THE LAWS OF VISION AND THE HARMONY OF COLORS.

In ordinary language the word *color* is used in different senses. Sometimes it signifies coloring matter, and sometimes it designates the special sensation that we experience at the sight of the latter. The distinction between the two senses of this word should thus be clearly established, and it is in the last mentioned acceptation that it will be employed in this place. This distinction appears to be very simple, yet the different senses given to the word have caused much confusion, and eminent minds, such as Newton, Chevreul, and Helmholtz, have in turn confounded the mixture of coloring matters with the mixture of colored lights, and this latter with the mixture of colored sensations; that is to say, studying color, they have confounded what is external to us —the physical phenomenon—with what goes on within us—the physiological phenomenon. The masters of science whom we have just mentioned having especially viewed the physical side of the question, it is hardly astonishing that their rivals who have published treatises upon the science of color should have perpetuated the confusion. In all courses of physics there is still shown the Muschenbroeck disk for effecting a synthesis of white light, while in reality it is not colored lights, but colored sensations that are mixed in the eye. In what follows we present the question, then, from a physiological standpoint. Our object is to teach a means of juxtaposing colors that set one another off. In order to reach that result, it is evidently necessary to know the organization of our eye perfectly, not from an anatomical, but from the standpoint of the sensations that it experiences and of the judgment that we formulate.

The following is an experiment performed by Dr. Gillet de Grandmont before the French Society of Physics. The head of an observer is rendered immovable by means of a support, upon which rest the chin and forehead, and a screen is placed before one of the eyes. Then a brilliant metallic button is placed for a few seconds in front of the free eye, and a small bright green surface is made to appear alongside of it by means of a spring. In less than half a minute this green surface completely disappears from the sight of the observer, and he no longer sees anything. A wink of the eye suffices to make it reappear, but entirely gray. Then, by another motion of the spring, a white surface is substituted for the green; but the eye does not see it white, for it appears to be colored fuchsine-red—a color the complementary of green. At the first wink of the eye, however, the illusion disappears, and the surface seems to be simply what it is, that is to say, white.

Thus, then, when the eye is fixed for some time upon a color, it becomes blind to it, but such blindness lasts but an instant. Another conclusion that must be drawn from such experiments is this: when the eye has seen a color, it is disposed to see the complementary thereof, that is to say, it experiences in succession the sensations as a whole that constitute white. Thus the eye of itself reconstitutes the elements of the sensation of white, if one does not represent them to it. Hence, if we offer to this organ a collection of colors that go to make up white, we shall avoid this trouble; whence the conclusion that the principle of the harmony of colors in a shade made of two others resides in the use of complementaries. I have had many opportunities of establishing the truth of this fact. A simultaneous view of complementary colors is agreeable, the eye never tires of looking at them, and the more it sees them the better they please it. The following is a simple way of performing the experiment:

I have a collection of sheets of colored paper which together form 16 pairs of complementary colors. In order to simplify the judgment of the mind, I have taken care to select 32 colors as similar in intensity as possible, that is to say, all equally bright and deep. This collection is in the form of squares of the same dimensions. After mixing them up, I present them to some one, and ask him to group the papers in pairs, and put side by side such colors as appear to him to produce the most pleasing effect when juxtaposed. In selecting colored surfaces of an identical form, made of the same material, and differing only in quality and not intensity, the judgment is not influenced by accessory phenomena, and acts only upon the color. Under such circumstances, the colors are invariably classed by complementaries. I have remarked, moreover, that women take less time than men to make the classification, the female eye being very sensitive to contrasts.

How can we proceed in practice to determine complementary colors? Among the methods that are utilizable I have given preference to that of rotary disks, because it is as applicable to dilute as to pure colors. The colors are painted upon small disks of thick paper cut out by a special punch. These little disks are slit, partly according to a radius and partly according to the circumference, thus allowing two of them to be connected so as to cause the relative angle of the sectors to vary up to the moment when, through the rapid rotation of the disk, the surface appears of a uniform, perfectly colorless gray.

