PROFESSOR TYNDALL ON LIGHT.

The eminent English scientist and investigator, Professor John Tyndall, has for the first time appeared before a New York audience, and in two masterly discourses has opened a series of lectures on the subject of "Light." Familiar as we are with the admirable works of this learned author, we naturally expected an able and entertaining disquisition on the prolific subject he had selected; but we confess we were unprepared for so excellent, clear and scholarly an elucidation of the most elementary principles of physics. He fairly placed light in a new light, and by his simple explanation of theory and splendid execution of experiments illuminated with the brilliancy of his genius even the dazzling rays from which he drew such treasures of learning and thought.

It is a matter of regret to us that the pressure upon our columns and the rapid sequence of Professor Tyndall's lectures prevent our giving them *verbatim;* but the most interesting and striking portions will be carefully selected and presented as fully as our space will admit. An allusion to the favor with which his books were received in this country, and the circumstances which brought about his visit to the United States, constituted the introductory remarks of the opening discourse. After briefly glancing at the birth of science and in a few words tracing its progress to the time of Newton, the lecturer entered upon his subject proper at its very beginning: The ancients, he said, satisfied themselves that light moved in straight lines; they also knew that these lines, or rays of light, were reflected from polished surfaces and that the angle of incidence was equal to the angle of reflection. This knowledge constitutes our starting point. To the source of light to be employed during the experiments attention was asked, and after alluding to the generation of heat and light by combustion, Professor Tyndall brought together coke points, which being attached to the poles of a small voltaic battery, glowed with a white heat. Whence comes this heat? Suppose, in the first instance, when the thick wire was employed, that we had permitted the action to continue till one hundred grains of zinc were consumed, the amount of heat generated in the battery would be capable of accurate numerical expression. Let the action now continue with this thin wire glowing until one hundred grains of zinc are consumed. Would the amount of heat generated in the battery be the same as before? No, it would be less by the precise amount generated in the thin wire outside the battery. In fact, by adding the internal heat to the external, we obtain for the combustion of one hundred grains of zinc a total which never varies. Here, continued the speaker, we have an illustration of the constant law that in physical nature we have incessant substitution, but never creation.

Professor Tyndall then added some further remarks regarding the electric light, saying that it would constitute the mode of illumination for experimental purposes, and noting the fact that, during the intense glow of the carbon, the eye failed to see the coke points whence the light issued. This, he stated, is due to the spherical aberration of the organ, or in other words, that the circumferential and central rays have not the same focus. To illustrate by means of a lens, the carbon points in the lantern were projected on the screen. The image was faint and nearly obliterated by a halo of light by which it was surrounded. A similar effect is produced in the eye, the blur of light upon the retina being sufficient to destroy the definition of the retinal image of the carbons.

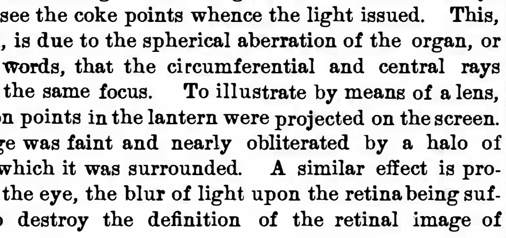
The theoretical defects of the eye were alluded to—its opacity, want of symmetry, lack of achromatism and absolute blindness in part—which, said the speaker, caused an eminent German philosopher to say that, if any optician sent him an instrument so full of faults, he would return it with the severest censure. Referring to the

PROPAGATION OF LIGHT,

its rectilineal nature may be shown by the simple experiment of allowing the rays to pass through a minute orifice into a darkened chamber, where external objects will be projected reversed upon a screen. Every straight ray proceeding from the object stamps its color upon the screen, and the sum of all the rays form an image of the object, which is seen inverted because the rays cross each other in the aperture. To explain this fact, the lecturer made a small perforation in a sheet of tinfoil stretched before the light in his lantern. A single reversed, though blurred, image of the carbon points appeared on the screen. A second aperture produced another image, several orifices a number of images, until if the foil be removed altogether all these bright figures run together and combine to form the circle of clear light.

ILLUSTRATION OF A LAW OF LIGHT.

The law that the angle of incidence is equal to the angle of reflection was experimentally illustrated by the simple apparatus shown in Fig. 1.

