw the "Nereid's" red light but never saw her green light. Both said the "Killochan" did not alter her course by starboarding, and the tugmaster appealed to his compass as showing this. The captain of the "Nereid" denied porting his helm and accused the "Killochan" of altering her course by starboarding. As both the vessels were in proper relative position when they sighted one another no alteration of course of either was needed; their lights were green to green and all clearly visible. If the man in charge of either vessel were colour-blind and mistook the green light of the other vessel for red, he would naturally alter his course in such a way as would explain this disaster. The captain of the "Killochan" was drowned, and as the evidence of those who spoke for each ship was conflicting the accident remains unexplained.

CASE 41.—Railway collision at Guisborough, North Eastern Railway (50). In this case an excursion train (train No. 2) returning from Saltburn to Leeds on January 1st, 1908, ran into the rear of a train of empty carriages (train No. 1). The empty train, which had been at a standstill at the station, had just started to move forward again. The excursion train was going at a rate of from 30 to 40 miles an hour until a very short distance before it ran into the empty train. Time of collision 10.55 p.m., night clear and dry, rails dry, all the brakes (Westinghouse automatic) in good order. All the signals were at danger (red) against No. 2, but the driver of this train stated in his evidence that the first of them was, when he sighted it, in a doubtful position, partly green and partly red, and that as it showed to him more green than red he acted as if it were green and did not slacken speed; in this he was wrong, the instruction being, when a signal is doubtful, act as if it were at "danger." But the signalman on duty in the box next before this signal, to whom it was as visible as to the driver of No. 2, asserted that it was a clear red at the time the driver of No. 2 said it was partly green. The next two signals were at danger, but the driver of No. 2 stated that he did not see either of them because he

was attending to his "injector," and there was also obscuration by steam and smoke from the engine. As his fireman, who was comparatively new to this part of the railway, was firing his engine whilst the train was passing these signals, his evidence was inconclusive. The driver of No. 2 had been in the service of the company thirty-two years, and a driver nearly ten years, and there was no record of his ever having run past a signal before. Was quite sober, and had never been known to be in liquor. As usual no inquiry or examination as to his sight was instituted after the accident. I entirely agree with the writer of the annotation in the *British Medical Journal*, of April 4th, (1908, i, p. 830) that a man suffering from tobacco amblyopia would be likely to make just such mistakes about his signals as the driver of No. 2 train actually did make. It should be added that such amblyopia would have come on probably within some weeks, or at longest some months, of the accident, and further it would be less likely than usual that his mate could help him in a difficulty if, as the record seems to show, the two men had worked together for only a short time.

CASE 42.—"Eagle" and "Cyelse" (50), Board of Trade Report No. S. 319. In this case the steamer "Cyelse," 236 tons gross, ran into and sank the fishing steamer "Eagle," 61 tons gross, in Milford Haven soon after 5 p.m. on December 11th, 1912, with loss of five lives. The "Eagle" was entering the Haven and kept a straight course, E. by S. $\frac{1}{2}$ S., at a speed of about 5 knots. The "Cyelse" was leaving the Haven on a course supposed to be W. by N. $\frac{1}{2}$ N. parallel to the "Eagle's" course, speed about 8 knots. "Eagle" sighted "Cyelse" about a mile off, and observed (1) "Cyelse's" mast-head and port (red light) rather on her ("Eagle's") port side, (2) all three lights of "Cyelse," (3) then for a moment "Cyelse's" green shut in, but (4) almost immediately it was opened again full on "Eagle's" port side, and "Cyelse" struck port side at an angle of 45 degrees. The look-out on the "Cyelse" stated that he saw only a

white light rather on his starboard side, and thinking it was the white riding light of a vessel at anchor, took no further notice of it ; two or three minutes later he saw a mast-head light and a red light close to on his starboard side, and immediately afterwards, in spite of ordering full speed astern, struck the port side of the "Eagle."

In this case it seems probable that the look-out on the "Cyelse" took the green light of the "Eagle" for a white riding light of an anchored vessel and did not keep a true course. It is much to be regretted that his colour-vision was not examined after the accident ; there was no reason to suspect that he was in liquor.

I mention, but do not enumerate, the two following accidents, because, though the question of defective sight has been mentioned in connection with them, there is no positive evidence on the point in either case, whilst other explanations that seem adequate and quite as probable were forthcoming in both.

The collision between the Cunarder "Oregon," 7300 tons gross, and an unknown schooner on March 14th, 1886 (50), (Board of Trade Report, No. 2900), has been sometimes mentioned as one of the class of which visual defects might furnish the explanation. I have read the report carefully, and cannot myself find in it any reason for suspecting that the disaster was due to any defect of sight. The extra second officer who ought to have been supervising the foreward look-out men had been temporarily taken off this duty to attend to the preparations for getting the mail-bags on deck, and it was considered by the Court of Inquiry that this led to the forward look-out's failing from mere carelessness to notice the lights of the approaching schooner in time.

