

find, too, that all of the types of motor hallucination are explicable as central irritations of these centres, in which these different factors are present in various degrees. The nature of these centres would in each case be both sensory and motor; and the hallucination, if properly analyzed, would also be of the mixed form.

#### Color-Vision and Color-Blindness.

Mr. R. Brudenell Carter,<sup>1</sup> in a lecture before the Royal Institution, outlined the position of modern science upon this important topic, and from his remarks the following points may be selected: the perceptive layer of the human retina consists of rods and cones; in the centre of the retina, only cones occur; in a ring around this, each cone is surrounded by a circle of rods; and as we recede from the centre, the proportion of rods to cones becomes larger and larger. There is good reason for believing that color-vision is limited to the cones, and certainly the perception of color is best where the cones are most numerous. Nocturnal animals have a less perfect development of cones than diurnal ones. The limitations of the color-sense on the human retina are very considerable. The color-sense is complete for three fundamental colors of the spectrum for not more than thirty degrees of the field, is limited to red and violet in a small ring outside this field, and from there on is sensitive only to differences of light and shade. In the lower animals, especially in those having their eyes more on the side of their heads and possessing acute vision, we find a power of perceiving colors over a much larger area of the retina; and this is associated, as has been shown in birds, in some reptiles, and in fishes, with a more abundant and more even distribution of the cones over the retina. There has recently been observed upon the cones of some birds, globules of a colored oil, which transmit only light of their own color; and green, orange, and red drops prevailed in the birds examined. Why this is so remains to be determined.

When the condition that exists normally in the outer zones of the retina exists also in the centre, we have color-blindness; but such a degree of color-blindness is rare, if indeed it exists at all. The more common defect is that which exists in the zone surrounding the fovea; that is, a blindness to green. Such persons can distinguish violet and yellow, and they can see red, but cannot distinguish it as a color from green. The most common defect, however, is a blindness to red; and an extremely rare form is blindness to violet. The Young-Helmholtz theory regards the defect in the red-blind person as a paralysis or an absence of the red-perceiving elements in the retina. To such a one, spectral red is not absolutely invisible, but appears as a green of feeble luminosity, and the brightest part of his spectrum is in the blue-green. When green stimulates the eye of the green-blind, there results the white of the green-blind, which to ordinary eyes is sort of rose-color. To both red and green blind, then, these two colors are indistinguishable, the only difference being that to the red-blind the red, and to the green-blind the green, seems, in comparison with the other, of feeble luminosity. By looking at colored objects through a glass of peacock-blue the colors will appear somewhat as they do to a red-blind person, and by looking at them through a purple glass they will appear somewhat as they do to the green-blind. These defects exist in about four per cent of the male population, and in about one-tenth of one per cent of the female.

With regard to the dangers resulting from the placing of color-blind persons in responsible positions, it is easy both to exaggerate and to underestimate them. We naturally think of the railway and marine service, in which colored signals are used; and it is certain that a considerable number of those thus employed suffer from this organic and therefore incurable defect. We would be apt to think that such persons would at once reveal the defect, and thus be released from duty. We must remember, however, that the existence of this defect remained unknown until about a hundred years ago, and that it is often concealed by the correct use of color-names, — a rather easy art for the color-blind to acquire. And, again, these persons always know where to look for a signal, and hence under ordinary occasions the slight distinction

they make between red and green, aided by good luck, may be sufficient to avoid accidents. The methods of testing and discovering this defect are various, but they all depend upon matching colors and avoiding the use of color-names in the process. There are all degrees of the defect, from a tendency to confusion of dark greens and reds and a hesitation in deciding between them, to absolute indistinguishability of pronounced shades of them. The necessity of an examination in all posts in which color-distinction is necessary is now recognized, and governmental regulations upon the matter have been largely adopted. It may be advisable to add that there is a form of imperfect color-perception not at all related to color-blindness, but sometimes confused with it. It is simply a lack of practice and of training in color-distinctions. It is quite surprising with what ignorance of colors and their various shades children may grow up. This is a thing that may be taught, and is now frequently introduced into primary education.

#### NOTES AND NEWS.

AMONG the geographical expeditions which are decided upon for next summer in Russia, one is of unusual interest, that to the Black Sea. The physical features of this important and deep basin are so little known that we have little information on the depth at even a short distance from the shore. As to the temperature, salinity, etc., of the water at great depths, we have only a few observations along the eastern coast by Professor Lapshin, and near the entrance to the Bosphorus by Count Admiral Makarow. Last winter, Professor Klossowsky and Dr. Andrusow, in a memoir addressed to the council of the Imperial Russian Geographical Society, showed clearly the importance of an investigation of the deeper part of this sea. It was warmly supported by the society, and the Ministry of Marine sends a vessel for this purpose on a cruise of a month's duration. The nautical part of the scientific work will be under the direction of Capt.-Lieut. Spindler, while the Geographical Society sends Drs. Wrangell, A. Woeikof, and Andrusow, the last mentioned of whom will have charge of the botany and zoölogy.

—The Elizabeth Thompson Science Fund, which has been established by Mrs. Elizabeth Thompson of Stamford, Conn., "for the advancement and prosecution of scientific research in its broadest sense," now amounts to twenty-six thousand dollars. As accumulated income will be available December next, the trustees desire to receive applications for appropriations in aid of scientific work. This endowment is not for the benefit of any one department of science, but it is the intention of the trustees to give the preference to those investigations which cannot otherwise be provided for, which have for their object the advancement of human knowledge or the benefit of mankind in general, rather than to researches directed to the solution of questions of merely local importance. Applications for assistance from this fund, in order to receive consideration, must be accompanied by full information, especially in regard to the following points: 1. Precise amount required. Applicants are reminded that one dollar is approximately equivalent to four English shillings, four German marks, five French francs, or five Italian lire. 2. Exact nature of the investigation proposed. 3. Conditions under which the research is to be prosecuted. 4. Manner in which the appropriation asked for is to be expended. All applications should reach before December, 1890, the secretary of the board of trustees, Dr. C. S. Minot, Harvard Medical School, Boston, Mass., U.S.A. It is intended to make new grants at the end of 1890. The trustees are disinclined, for the present, to make any grant exceeding three hundred dollars: decided preference will be given to applications for smaller amounts. A list of the grants hitherto made, amounting to about six thousand dollars, is given in a circular just issued by the trustees.

—The American Swedenborg Printing and Publishing Company of this city are issuing the more important of Swedenborg's writings in clearly printed pocket volumes. "Angelic Wisdom concerning the Divine Love and the Divine Wisdom," the latest issue from their press, is a model of neatness and of good book making.

<sup>1</sup> See *Nature*, May 15, 1890.