

strength of the stomach contractions and the degree of hunger sensations experienced simultaneously," that with prolonged fasting a mild contraction is accompanied by unusually intense hunger, that continuous hunger is associated with gastric tetanus, that a single contraction of even the "twenty-seconds rhythm" (the weaker of the two typical stomachic rhythms) may, if fairly strong, give rise to a recognizable hunger pang, and that "the recognition of a stomach contraction as a hunger pang depends not only on the strength of the contraction, but also upon the rapidity of the development of the contraction phase." Mechanical pressure upon the mucosa is not adequate to the hunger sensation; tension of the muscular fibers probably is. No attempt is made to establish a specific sensory quality of hunger, which is said to contain "elements of kinesthetic sensation as well as of pain."

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Psychological Bulletin

SYNÆSTHESIA

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Langenbeck (4) in his article upon chromæsthesia describes his own case. He sees colors both in connection with the vowels and the cardinal numbers. The sound of the words, and not the meaning, immediately produces the colors. This is especially proven from the fact that foreign words may produce colors antagonistic to their meaning. "Rouge" and "noir," for example, are accompanied by black and red respectively. A table prepared to show the colors reported by a number of authors to be connected with the vowels shows the usual divergencies. The difference of location of the colors by different subjects is described, and there is also a discussion concerning terminology. The principal part of the paper is concerned with the several theories as to the origin of the phenomenon. The important facts for and against the physiological, the Darwinian, and the psychological theories have been gathered from the literature. The author considers the psychological theory of chance association to be the most adequate; associations which have occurred in youth and whose origins have been forgotten.

C. S. Myers (6) reports an investigation he has made of the chromæsthesia of the Russian composer Alexander Scriabin. Colors are so important for the musician that he wishes his "Prometheus" to be played to the accompaniment of colored lights and his "Mystery" with both colors and odors. For Scriabin the colors are connected with the tonality of the music. He frequently notices a change of color before he does one of tonality. "Scriabin finds that as he passes from hue to hue, the successive colors correspond to tonalities rising by a series of fifths." This association of consecutive scales with consecutive spectral colors confirms Myers previous assertion "that for the full development of synæsthesia, a strong tendency to a certain kind of association is requisite." The second case described by Myers is that of a woman painter. The colors vary with the pitch and the timbre, and are different from those seen by Scriabin. Like the latter this subject is more "alive" to the color components than to the tonal components. They also agree in that "the effect of increasing the richness of a tone by adding to its overtones results in a 'rise' of the color of the tone."

Coriat (2, 3) reported two cases of synæsthesia. The one had colored hearing and taste synæsthesia. Blue in its various shades was suggested by sounds. Unlike Langenbeck (mentioned above) the synæsthesia was limited to English words. Numbers were arranged visually in geometrical forms. Colored gustation was not well developed. Beautiful colors tasted good, and color discords were nauseating. The synæsthesia was irreversible and this is one of the facts used by Coriat in support of a physiological explanation. He believes in the "theory of nerve irradiation, arising from a congenital defect of the nervous system." The other case of synæsthesia is that of "colored pain." Hollow pain is blue; sore pain, red; deep headache, vivid scarlet; etc.

Langfeld (5) has investigated the chromæsthesia of a talented woman musician. Two examinations, seven years apart, were made. The color associations remained practically unaltered. When tones, which corresponded to the complementary colors, were struck together a gray effect was produced. In chords the color of the fundamental predominated. In dissonances the colors were paler. Langfeld believes that the facts support a physiological explanation.

Bleuler (1) has written a long and interesting theoretical discussion of synæsthesia. Lack of space prevents details, but the main theme is a defense of the physiological theory as against a theory of accidental association.

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DISCUSSION

MONOCHROMATIC STIMULI OBTAINED BY MEANS OF FILTERS

A recent note by Schulz¹ sets forth certain facts regarding the use of filters in color-experiments. These facts have been long familiar to physicists, but seem to have been largely disregarded by psychologists, although it is probably to the latter that they can be made most useful.

Certain purposes demand the use of stimuli extending over a very narrow range of wave-lengths and giving a high brightness over a large surface. If the source of light used gives a continuous spectrum, a spectrometer system is necessary for obtaining monochromatic bands in all regions of the spectrum. The total flux which can be passed through such a system is very small as compared with that emitted by the source, since the quantity available is limited by the comparatively small sizes in which the optical parts can be made, and is greatly reduced by absorption and reflection in passage through the system. The total area which can be highly illuminated is therefore quite small; in fact, it is usually necessary to require the observer to look directly at the face of the lens or prism, keeping the eye close behind a narrow slit placed in the plane of the spectrum, in order to obtain sufficient illumination on the retina. It should be remembered also that even the narrow portion of the spectrum limited by the optical slit is not strictly monochromatic; for, due to the factor of width of the slit-openings and to multiple reflection in the system, there is mixed with the "monochromatic" band an appreciable quantity of light of all other wave-lengths. This fact is easily demonstrated by passing the selected band through a second spectrometer system. Ordinary spectral saturation is insufficient for some purposes.

If color-filters are used with sources giving a continuous spectrum, it is possible to produce a high illumination on a fairly large surface, but (except in the case of a few filters) the range of wave-lengths sensibly transmitted is quite wide, with considerable in-

¹SCHULZ, H.: Ueber Gelatine-Farbfiler für Quecksilberlampen. *Ber. d. Dtsch. Physik. Gesellschaft*, 1913, 15, 286 ff.