

PHYSIOLOGY

Discovery of Color-Blindness

"A Classic of Science"

**Dalton Lived in a Blue and Yellow World;
He Could See No Red or Green Colors**

EXTRAORDINARY FACTS RELATING TO THE VISION OF COLORS: with observations. By Mr. John Dalton. Read October 31st, 1794. Published in Memoirs of the Literary and Philosophical Society of Manchester, Vol. V. London and Manchester, MDCCXCVIII (1798).

IT HAS been observed, that our ideas of colours, sounds, tastes, &c. excited by the same object may be very different in themselves, without our being aware of it; and that we may nevertheless converse intelligibly concerning such objects, as if we were certain the impressions made by them on our minds were exactly similar. All, indeed, that it required for this purpose, is, that the same object should uniformly make the same impression on each mind; and that objects which appear different to one should be equally so to others. It will, however, scarcely be supposed, that any two objects, which are every day before us, should appear hardly distinguishable to one person, and very different to another, without the circumstance immediately suggesting a difference in their faculties of vision; yet such is the fact, not only with regard to myself, but to many others also, as will appear in the following account.

I was always of opinion, though I might not often mention it, that several colours were injudiciously named. The term *pink*, in reference to the flower of that name, seemed proper enough; but when the term *red* was substituted for pink, I thought it highly improper; it should have been *blue*, in my apprehension, as pink and blue appear to me very nearly allied; whilst pink and red have scarcely any relation.

In the course of my application to the sciences, that of optics necessarily claimed attention; and I became pretty well acquainted with the theory of light and colours before I was apprized of

any peculiarity in my vision. I had not, however, attended much to the practical discrimination of colours, owing, in some degree, to what I conceived to be a perplexity in their nomenclature. Since the year 1790, the occasional study of botany obliged me to attend more to colours than before. With respect to colours that were *white*, *yellow*, or *green*, I readily assented to the appropriate term. *Blue*, *purple*, *pink*, and *crimson* appeared rather less distinguishable; being, according to my idea, all referable to *blue*. I have often seriously asked a person whether a flower was blue or pink, but was generally considered to be in jest. Notwithstanding this, I was never convinced of a peculiarity in my vision, till I accidentally observed the colour of the flower of the *Geranium zonale* by candle-light in the Autumn of 1792. The flower was pink, but it appeared to me almost an exact sky-blue by day; in candle-light, however, it was astonishingly changed, not having then any blue in it, but what I called red, a colour which forms a striking contrast to blue. Not then doubting but that the change of colour would be equal to all, I requested some of my friends to observe the phenomenon; when I was surprised to find they all agreed, that the colour was not materially different from what it was by day-light, except my brother who saw it in the same light as myself. This observation clearly proved, that my vision was not like that of other persons—and, at the same time, that the difference between day-light and candle-light, on some colours, was indefinitely more perceptible to me than to others. It was nearly two years after that time, when I entered upon an investigation of the subject, having procured the assistance of a friend, who, to his acquaintance with the theory of colours, joins a practical knowledge of their names and constitutions. I shall now proceed to state the facts ascertained. . . .



From an Old Engraving.

JOHN DALTON

The chemist and author of the atomic theory, who was color-blind.

Of My Own Vision

It may be proper to observe, that I am short-sighted. Concave glasses of about five inches focus suit me best. I can see distinctly at a proper distance; and am seldom hurt by too much or too little light; nor yet with long application.

My observations began with the solar spectrum, or coloured image of the sun, exhibited in a dark room by means of a glass prism. I found that persons in general distinguish six kinds of colour in the solar image; namely, *red*, *orange*, *yellow*, *green*, *blue*, and *purple*. Newton, indeed, divides the purple into *indigo* and *violet*; but the difference between him and others is merely nominal. To me it is quite otherwise—I see only two or at most *three* distinctions. These I should call *yellow* and *blue*; or *yellow*, *blue* and *purple*. My yellow comprehends the *red*, *orange*, *yellow* and *green* of others; and my *blue* and *purple* coincide with theirs. That part of the image which others call red, appears to me little more than a shade, or defect of light; after that the orange, yellow, and green seem *one* colour, which descends pretty uniformly from an intense to a rare yellow, making what I should call different shades of yellow. The difference between the green part and the blue part is very striking to my eye: they seem to be strongly contrasted. That between the

blue and purple is much less so. The purple appears to be blue much darkened and condensed. In viewing the flame of a candle by night through the prism, the appearances are pretty much the same, except that the red extremity of the image appears more vivid than that of the solar image.

