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THE SCIENTIFIC AMERICAN SUPPLEMENT,

No. 67,

For the Week ending April 14, 1877.

THE PROPERTIES OF LIGHT AND COLOR.

The idea that anything can be added to light by passing it through colored transparent substances, or by reflecting it from colored surfaces, is utterly erroneous, and proceeds simply from ignorance of the nature of light. It has been proved by Isaac Newton, and since his time by innumerable experiments of various kinds, that pure white light, such as comes from the sun to us, contains all the colors, as well as heat and chemical activity, and that they may be separated, or the light analyzed, by simply passing it through a prism of a transparent substance. The possibility of such a separation has been understood only since the adoption of the vibratory theory, which also explains the nature of the caloric, luminous, colored, and chemical rays. According to this theory, the vibrations, when at comparatively low velocity, manifest themselves as heat only; when the vibrations are rapid enough to produce four hundred and fifty billion waves per second, they become visible as red light. Five hundred billions produce the sensation of orange, five hundred and fifty billions that of yellow, and so on through green, blue, and violet, the latter resulting from eight hundred and fifty billions of vibrations per second. Vibrations still more rapid are invisible to the human eye, but their existence is demonstrated by their chemical action, in the same way as the invisible vibrations below four hundred and fifty billions per second manifest themselves as heat only.

Densely transparent media retard the light, and this retardation will affect the rapid vibrations more than those of slower velocity; and under certain circumstances such media will cause light to be deflected from its course in such a way that the most rapid vibrations will be most deflected and the slowest least. This is the principle of refraction, by which light can be separated into its caloric, chemical, and luminous rays of different colors. The refraction of light, permitting the examination of the colors into which it has been split up, is the fundamental principle of the spectroscope, by which the nature of various luminous and illuminated substances can be determined.

The apparent colors of objects are caused by their reflecting rays of vibrations of certain velocities, and neither reflecting nor absorbing others; and the hues of transparent colored objects are similarly produced. They pass only certain rays, and absorb the others; and the reflected or transmitted color is then called the color of the object. In order to perceive such a hue, it is essential that the light by which it is illuminated contains that color; and this is directly demonstrable by illuminating objects with light of one color, when objects of all other colors will appear black or gray. Such a light can, for instance, be produced by burning alcohol in which common salt has been mixed; this produces a pure yellow flame, and objects of whatever color, when seen by daylight, if illuminated by such a flame, will only show this color. Human faces, for instance, have in this light a ghastly, death-like appearance.

An ordinary gas, lamp, or candle light is not a pure white, being deficient in blue rays, and has an excess of red, orange, and yellow; a white object cannot, by such a light, be distinguished from a yellow one; light blue cannot be distinguished from green, and dark blue looks almost black.

In regard to the nature of colored objects, whether painted or dyed, and of transparent media, such as colored glass or liquid solutions, the analysis of their colors by means of the spectroscope shows that what we call simple colors are in most cases complex. Only those colors are pure and simple which we obtain by the prismatic refraction, namely, the spectroscopic colors. The blue cobalt glass, for instance, which is now called mazarin glass, is proved by the spectroscope not to owe its violet shade to the very refrangible and chemically active violet rays at the extreme end of the prismatic spectrum; but on the contrary, this part of the spectrum is totally absent from light passed through blue glass. The special shade of the mazarin glass is caused by the fact that its blue is tempered by a considerable quantity of the less refrangible red rays at the other or caloric extremity of the spectrum, and even with a trace of orange. Its blue is, therefore, of less chemical activity than the prismatic blue, and of course in all its functions, such as heat, chemical action, etc., is far below the original unchanged solar light.