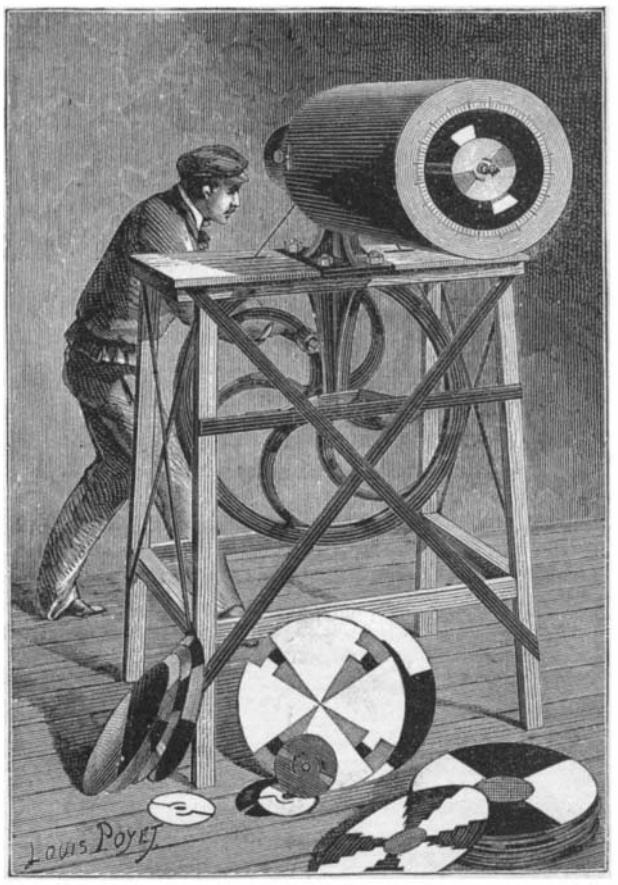


Fig. 1.—APPARATUS FOR STUDYING THE HARMONY OF COLORS.

In order to judge whether the gray obtained really fulfills this condition, it is indispensable to have before the eyes a type of comparison that is of exactly the same *depth of tone* as the gray produced by the two complementaries. We obtain this as follows: In a wooden box, closed on every side, and lined internally with black velvet, a small aperture is made (Fig. 1). In front of this circular aperture, which is of as perfect a black as is possible to make it, I place a white sector of variable angle made of paper painted with pure sulphate of barytes. This sector may be rapidly revolved by means of an axle that traverses the box and terminates at the center of the aperture. There is thus produced a gray, of which I vary the tone at will by modifying the angle of the white sector. In the center of the circle I arrange, upon the same axis, the little slit disks painted with complementary colors. Through experiment we quickly succeed in obtaining two grays, which appear identical to the eye, although obtained in two so different ways.

By measuring the angle of the sectors we find (1) the proportion of two colors that reproduce the sensation of white, and (2) the quantity of white produced.

This revolving disk apparatus is especially one for study. The experiments can be seen by but a small number of spectators, for the disks must be viewed from the front, or at least at a very slight angle. This inconvenience has given Mr. De Luynes the ingenious idea of replacing the disks by revolving cylinders, in his lectures at the Conservatoire des Arts et Metiers. By painting stripes lengthwise upon a cylinder we can have at our disposal a certain number of colors upon one circumference, and, through rapid rotation, obtain mixed sensations (Fig. 2). The cylinder, according to its length, permits of juxtaposing a certain number of systems of bands of diverse composition, so that through rotation we see the result of several mixtures simultaneously.

The trouble with cylinders is that they do not show flat tints and do not permit of varying at will, and instantly, the proportion of the mixture, a thing very easily done with the slit disks.

Up to this point we have dealt merely with the use of complementary colors in order to avoid what M. Chevreul terms "contrast." But this is not the sole means. We shall evidently reach the same result by coloring with a monochrome of different degrees of intensity and luminosity. I am thus naturally led to present the results that experiment has taught me as to the *degradation of colors*. Here, again, the disks have been of the most advantageous use, since they have shown the grave error that is committed by degrading colors in the usual way. The hue of a coloring matter varies with the thickness of the coat in which it is seen, when it is mixed with colorless matters. In a thick coat it is redder than in a thin one. Moreover, the modification not only relates to the quality of the color, but also to its intensity. Coloring matters that possess of themselves a very intense hue, such as chrome yellow, give, through mixture with colorless matters, less and less intense colors, as might be expected; while with others, whose hue is of slight intensity (ultramarine, for example), the coloring power increases, on the contrary, under the same circumstances, up to a certain limit, beyond which the intensity decreases.

