

The chapter relating to the Wordsworthian education of nature is particularly suggestive. "Exclusive preoccupation with society is not the way to know it best. Through communion with nature man may come to understand life better."

While great stress is laid upon the physical basis of life and growth, the author does not overlook the importance of moral ideals and especially of those ideals which dominate social activity. He finds that not only in the personal life but in all organized effort there are guiding principles which inspire the human heart. "It is precisely in the sphere of industrial and commercial life that ideals are most needed to uplift the practice of the world."

This profound study of social and ethical values finds its climax in the two concluding chapters on Self-Development and Self-Control. Here we have the latest and best educational thought of our time. No word has been spoken which better voices the deep convictions of parents and teachers to-day than the idea that all growth and training must seek to develop a self-poised, self-governing being who finds his freedom in the proper use of all his powers and who experiences his highest joy in serving his fellow-men.

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COLOR VISION.

Ueber relativen absoluten Mangel des Farbensinnes. E. RAEHLMANN. *Ztch. für Augenheilkunde*, II., 315, 403. 1899.

Raehlmann adds some observations on partial color-blindness, but by far the most important part of his two articles is that which gives a detailed account of a very remarkable case of total color-blindness, the only one hitherto discovered in which the eyes of the patient were in every other respect perfectly normal. No trace of disease or of abnormality could be detected except the lack of color-vision: there was perfectly normal visual acuity and rather more than that, normal 'light-sense,' and normal visual field. The distribution of brightness in the spectrum, however, resembled that of no other case of either disease or health; there was an extreme darkening in the part which is yellow to normal eyes, so much so as to divide the spectrum almost into two separate regions; the normally blue part, on the other hand, was distinctly intensified. Raehlmann did not apparently make use of a spectrophotometer, but there seems to be no doubt that the patient was extremely insensitive to, Raehlmann says, yellow light—it would be better to say light of the yellow wave-length, as yellow

light did not exist for her. Here as in other respects, language needs some remodeling in the interest of more accurate distinction between the objective and the subjective. The patient, an intelligent lady and the wife of a university professor, had unusual powers of discrimination in regard to her sensations, and unusually good capacity for observation. There are several cases of color-disturbance in her family, and especially that of a son of the Frau Professor herself; his vision is dichromatic, but he has very keen sense of difference of brightness. Mrs. R. is wholly lacking in any idea of what a color is. It is said that an oil-painting does not correctly represent to her the relative brightnesses of a landscape, which are better given in a photograph, and that a picture gallery seems to her an absurdity. The spectrum is increased in length at both ends, more especially at the violet end; it is brightest in the green—there is also a maximum in blue and again in red. Adaptation to a faint light was normal. The threshold in the yellow part of the spectrum was extremely high, but in the blue it was far lower than for the normal eye. Visual acuity, which was normal at an ordinary illumination, was in an extremely faint light twice as good as that of any of the five assistants of Professor Raehlmann who examined her. After-images were normal, but simultaneous light induction seemed not to take place (p. 331). There was astonishingly acute perception of brightness differences, even at a strong illumination, and there was no trace of photophobia.

This case of Mrs. R., while it is absolutely unique, attaches itself readily to the cases of dichromasy with perfectly undisturbed vision in other respects, which are no rarity. It is evidently to be referred to some defect of development in the visual centers, and is to be connected with those cases of achromasy in which (although vision is markedly defective) there is no foveal blindness, and hence there is no reason to believe that the entire cone-system is out of function. That the brightness curve is totally different from that of nearly all the other achromates and also, consequently, from that of the normal eye in the reinforced vision of darkness, is by far the most remarkable phenomenon presented by the case, and it must stand for the present as something totally disconnected with all the other facts of vision. So far as it goes, it gives substantiality to the idea of an abnormal shift of excitability (not, indeed, in the retinal visual substance but in the cortical receiving stations) of which the Helmholtz school makes so much in its explanations of defects in color vision. But even before this the shift of excitability hypothesis could not be said to be an instance of *non vera causa*, for already there were known the cases of what are

called anomalous color vision in which the maximum red sensation is produced by a light wave of not the same frequency as in the normal eye. These cases, too, it is not the custom to keep sufficiently in mind.