At about 2 a.m. on Tuesday, October 15th, 1907, a very bad railway accident occurred at Shrewsbury Station (50) to an express train travelling at from 50 to 60 miles an

hour. It was caused by the driver running past the signals that were at "danger." He (the engine-driver) was said to have had his sight tested eight months previously. If he were suffering from tobacco amblyopia at the time of the accident, as is quite possible, his failure to see the danger signals would be natural enough and could be easily explained ; but as he was killed no inquiry was possible.

His time record showed that he had been driving, and therefore out of bed, for the whole of four nights out of the six immediately preceding the accident ; that although aged 51, of many years' service and sober, he had twice before run past signals at danger, and four times run through stations at which he was booked to stop apparently from carelessness in misreading his "time book," and that on the night of the accident he had as fireman a man with whom he had never worked until two days before, and who therefore would not know the "personal equation" of the driver. Lieut.-Col. York, who conducted the official inquiry, came to the conclusion from all the circumstances that the driver (Martin) was probably dozing or actually asleep on his footplate at the time of the disaster, and he quotes from a letter sent to him by an old railway man to the effect that men preparing for night duty do not always go to bed in the day as they are supposed to do, and further, that he (the writer of the letter) knows how easily a man can go to sleep whilst travelling on an engine at night.

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(12) *Report of the Departmental Committee on Sight Tests*, 1912. This Committee was appointed by the Board of Trade on June 22nd, 1910.

(13) "Minutes of Evidence and Appendices to the above Report," *Blue Book*, 1912. [Cd. 6319.]

(14) *Invention*, vol. xi, p. 1155 (December 28th, 1889).

(15) *Transactions of the Seventh International Medical Congress*, London, 1881, Section Ophthalmology, pp. 72–75.

(16) *Annual Report to the Secretary of the Treasury for the Fiscal Year ended June 30th, 1880*, Washington Government Printing Office, 1880; p. 6, under date November 24th, 1880.

(17) ARMSTRONG, S. T., M.D., Ph. D., Passed Assistant Surgeon United States Marine Hospital Service.—*Brit. Med. Journ.*, January 28th, 1888, i, 188.

(18) BARRETT, Dr. T. W., and ORR, Dr. W. F.—“The Wreck of the ‘Australia,’” *The Lancet*, October 29th, 1904, ii, 1202, 1904. Referred to also in *Brit. Med. Journ.*, October 19th, 1912, ii, 1025 (Discussion).

(19) NETTLESHIP, E.—“Report of Departmental Committee on Sight-tests,” Appendix H. *Minutes of Evidence and Appendices*, 1912, p. 156.

(20) NETTLESHIP, E.—*The Brit. Med. Journ.*, 1887, ii, p. 505. Remarks in the Report of meeting in Dublin.

(21) JEFFRIES, B. JOY, M.D., M.A.—Two letters: (1) January 12th, 1913, to Mr. R. Brudenell Carter, who allowed E. Nettleship to see it, and (2) February 11th, 1913, to E. Nettleship, supplemental to the previous one. (See 27).

(22) GINTL, Dr. HEINR. E., Central-Inspector der Lemberg—Czernowitz—Jassy Bahn, *Ueber den Farbensinn und dessen Einfluss auf die Verkehrssicherheit der Eisenbahnen*.

Zeitung des Club österreichischen Eisenbahn-Beamten, I Jahrgang, 1877–78, S. 93–103. XXI Club-versammlung am April 2nd, 1878.

Also given by Geissler, Dr. med. Arthur, in his “Ueber Farbenblindheit. Nach den neuern Untersuchungen zusammengestellt,” in *Schmidt's Jahrbucher Gesammten medicin*, Bd. cxc, pp. 73–113 (footnote to p. 107, 1881.) Geissler's paper also as *Separat-Abdruck*, pp. 1–40, quotes the same case from Gintl at pp. 34–35.

(23) WALTON, HAYNES.—*The Times*, January 3rd, 1877, p. 8; letter headed “Colour Blindness.”

(24) MINDER, F.—“Beiträge zur Lehre von der Farbenblindheit,” *Inaug. Dissert.*, pp. 38. Berne, 1878.

(25) STRETTON, CLEMENT E., C.E.—*The Engineer*, vol. lxviii, p. 472, December 6th, 1889.

(26) Letter signed "Thirty Years Railway Man." *Invention*, vol. xi, p. 1153, December 28th, 1889.

(27) CARTER, R. BRUDENELL.—*Nature*, vol. xlii, pp. 55–61; a lecture delivered at the Royal Institution on May 9th, 1890. The case as there given supplemented by a letter from Dr. Joy Jeffries of Boston to Mr. Brudenell Carter dated January 12th, 1913. (*See* 21.)

(28) HOLMGREN, Prof. DR. F.—"De la Cécité des Couleurs dans ses Rapports avec les Chemins de Fer et la Marine." *Traduit du Suédois avec l'autorisation de l'Auteur*. Stockholm, 1878.