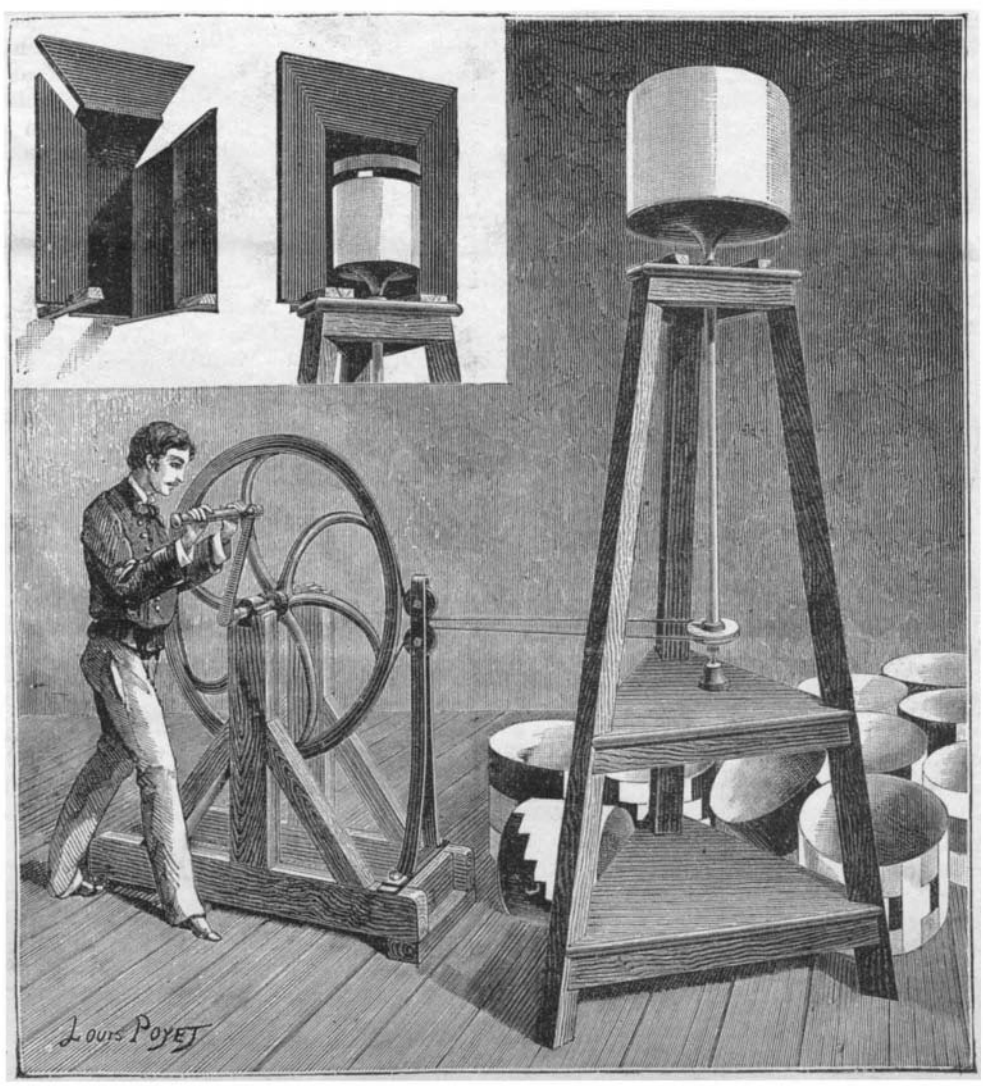


Fig. 2.—DE LUYNES' CYLINDER APPARATUS.

These facts explain why, if we seek the complementaries of tones of the same gamut of Chevreul's chromatic circle, we find that each tone has a different complementary, and that consequently all the tones of the gamut are derived in reality from one color. And it could not be otherwise, since Chevreul defines the "tones of one color" as "the different degrees of intensity that a color is capable of taking, according as the *substance* that represents it is purer, or simply mixed with white or black."