We have gone into the details of these rather elementary matters for the purpose of exposing the ignorance of those who ascribe to the glass a special chemical or curative influence. Some photographers have used blue glass long ago, in order to moderate the intensity of the light for the eyes of the sitter, without robbing it of too much of its chemical activity; and those photographers who possess common sense or experience know that, far from adding to the effect of the light, the blue glass is an impediment, and the necessary time of exposure is rather extended by its use than otherwise. It is strange that such errors can prevail for years, when a simple experiment can settle the matter. All that is necessary is to photograph the solar spectrum, to do the same with a surface painted with a number of various colored pigments, and also to expose a sensitized surface under a series of colored strips of glass. The writer of this article did this more than thirty ago by the Daguerrean process, and satisfied himself about the following points: 1. The chemical effect of the prismatic spectrum extends, foriodide of silver, from beyond the violet to the blue. 2. When bromine is used in connection with the iodine, it extends to within the green, while the yellow and red rays appear to have no effect on silver compounds, but may possess it for other substances. 3. In photographing pigments there is the utmost diversity in the results, according to the nature of the pigment: much greater than the differences in shade would lead us to expect. As a general thing, the pure reds, orange, and yellow, such as are produced by vermilion and chromates of lead, are photographically inert, and give blacks. The blues are the most active, most of all being being ultramarine, next the violet lakes. But even the red carmine takes well, as it has a violet shade; but among the blues, those bordering on green take least, and hence foliage tends to give dark effects, which are only slightly corrected by using bromine. 4. In using as negatives strips of colored glass to print in sunlight, much depends on the shade and intensity of the color. In general, the chemical effect follows the prismatic series from red to blue; but the most effective blue glass is always found to be far inferior to the sunlight alone, pure and simple. And this fact is sufficient to settle the question about the special virtues claimed for blue glass: it cannot possibly have any not already possessed by sunlight. However, if people are induced by its pretended curative properties to take sun baths, which they otherwise might neglect, they may be often benefited by the salubrious influence of the radiation of the mighty orb, an influence which cannot sufficiently be appreciated; but the blue glass would probably get the credit which exclusively belongs to glorious old Sol.

THE AMERICAN EXHIBIT AT THE COMING PARIS EXPOSITION.

Thirteen months now remain between the present time and the opening day of the French International Exposition. We believe that our manufacturers, from their experience at the Centennial, and at previous world's fairs, fully appreciate the value of these exhibitions as advertising mediums; and therefore it is unnecessary for us to dwell upon their advantages in that direction. The prominent consideration now relates to speedy preparations of exhibits; and as the intervening time is short, and a large amount of work must needs be done, those who propose to contribute should realize the fact that there is no time for delay. Our people have a proclivity for leaving things to the last moment, and then doing prodigies of execution. While perhaps many individual displays are thus produced, fully as good as they might have been had more time been taken to their elaboration, still, collectively, a nation's exhibit organized in a hurry is apt to be but a poor show. The American display at Vienna is an example directly in point; and it is certainly to be hoped that the country will not be misrepresented in Paris after a similar fashion. The matter is one which appeals to every manufacturer or inventor who intends to exhibit, and to him individually. It relates to work which every exhibitor should see to himself, and not wait in the expectation that the government is going to boost him into the show by paying for his transportation, or otherwise misdevoting the people's money to his benefit.

There is much being said about the necessity of a large appropriation from Congress, and the organization of a cumbrous body of officials to secure a suitable exhibit from this country. We need neither. The gentlemen who prepared their display at our Centennial can do it again, and need no official help. Our diplomatic officers in Paris should be able to look after the interests of American exhibitors there; and the organization of the national contribution, so far as it may be found conducive to timely despatch and compliance with the regulations of the Exposition officials, may be done on this side of the ocean. There is no need of any appropriation, save the small sum requisite for the purposes above specified. It is an agreeable assumption, doubtless, that our manufacturers are actuated by high patriotic motives in sending their productions across the Atlantic, and that consequently such self-abnegation should be fostered and rewarded. But, unfortunately, such is wide of the fact. Those who contribute do so because they believe that, directly or indirectly, they are going to gain by it; and therefore, if the people are to pay under such conditions, it is just as sensible for Congress to pass a bill for the liquidation of the expenses incurred by manufacturers for advertising in this journal, or in any of the other mediums which they select for informing the public as to their business. The mistake—too commonly made—is that, because foreign governments appropriate large sums and appoint commissions headed by high dignitaries, this country must follow their example. The distinction is ignored that, in the old world, the paternal government acts for the people, and that the government orders that such a display be gathered, and pays for it all of its own motion. Here the people are the rulers; and if any display is made, it is done by the people for their own benefit. It is for the people to say what part they will take in the Exposition, and to act thereon; and therefore for our contemporaries to spur the government on in the matter, as if the people's servants were absolutely in control of the people's actions, is both contrary to the spirit of our institutions and radically absurd.

It is urged that, because France made a good show at our Centennial, international comity requires that we should make as fine a display at her Exposition. Let those who hold this view, then, see that such an exhibit as they will be proud of is made, and let them pay for it. If money is necessary to help inventors who have not the means to forward their productions—and that is the least objectionable use to which pecuniary assistance can be devoted—let it be raised by popular subscription. A display thus prepared will be more truly representative than any other which could be gathered; and every subscriber will have a direct personal interest in its excellence.