(29) HOLMGREN, Prof. DR. F.—Two letters to the Swedish newspaper *Aftonbladet* in May, 1876, arising out of the agitation that followed the Lagerlunda accident.

(30) Editorial paragraphs from the *Upsala-post*, *Aftonbladet* and *Östgöta-Correspondenten* in 1876, referring to colour-blindness in railway men and to the Lagerlunda accident.

(31) Geissler.—*See* Gintl (22).

(32) ALLANDER, ALLAN.—Pamphlet in Swedish. Title in English, "*Pamphlets on Railway Matters. No. 1: Lagerlunda-Malmslätt. Lecture delivered on November 2nd, 1912, before the Society of the Upper Employés of the State Railways.*" Stockholm, published by Robert Holmberg.

(33) "Toronto" and "Freidis" collision, January 17th, 1888. *Board of Trade Report*, No. 3484, February 16th, 1888.

(34) "Violet" stranding. January 10th, 1892. *Board of Trade Report*, No. 4456, February 3rd and 4th, 1892; and official supplementary information as to some previous voyages of the master and mate.

(35) "Cambrian Princess" and "Alma" collision. April 1st, 1902. *Board of Trade Report*, No. 6368, May 9th, 1902.

(36) Letters from Dr. Sannemann, Hafenarzt, Hamburg,

dated February 27th and April 26th, 1913. See also Nagel (8).

(37) GALLOWAY.—“The Board of Trade Sight Tests, with Twelve Illustrative Cases,” *British Medical Journal*, 1910, April 16th, Case X. Also *Report of Departmental Committee; Minutes of Evidence* (See 13). Questions 1501–1505.

(38) NAGEL, W.—Farbenblindheit u. Verkerssicherheit zur See u. auf der Eisenbahn. An important article in the *Rundschau täglichen*, July 23rd, 1907.

(39) KÖLLNER.—Die Störungen des Farbensinness, ihre klinische Bedeutung und ihre Diagnose, pp. 1–428. Berlin, 1912.

The subject of accidents due to colour-blindness is mentioned at p. 63 and Nagel's paper (8) referred to, but no cases are quoted.

(40) GUTTMANN, A.—Eigene Erfahrungen eines Farbenschwachen auf Binnengewässern und auf See. *Hansa Deutsche Nautische Zeitschrift*, 44 Jahrgang, No. 15, April, 1907. Hamburg. (Pp. 186–189.)

(41) NUEL.—*Ann. d'Oculistique*, t. lxxxii, pp. 64–72, Juillet et Août, 1879.

I have also to acknowledge with gratitude replies to inquiries and information received from (42) Professor GULLSTRAND (Upsala), (43) Dr. PRINZ (Freiburg im Breisgau), (44) Dr. SANNEMANN, Hafenarzt (Hamburg), (45) Dr. ZEITLMANN (Munich), (46) Prof. TRUC (Montpelier), (47) Prof. LANDOLT (Paris), (48) Dr. B. JOY JEFFRIES (Boston, U.S.), (49) Mr. E. W. DAHLGREN, Librarian of the Royal Library, Stockholm, and (50) (through the Board of Trade) several British Consuls, and reports of British and Foreign accidents.

Postscript to Case 14 (p. 18).—I have just received, through the Board of Trade, the official Danish Report of this collision, which occurred at 3.40 a.m. on October 24th,

1906. Nagel's account is confirmed in essentials. The mate, æt. 30 years, standing close by the steersman and seeing what he thought was the red light of a sailing vessel on his port side, gave the order to "port the helm," and immediately afterwards an urgent order "hard a-port," and himself seized the helm to help. The collision took place a few minutes later. Just before the collision, however, the mate saw the light green. Neither the steersman nor another sailor who was also on the bridge with the mate until a few minutes before the collision saw any red light. The mate was stunned by a broken mast in the collision (and was in hospital for some time after). Between two and three weeks later he was examined with Nagel's dots by Dr. Koogh, of the Physiological Laboratory, who found that he confused the greys and greens, but made no mistakes with the reds. A few days after this Dr. Bjerrum, Professor of Ophthalmology, also found some degree of the same defect; but at a third and more exhaustive examination made rather more than a month after the collision, by means of Nagel's cards (1905), Stilling's tables (1889), Holmgren's and other wools, a lantern and spectrum colours, no defect for colours was found (the lantern and spectrum tests not fully described); there was no ophthalmoscopic sign of disease and the sight was "normal." The mate is said to have been a sober man who did not drink spirits. Unfortunately we are not told whether he smoked, nor does central scotoma appear to have been sought for. It seems practically certain that his colour-vision was somewhat defective at the time of the collision not only from the expert medical evidence, but because the Court pointed out to him, and he admitted, that, the course and positions of the two ships being as they were, only the green light of the "Onni" could have been visible to the "Heimdall." A moderate degree of tobacco amblyopia becoming cured whilst he was in hospital affords the most likely explanation.—E. N., July 6th, 1913.