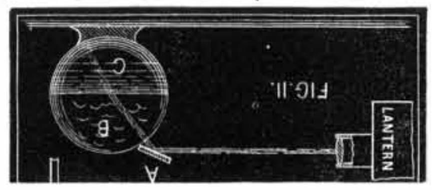


A straight lath is placed as an index perpendicular to a small mirror, A, capable of rotation. The beam of light from the lantern is received upon the glass and reflected back along its line of incidence. The index being turned the mirror turns with it, and at each side of the former the incident and the reflected beams are seen tracking themselves through the dust of the room. This device enables us also to illustrate the law that, when a mirror rotates, the angular velocity of the beam reflecting from it is twice that of a reflecting mirror. That is, referring to our engraving, that while the mirror B passes from the perpendicular to its represented position at an angle of 45°, the beams diverge to a right angle or 90°. This is shown by mere inspection from the position of the index.

Passing to the subject of

REFRACTION,

Professor Tyndall gave a short historical sketch, of the course of inquiry into the phenomenon from the year 1,100, by Alhazen, an Arabian philosopher, to the first discovery of the principle by Willebord Snell in 1621. The bending of the ray in passing from a thin to a dense medium was admirably illustrated by the apparatus shown in Fig. 2,



the lecturer observing that he preferred to produce direct optical proof rather than ask the audience to believe facts from chalk lines on the black-board. A circular vessel with its two sides of clear glass is partially filled with colored or turbid water; A is a movable inclined mirror which may be placed at any point on the periphery of the circle, so as to reflect a beam of light from the lantern either perpendicularly to the surface of the water or obliquely, as represented. Striking the liquid perpendicularly to its surface, the course of the ray is shown in a bright vertical line in the water, so that it is unrefracted. Meanwhile the beam passes unseen through the air above the water. Laughingly observing that he was not addicted to the small vice of smoking, Professor Tyndall lit a cigar and puffed the smoke into the space B, when the track of the ray became clearly apparent. Moving the mirror A to the position shown in the cut, the beam was caused to strike the liquid obliquely, when refraction was clearly produced as represented. Snell's discovery that the quotient (the index of refraction), obtained by dividing the sine of the angle of incidence by the sine of the angle of refraction, was always a constant quantity for the same medium, whatever the obliquity of the rays may be, was then graphically described and referred to as one of the cornerstones of optical science. This was applied by Descartes to the

EXPLANATION OF THE RAINBOW.

The bow is seen when the back is turned toward the sun. Draw a straight line through the spectator's eye and the sun; the bow is always seen at the same angular distance from this line. This was the great difficulty. Why should the bow be always, and at all parts, forty-one degrees distant from this line? Taking a pen and calculating the track of every ray through a rain drop, Descartes found that at one particular angle the rays emerged from the drop almost parallel to each other, being thus enabled to preserve their intensity through long atmospheric distance; at all other angles the rays quitted the drop divergent, and through this divergence became practically lost to the eye. The particular angle here referred to was the foregoing angle of forty-one degrees, which observation had proved to be invariably that of the rainbow.

Newton's experiment with the prism was then described, and served to introduce the subject of the

PHENOMENA OF COLOR.

Various well known experiments were made in the analysis and synthesis of light, proving that the colors of a spectrum may be squeezed or blended together by the aid of a lens; that an image of the carbon points, whence the light issues, may be built up from the colors of the spectrum, and that, in virtue of the persistence of luminous impressions upon the retina, the prismatic colors may be mixed together in the eye itself, the impression of whiteness being the result.

DISPERSION

is the drawing out of a white line into a spectrum. Newton supposed that refraction and dispersion were inseparable, but Dollond showed that, by combining two different kinds of glass colors could be extinguished still leaving a residue of refraction, and he employed this residue in the construction of achromatic lenses. This point was illustrated by throwing a beam through a prism of water and marking with a pointer the position of the spectrum on the screen; then, by adding a prism of glass, a white image was produced, which, compared with the point noted, was still considerably refracted. The refraction and dispersion of bisulphide of carbon, as compared with water, was alluded to in order to show the great extent and richness of color of the spectra of the former substance.

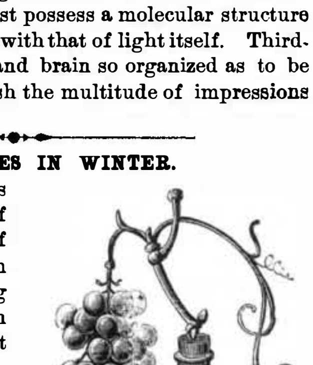
WHAT IS COLOR?