In order to obtain several tones of the same color that have definite relations to each other, it is necessary, in order to guard against such irregularities, to have a model in which we can follow a *true gamut.* Such a gamut, which I call an *esthetic* one, will be given by the result of a mixture of the sensations, such as we obtain, for example, by means of the disks. This instrument is an infallible guide that permits of ascertaining whether two tones of color are qualitatively identical, that is to say, whether they correspond to the same colored sensation, modified only as regards its intensity, or by the sensation of the white that is mixed with it.

Two colors are qualitatively identical when they are complementary; and two colors which, mixed, by means of revolving disks, with the common complementary,

produce a sensation of white with equal sectors are quantitatively identical. In short, we can now give the following conditions of the harmony of colors as certain:

(1.) *Hues derived from a pure color* (monochrome).—The degradations of one and the same color, according to the esthetic gamut, form with each other harmonious assortments.

(2.) *Hues derived from two pure colors.*—The most agreeable assortment is that of two complementary pure colors, and of their derivatives.

In the case of a tint composed of two colors it is necessary to add some advice relative to the selection of the shades, and this is, that the degree of intensity should be in ratio inverse the surfaces to be colored.

In applying the propositions that I have just formulated, it must not be forgotten that in order that a coloring shall be pleasing it is not enough that it shall flatter the eye by color, for there is a more important condition to fulfill—it is necessary to satisfy the mind, that is to say, it is necessary before all else to observe principles that are outside of the limits of the present paper, *i. e.*, those of distinct vision and concordance.—*A. Rosenstiehl, in La Nature.*

The Mind Cure.

Professor David Swing, in our excellent literary contemporary, *The Current*, published in Chicago, has an interesting article on the influence of the mind in the curing of diseases, from which the following is extracted:

On account of the dignity and wise look of large words, says the Professor, science never uses a simple term when a large one can be impressed into service. Thus the sleep produced by long gazing at a bright object or by the hands of a Mesmer is called *hypnotism*, while the sleep which comes from disease is called a *profound coma*. Following this tendency of science to use high sounding terms, those who discovered the value of the mind in overcoming disease saw fit to name the fact or theory *The Metaphysical Cure*. As those who are the parents of a child have the right to name it, so these discoverers of a new power in the mind had a perfect right to call it by the name that most pleased them.

It has always been known that the mind can exert a good or bad influence over the body. The old mental philosophies were full of stories which had a tendency to show how persons had taken to bed after having been told, by a succession of acquaintances, about the dreadful paleness of face or of a most unhealthy expression of the eyes. It was also affirmed, in the olden newspapers, that some mischievous wife made her husband believe that he was swelling up with dropsy, and should by all means hasten to the German Springs, and should take her along as nurse, his condition being so critical. The wife thus secured a trip to Europe—her art being that of taking pieces out of her husband's vests, so that it became almost impossible for him to make them reach around his abnormal body.

The Metaphysical Cure is, therefore, not a discovery, but the expansion into a medical practice of a power which had once been little else than a curiosity. A tendency of our age is to utilize forces. Nothing so pains the American mind as the thought of having anything go to waste. We are now in a worry lest there may be an electric potency that might turn all our wheels; we are attempting to run engines by sunbeams; the waste of water power at Niagara is the grief of many; while those who have escaped these forms of distress are made unhappy because the air is not as full of balloons as the streets are of cars and wagons.

In such a day it was very naturally concluded that if mind has a power over health and disease, let us utilize this power. Let us not permit the force to escape all duty, like the waters of Niagara. Let us not permit merely artful women to use it as a means of inducing dropsy and a foreign trip. Let us domesticate this mental influence, and extract from it valuable service.

