

Scientists Tell of Oddities of Colors

It would be an awkward world without color if all things were like soap-bubbles and all creatures like soap-bubbles, what endless collisions there would be! No doubt we should avoid one another like electric charges of the same sign—positive or negative; but what of those of different signs that would be mutually attracted? It would be a world of blind experiment—think of a football match or a railway station, even if all had eyes. Heads of ice leading to glass houses inhabited by transparent men and women feeding on limped food! In the course of time a diamond statue would be erected to the investigator who succeeded in making soap. It is not altogether easy to get a clear view of the difference between coloration and pigmentation. A soap-bubble may show all the colors of the rainbow, and yet there is no pigment—nothing but a transparent film of soapy water.

White a Blend of All.
On the other hand, writes Prof. J. Arthur Thomson in T.P.'s Weekly, some lower animals have blood that seems colorless to ordinary inspection, though it contains an abundance of oxygen-capturing pigment. There may be color without pigment, as in higher - of - pearl, which becomes chalky powder when pounded up; and there may be pigment without color. But it often happens that the color of a pigmented body, like a peacock's feather or a butterfly's wing, is not wholly due to the pigment, but to the physical structure as well. Thus the familiar peacock's feather shows blue and green color, though there is no trace of blue or green pigment. From a source of energy like the sun there is a ceaseless outpouring of radiations into space in the form of waves of varying length from crest to crest. Some of these waves are short, like those of the X-rays, and some are very long, like those of wireless, but there is only a small section of them that we can see. Of these the longest are those which we call violet, while the shortest are red, at the other end of the spectrum, so familiar to us in the rainbow. A blend of all the rays from violet to red is the white light of a sunny day.

Complementary Colors.
If we write down the colors in two parallel columns:—

VIOLET	GREEN
INDIGO	YELLOW
BLUE	ORANGE
RED	GREEN

the pairs grouped together in this arrangement are called "complementary colors." For if by some process of filtering we subtract from the complete white light (see diagram) then the balance will be disturbed and the light will appear of the color opposite or complementary to that which we have removed. Thus if we remove red the light will appear green. Such filtering as we have spoken of may be effected in various ways. Thus, if the white light falls on a sheet of copper, most of the light is absorbed, but a small part of the ruddy glow of the copper. But if the sheet of copper is thin enough so that the light can pass through, then the red is absorbed and the filtered light appears green. The blue color of solutions of copper is due to the absorption of copper ions, such as we sometimes see in a blue cloth in the daughter's window, due to the power the copper molecule has of absorbing light towards the red end of the spectrum. Thus the color of an object depends on the rays of light which are absorbed or reflected or allowed to pass through. Different conditions the metal compound may appear ruddy or green or blue.

Whiteness.
When a body has a highly polished surface, it is made up of numerous minute crystals with entrapped air between them, there is complete reflection of light, and we say that the body is of the quality of whiteness. Thus a saucer may be white, and the snow very white, and the waterfall is white. The hair of the ormine and the feathers of the ptarmigan are white because of the reflection of the light from the numerous vacuoles among the cells. In the summer dress of these creatures the place of the bubbles is occupied by minute pigmented particles. If we press snow very firmly, we drive out the entrapped air and the snow approaches transparent ice. Similarly, if we squeeze out the air from between the cells of the petals of the white narcissus, we make the petals foam transparent.

Pigment.
When the absorption or reflection of certain parts of the visible spectrum is due to some chemical property of the molecules of a substance occurring naturally in plants or animals, we use the term "pigment." But it is a deep and difficult problem to connect the pigmentary color with chemical structure. When the interference with the white light is due to physical state of the body, as when there is a finely grained surface, a reflection of the light at two different levels, as in mother-of-pearl, but most of all is the combination of the physical and the chemical now so near that it is to say, of structural pigmentary coloration, as in butterfly's wings and peacock's feathers.

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