Natural bodies have showered upon them, in the white light of the sun, the sum total of all possible colors, and their action is limited to the sifting and appropriating from this total the colors which really belong to them and rejecting those which do not. The portion rejected gives them their hue. But what is black? Throwing a brilliant spectrum upon the screen, the lecturer placed a piece of black ribbon in succession in the different colors. It quenched all, and consequently blackness is the result of the absorption of the constituents of solar light. Taking a second piece of ribbon he held it in the red portion of the spectrum; it appeared as black as the first piece. He then moved it along until it reached the green, when it appeared of a vivid shade of that color. Therefore the ribbon absorbs all the red and yellow light and offers mere darkness to the eye; while it rejects the green and blue shades, appearing of its proper hue. The same was similarly shown with a red ribbon, which absorbed the green color and rejected the red. Why is it that on looking at objects through a red glass, all are tinged with that hue? This was answered by passing the dispersed rays through such a colored glass, when the spectrum showed nothing but the red, all other tints being quenched. A blue glass allowed blue, indigo, violet and green rays to pass, and a yellow glass permitted only the transmission of green, yellow, orange and red. A very beautiful experiment was made with a solution of permanganate of potash, which is a very exquisite purple and unlike the pure tone of that tint in the spectrum. Passing the light through the prism of that liquid, it was found that not only the purple but the red rays were allowed to pass, so that by the mixture of these colors the unusually beautiful shade was obtained.

BLUE AND YELLOW DO NOT MAKE GREEN

but white, as they are complementary colors. Why is it then that by mixing chrome yellow and Prussian blue we obtain a green pigment? It was shown in the course of the above experiments that a blue glass permits not only the blue of the spectrum to pass through it but a portion of the adjacent green. A yellow glass, though cutting off the blue, also allows the passage of the green. This may be expressed as follows, representing the colors by their initials, those absorbed being in italics, thus: Blue glass, *R, O, Y,* G, B, I, V; yellow glass, R, O, Y, G, *B, I, V.* Now combine both glasses; together they destroy every color but the green which, as experiment proved, appeared singly on the screen. Consequently the blue and yellow powders when mixed together absorb all other colors and appear to the eye as of the only color to which both are transparent. The blending of blue and yellow light to make white will be explained in a subsequent lecture. In conclusion, said Professor Tyndall, we may profitably glance back on the web of relations which these experiments reveal to us. We have, in the first place, in solar light an agent of exceeding complexity, composed of innumerable constituents, refrangible in different degrees. We find, secondly, the atoms and molecules of bodies gifted with the power of sifting solar light in the most various ways, and producing by this sifting the colors observed in nature and art. To do this they must possess a molecular structure commensurate in complexity with that of light itself. Thirdly, we have the human eye and brain so organized as to be able to take in and distinguish the multitude of impressions thus generated.

FRESH GRAPES IN WINTER.



Parties still having grapes on their vines at the end of October or the beginning of November can keep them fresh and juicy by observing the following method: When the first frost comes on, cut the grapes with a considerable stem, having one or two knots below and one above the grape (see engraving). The upper end of the stem is to be covered with beeswax to prevent the escape of the circulating juices. After the grape is thus prepared, remove all bad berries from the bunch, and place the stem in a bottle of water, having a layer of charcoal at the bottom, which tends to keep the water clean; then close the bottle with a cork letting the stem pass through the center, and cover the top with beeswax. Grapes prepared in this manner will be sure to keep fresh and juicy all winter. DAHEIM.

A Composite Counterfeit $500 Note.

The ingenuity of counterfeiters is well illustrated by the following recent development at Washington:

There was received, a few days ago, at the Treasury of the United States, a note purporting to be a United States legal tender note of the denomination of $500. It is composed of parts of different genuine notes of various denominations. The center is a part of a one hundred, with the "one" taken out in the center and upper border, and a "five" neatly inserted. The left hand lower end contains a portrait of Andrew Jackson taken from a five dollar note, and the right hand lower end, a vignette from a ten. The scroll work, containing the figures 500, has been taken from a national bank note. The back of the note is from a ten dollar United States note, the "ten" having been cut out and replaced by the "ovals" from the back of a five. Although this note is not calculated to deceive bankers and brokers, it would be readily taken by those who are not accustomed to handling much money, as the engraving is all genuine. Fortunately its general appearance has no resemblance to the note of the denomination of which it purports to be a genuine issue.

THE Boston *Globe* says: "Our friend Potts read somewhere that electric sparks could be evolved from a cat by taking it into a dark room and rubbing its back. He made the experiment, and was surprised to hear a loud yell, and to feel something clawing across his face. Then he missed the cat. Mr. Potts is now uncertain whether he was struck by lightning evolved from the cat's back, or whether she became unduly excited as he stroked her, and stroked back again; but he is certain that, when he undertakes to procure electricity again from a cat, he will first soothe her with a shot gun."