I now proceed to state the results of my observations on the colours of bodies in general, whether natural or artificial, both by day-light and candle-light. I mostly used ribbands for the artificial colours.

Red
(By day-light)

Under this head I include *crimson*, *scarlet*, *red*, and *pink*. All crimsons appear to me to consist chiefly of dark blue; but many of them seem to have a strong tinge of dark brown. I have seen specimens of *crimson*, *claret*, and *mud*, which were very nearly alike. *Crimson* has a *grave* appearance, being the

reverse of every shewy and splendid colour. Woollen yarn dyed crimson or dark blue is the same to me. *Pink* seems to be composed of nine parts of light blue, and one of red, or some colour which has no other effect than to make the light blue appear dull and faded a little. *Pink* and light blue therefore compared together, are to be distinguished no otherwise than as a splendid colour from one that has lost a little of its splendour. Besides the pinks, roses, &c., of the gardens, the following British *flora* appear to me blue; namely, *Statice Armeria*, *Trifolium pratense*, *Lychnis Floscuculi*, *Lychnis dioica*, and many of the *Gerania*. The colour of a florid complexion appears to me that of a dull, opaque, blackish blue, upon a white ground. A solution of sulphate of iron in the tincture of galls (that is, dilute black ink) upon white paper, gives a colour much resembling that of a florid complexion. It has no resemblance of the colour of blood. *Red* and *scarlet* form a genus with me totally different from pink. My idea of red I obtain from *vermillion*, *minium*, *sealing wax*, *wafers*, a *soldier's uniform*, &c. These seem to have no blue whatever in them. *Scarlet* has a more splendid appearance than red. Blood appears to me red; but it differs much from the articles mentioned above. It is much more dull, and to me is not unlike that colour called *bottle-green*. Stockings spotted with blood or with dirt would scarcely be distinguishable.

Red
(By candle-light)

Red and *scarlet* appear much more vivid than by day. *Crimson* loses its blue and becomes yellowish red. *Pink*

forms an excellent contrast to what it is by day. No blue now appears; yellow has taken its place. *Pink* by candle-light seems to be three parts yellow and one red, or a reddish yellow. The blue however, is less mixed by day than the yellow by night. *Red*, and particularly *scarlet*, is a superb colour by candle-light; but by day some reds are the least shewy imaginable: I should call them dark drabs.

Orange and Yellow
(By day-light and candle-light)

I do not find that I differ materially from other persons in regard to these colours. I have sometimes seen persons hesitate whether a thing was white or yellow by candle-light, when to me there was no doubt at all.

Green
(By day-light)

I take my standard idea from grass. This appears to me very little different from red. The face of a laurel-leaf (*Prunus Lauvo-cerasus*) is a good match to a stick of red sealing-wax; and the back of the leaf answers to the lighter red of wafers. Hence it will be immediately concluded, that I see either red or green, or both, different from other people. The fact is, I believe that they both appear different to me from what they do to others. *Green* and *orange* have much affinity also. *Apple green* is the most pleasing kind to me; and any other that has a tinge of yellow appears to advantage. I can distinguish the different vegetable greens one from another as well as most people; and those which are nearly alike or very unlike to others are so to me. A decoction of bohea tea, a solution of liver of sulphur, ale, &c., &c., which others call brown, appear to me green. *Green* woollen cloth, such as is used to cover tables, appears to me a dull, dark, brownish red colour. A mixture of two parts mud and one red would come near it. It resembles a red soil just turned up by the plough. When this kind of cloth loses its colour, as other people say, and turns yellow, then it appears to me a pleasant green. Very light green paper, silk, &c., is white to me.

Green
(By candle-light)

I agree with others, that it is difficult to distinguish greens from blues by candle-light; but, with me, the greens only are altered and made to approach the blues. It is the real greens only that are altered in my eye; and not such as I confound with them by day-

**The Dinosaur
TRICERATOPS**

which was at first thought
to be a fossil buffalo is the
subject of

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light, as the brown liquids above mentioned, which are not at all tinged with blue by candle-light, but are the same as by day, except that they are paler.

Blue

(By day-light and candle-light)

I apprehend this colour appears nearly the same to me as to other people, both by day-light and candle-light.