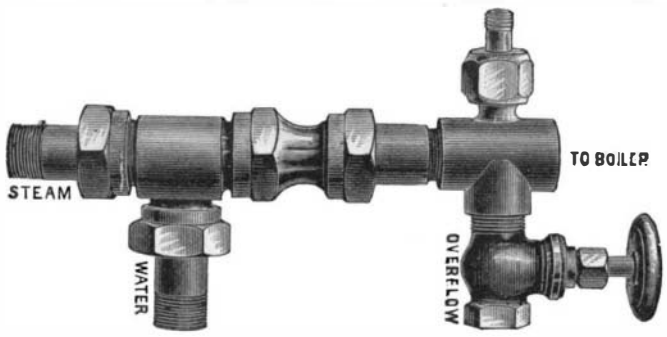
Thus came the "Metaphysical Cure" about eight or ten years ago. In the hands of extremists it is made partly one of the delusions of the world, but in the hands of the wise and moderate it is a tonic of great value, and will displace a large amount of quinine and wild cherry bitters. Its philosophy may all be summed up in the fact that the soul affects the body, and can rouse up its torpid blood, can make the liver, heart, lungs, and the brain—that nerve center—quicken their pace and use up or crowd out the diseased globules from the blood and fluids.

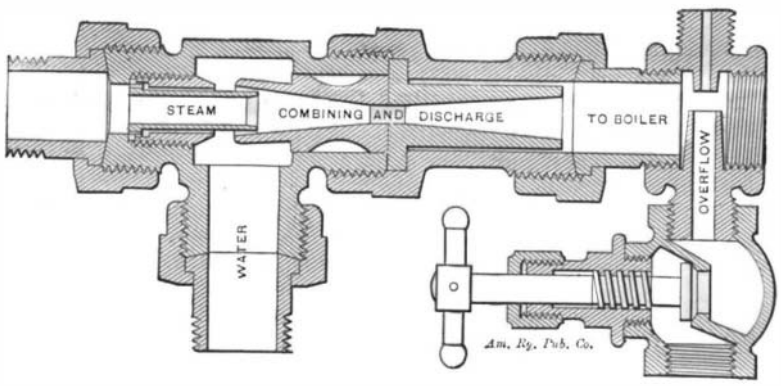
This is, then, the philosophy of the mind cure. It can do much for man, and is not to be reproached because it cannot do everything. If the influence of the mind may benefit one sick person in twenty-five, it will then surpass in value many popular medicines; and if it shall prevent many others from falling into any imaginary illness, it will confer a second benefit upon the community. Man is not in a condition to reject the help of any of nature's kind offers. By means of all these discovered helps the evils of ill health may be mitigated, if not banished from the world. Will, energy, medicine, fasting, good air, good food, good water, are all friends of health, but no one of these is master of the entire field of ailment. He will act most wisely who employs all these causes at different times of need.

With masses of evidence of the power of mind over matter, either to weaken it or to build it up, it is high time for us all to invoke the aid of this spiritual influence in not a few days of life; but to call it a general practice of medicine is to attempt to make a part equal the whole. This feat the new practitioners are attempting to perform. They are even attempting to cure disease when it is far away from the alleged doctor—the doctor throwing his mental force a thousand miles, and making it land like a bombshell amid the works of the enemy. This is that *reductio ad absurdum* which has been common in all times.

THE "UNIQUE" SINGLE TUBE INJECTOR.

The accompanying engravings show an injector possessing many admirable features, and, as will be seen, the aim of the manufacturers to make a perfect injector of the simplest construction, so as to be readily understood, has been most successful. This injector may be placed in any position, requires no change for varying pressures of steam, and the arrangement of its parts is such that the tubes can be conveniently taken out and cleaned when required. As it has no special valves to become defective by use, the necessity of often sending the injector to the maker for repair is avoided; all of the valves and fittings here required can be found where supplies for steam fitters are furnished. The overflow valve can be located at any point between the injector and check valve that may be most convenient. This style of injector is made either non-lifting or lifting, the latter form being shown in perspective and section in the cuts.





THE "UNIQUE" SINGLE TUBE INJECTOR.

The "Unique" injector is made by the Rue Manufacturing Company, of Filbert Street, Philadelphia, Pa., and although it has been on the market but about a year, its success has been most flattering. It is made of gun metal, neatly finished, and all the parts are fitted to standard gauges.

The Olive Oil Industry at Leghorn.