Raehlmann speaks of this insensitiveness of the eyes of Mrs. R. in the region of the sodium line as if it were a sort of yellow blindness over and above the absence of specific color sensation throughout the spectrum; and he even says (p. 334) that in a sense every gray-sensation contains a color component (because it is produced by ether rays, which, if they acted alone, would give rise to a color-sensation). But this is visionary in the extreme.¹ It is the great advance of recent years in this field to have shown that the quenching of opposite colors is an affair of physiology quite below the level of consciousness and that the colors which are mutually destroyed have never had an existence as colors. Here again appears the need of a better phraseology—of distinguishing between the spectral *colors* and the regions in the gamut of ether-vibrations which give rise to them.

This case ought also to have the effect of causing us to accentuate more than we do now the difference in nervous level at which color-defect may take place. The central color scotoma of the tobacco and alcohol amblyopia is surely due to disease of particular bundles of the optic nerve trunk—a sort of fact that the psychologist is too little apt to have in mind; in general not enough attention has been given, in the discussion of color-blindness especially, to such pathological cases as are plainly due to retrobulbar lesions—there has been too constant an attempt to explain everything by abnormal processes in the retina. On the other hand, the authenticated cases of uniocular color-blindness can be explained only by an ante-commissural defect; it is, therefore, necessary to bear well in mind that different cases of defective color-sense may be of widely different origin.

Raehlmann calls attention to a very important experiment made by himself twenty-five years ago (*Arch. f. Ophth.*, XIX.) in which a dichromate was given santonine with the effect that his yellow-blue vision was reduced to vision of a single quality only, blue; the whole warm end of the spectrum became to him gray. Such a case as this speaks strongly (and there are other indications leading in the same direction—cortical lesions, chromatopsias, etc.) in favor of their being (whatever the number of chemical processes in the retina) four distinct centers in the cortex for the four fundamental hues. Knies

¹ Moreover, he quite forgets that in night-vision, and in the achromatic vision of the extreme periphery of the eye, there is no question of color-components (in the subjective sense) being by any possibility present.

seems to have shown (Arch. f. Augenh., 37, p. 102) that in santonine color effects the source of the change is not any coloring of the retinal layers of the eye—that is, he draws this conclusion from the fact that in dogs and frogs, after very strong doses of santonine, the visual red, after darkness-exposure, had its color not in the least disguised.

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The Order of Development of Color Perception and of Color Preference in the Child. By WARD A. HOLDEN, M.D., and K. K. BOSSE, B.S., New York City. Archives of Ophthalmology, Vol. XXIX., No. 3. 1900.

In this paper are described the results of a series of experiments made on over 200 children between the ages of six months and thirteen years, relative to some of the phases of developing color perception. In the first part of the paper, by a method devised by Dr. Holden, the child is tested for its absolute color perception by making use of a background shaded from dark to light gray upon which squares of colored tissue paper are so placed that their luminosity is equal to that of the gray background. The child that reaches for a colored square under these conditions, must perceive that color as differing from gray. At the age of six or seven months infants react readily to red, orange and yellow but without much certainty to green, blue and violet. At eight or nine months they react promptly to the first three, and sluggishly to the last three. At ten or twelve months there is often equally prompt reaction to all colors.

Preference tests carried out with satin ribbons showed that children below three years preferred the red end of the spectrum, selecting red first and then following very closely the order of the spectrum, and selecting blue or violet last. After the end of the third year the order of selection is reversed, however, blue or violet being chosen first and red last. This remarkable change is accompanied by a general disinclination on the part of the child to make any selection at all, so that at the age of about three years only a small percentage could be induced to perform the required action. The results thus obtained were tabulated and the figures give a fair picture of the gradually changing conditions. As a brief summary: The child passes through these phases of development: Up to about the third year the red end of the spectrum is preferred, then follows a period in which the attractiveness of the blue end increases until it becomes as strong as that of the red end, the consequence being a disinclination to make any