Purple

(By day-light and candle-light)

This seems to me a slight modification of blue. I seldom fail to distinguish purple from blue; but should hardly suspect purple to be a compound of blue and red. The difference between day-light and candle-light is not material.

Miscellaneous Observations

Colours appear to me much the same by moon-light as they do by candle-light.

Colours viewed by lightning appear the same as by day-light but whether exactly so, I have not ascertained.

Colours seen by electric light appear to me the same as by day-light. That is, pink appears blue, &c. . . .

Most of the colours called drabs appear to me the same by day-light and

candle-light.

A light drab woollen cloth seems to me to resemble a light green by day. These colours are, however, easily distinguished by candle-light, as the latter becomes tinged with blue, which the former does not. I have frequently seen colours of the drab kind, said to be nearly alike, which appeared to me very different.

My idea of *brown* I obtain from a piece of white paper heated almost to ignition. This colour by day-light seems to have a great affinity to green, as may be imagined from what I have said of greens. Browns seem to me very diversified; some I should call red—dark brown woollen cloth I should call black.

The light of the rising or setting sun has no particular effect; neither has a strong or weak light. Pink appears rather duller, all other circumstances alike, in a cloudy day.

All common combustible substances exhibit colours to me in the same light; namely, *tallow, oil, wax, pit-coal.*

My vision has always been as it is now.

Science News Letter, March 21, 1931

GENETICS

Eye Color Is Not Dependable As Evidence of Paternity

MENDEL'S law of inheritance will not often serve as an aid to the harassed judge who must decide cases of disputed parentage. This natural "law" was recently cited, supplementary to man-made laws, in a case where a man with brown eyes claimed to be the son and heir of a couple, both of whom, it was testified, had blue eyes.

Scientists agree that parents having pure blue eyes do not have brown-eyed children, but this fact will not help the judge as much as it might appear, because many individuals with blue-looking eyes do not have eyes which would be scientifically classified as "pure blue."

Take a close look at the eyes of some blue-eyed person. If you use an ordinary reading or magnifying glass you will very likely discern a dark ring around the pupil of the eye. Or you may see streaks like the spokes of a wheel coming out from the center of the eye. Or you may see tiny flecks of

color scattered over the entire surface.

Brown or black eyes are given their color by a pigment in both the front and back walls of the iris. Eyes without this pigment are completely colorless, but appear pink because of the color of the blood vessels. Such eyes are seen in albinos. Blue eyes have the pigment in the back wall of the iris, but none in the front. The blue look is due to the reflection of light through the colorless front walls.

The color of eyes may also change during the lifetime of an individual as a result of injuries to or diseases of the eye. And there is a normal change due to age. Nearly all infants of the north European races are born with blue eyes, and this color may persist until the child is eight years old. Then when they grow old the color may fade from their eyes, the eye color changing from brown to a pale bluish shade by a process of color absorption similar to that which changes brown hair to gray.

Science News Letter, March 21, 1931

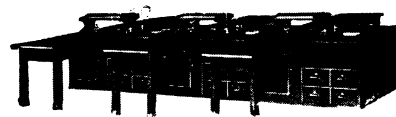
Lincoln Science Desks

Stopped New Building Plans at Mankato, Minn.

Good Counsel Academy Saves 2 rooms then Expands Science Classes

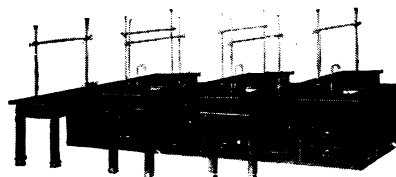
Is Your Old Laboratory Furniture Crowding Your Present School Building?

Don't build a new school until you've considered refurnishing the old laboratories. Perhaps your Science Classes are using too much room. Perhaps by installing Lincoln Science Desks a room or two can be released for other studies, without in any way affecting Science classes. Read what happened in Mankato, Minn.



Lincoln Science Desk No. D-503

Good Counsel Academy was on the verge of starting a new 3-story building. They first checked up on their science classrooms and this is what happened. One twelve-student Lincoln Science Desk and one Instructor's Desk with one of their old Chemistry Desks were installed in the smaller second floor recitation room. This released the old chemistry room and the larger recitation room for other classes. The new equipment made it possible to add Physics to General Science, Biology and Chemistry, the three subjects being taught. The two released rooms relieved the congestion, the new laboratory accommodates more students and the new addition to the school is not needed.



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