As soon as the oil is received at the warehouse, it is placed temporarily in tanks and large earthenware jars to settle. New oil from the country is always thick, and in winter time generally congealed; after having been allowed to remain undisturbed for six or eight days it is, if still congealed, slightly heated before being placed in the filters, in a large tin lined pan, with a double bottom or jacket, through which steam is made to circulate. Thus the oil does not come into contact with fire, but is gently warmed by steam until it is quite fluid. The oil filter is a rectangular wooden tank, lined inside with tin, and it is divided into two compartments, an upper and a lower one. The oil is pumped into the upper compartment, and is allowed to filter through perfectly clean carded cotton—brought here from Malta, and preferred to any other on account of its purity—into the second or lower compartment, when it has again to pass through another layer of cotton, and finally comes out into a tank placed beneath the filter, from which, if perfectly bright, it is pumped into large marble lined tanks, holding about 50 tons of oil each. If the oil is not perfectly bright it is passed through the filters again and again until it becomes so. As a rule, however, oil, particularly if of the finest quality, becomes perfectly bright after one filtering. In the large tanks the oil is allowed to remain undisturbed until required for exportation, whether for Great Britain or the United States of America.

Concentration.

Among the powers of the human mind that seem of themselves to make life worth living, that of concentration occupies a prominent place. To be able to fix the thoughts or the attention exclusively upon one subject, and to keep them there without wavering as long as is necessary, is a most important element of success in every occupation. It is a common mistake to think that although this ability is essential in professions, in literary pursuits, in the management of large enterprises, or in any position involving the laying of plans or the carrying out of systems, for the ordinary and commonplace worker, especially if his work be chiefly manual, it is of little consequence. This is one of those fallacies which lie at the root of much of the poor, inefficient, and inferior quality of work which is offered to the world in quantities far exceeding the demand. It is a well known fact that while hundreds of unserviceable men and women stand idle, waiting for employment which does not come, every one who is able and ready to do superior work in any department is eagerly caught up, and may almost command his own terms.

One of the most radical differences between these two classes of workers is this very power of concentrating the energy and strength of both body and mind upon the work immediately at hand. Two men, working side by side in the field or the factory, may be equally competent, as far as knowledge or physical strength or previous training go, to perform the labor before them. They begin with equal promise of good success, but in a short time, while one is persisting, the other is relaxing in effort. One pursues his work with unremitting zeal; the other spasmodically, with intervals of wandering thoughts and flagging attention. It is already an assured fact that the one who has acquired the habit of concentration will be the successful competitor. He will be anxiously sought for and re-engaged, while the other will soon go to swell the ranks of the unemployed. It matters not what is to be done; from the simplest mechanical work to the most abstruse and complex mental operation, the power of putting all the thought, energy, and attention on that and nothing else for the time being, will very largely determine the quality and amount of labor performed.

To some extent this is a natural gift. We see children at play who, without other motive than their instinctive tendencies, persist continuously in any effort they make, or purpose they form, with a perseverance and earnestness which may well shame many of their elders, while others will be distracted by every passing object, and forget their determinations as soon as they are formed. Yet here, perhaps more than in most tendencies, culture and practice come in to strengthen what is lacking. The discipline of the schools is most valuable in developing the concentrative power in the province of thought, and it would be a blessing to every child if, in some way, a like discipline helped him in the work of his hands. Like every other faculty, this, too, is strengthened by exercise. Each time we recall our scattering energies and wandering thoughts, and force them resolutely in one direction, we increase the power and develop the habit, and the exertion, at first painful and laborious, becomes in time easy and agreeable.

Mr. Thomas A. Edison attributes his success as an inventor largely to this faculty, which he gained by steadfast exertion, once being able only to think upon a given subject for ten minutes before something else would come into his mind, but gaining by long practice the power of continuous and uninterrupted thought for hours on a simple topic. At one time he worked with his assistants in trying to connect a piece of carbon to a wire. Each time it would break, and they would spend several hours in making another, until after working in this way one day and two nights they finally succeeded.

This habit does not necessarily make a person so absorbed in one thing as to become narrow and one-sided. He may become so by yielding wholly to a native impulse of dwelling on one thing; but the same self-control that concentrates his energies at will can also divert them at will into another channel when the proper time arrives. Many things rightly claim our attention, but none of them will receive it aright if our thoughts aimlessly wander from one to another, without compass or guide.—*Phila. Ledger.*

PROTECTIVE inoculation against yellow fever is being tried extensively in the Mexican army.