Let's Talk About Color

Faye C. Jones

Color may be expressed in a language as highly technical as wavelengths on the chromaticity scale or as popularly as sky blue, orange, or lavender.

Between wavelengths which are measured in millicrons, and the popular nomenclature which results from association or imagination, there is a scientific language. While this language is not generally understood, or used, it is descriptive of the three components which make up single specimens of color. The concept of a single color is meaningless without some description which identifies all of its attributes: How pure? How light? How bright?

In the Munsell System of Color, the system which is used in experimental work, color is a product of three attributes. When either of the three are changed enough that the human eye can identify a difference between a changed and unchanged specimen, for all practical purposes, a new color has been produced.

When Colors Are Mixed

The hue of a color is the attribute which gives the color a name — red, yellow, green, blue or purple. By mixing the adjoining hues, e.g., red and yellow, a new hue, yellow-red is produced. The five principal hues and five which are produced by intermixing make up 10 constant hues. It is accurate to refer to these as families of colors. In popular usage, some of the family names were changed; e.g., yellow-red is known as orange. The hues are produced by a variety of organic and inorganic substances.

In the pure form, the hues which are made from inorganic pigments are brilliant. Without alteration they may be used to paint fire engines, billboards and danger signs, but they are not appropriate colors for house surfaces. The brilliance of the pure form is reduced by employing the second and third attributes of color.

Lightness, the second attribute, determines the amount of lightness which is reflected back to the eye from the surface of a color. Lightness may be defined as a vertical scale of color with values ranging between white at the top and black at the bottom of the scale. By varying the proportion of white and black it is possible to produce grays of different lightnesses. The eye can identify nine grays, each of which has a different lightness or reflectance.

No color can reflect as much light as white or as little as black. However, values of color parallel the reflectance of the grays. From the lightest color to the darkest the descriptions consist of whitish, very light, light, medium light, medium, medium dark, dark, very dark and blackish.

Third is Saturation

The third attribute of color is saturation. Saturation is the term which describes the dullness or brilliance of the color. For convenience, this attribute may be visualized as being the horizontal scale of color. One end of this scale is the color which is equivalent in brilliance to the pure inorganic pigment.

In the highly saturated state it is described as brilliant or vivid. At the opposite end of the scale, the color is so nearly lacking in pigment that gray is more prominent in the technical description than the hue name; e.g., reddish gray or bluish gray. Between the desaturated reddish gray, or bluish gray and the brilliant red or blue, the brightness of the colors are defined as grayish, moderate, moderately bright, bright to brilliant or vivid.

Housing research currently under way in the Arizona Agricultural Experiment Station is concerned with the use of color to improve house comfort, durability and economy. Results of experimental work which has been completed thus far show that all three attributes of color influence heat absorption. In regard to the attribute of hue, the various hues were found to absorb different amounts of heat.

"Cool Green" Isn't

When the temperature rise of the 10 constant hues, at equal lightness and equal saturation, were measured, a moderately bright medium green, with a reflectance of 32 percent, absorbed 75 percent as much heat as black. Black will rise 82° F above ambient air temperature when the air temperature is 100° F. So the nice cool green, psychologically speaking, was physiologically the warmest of all of the 10 constant hues. Purple-blue, red-purple, blue and purple were the coolest. The latter was 14 percent cooler than green. Yellow-red and red absorbed less heat than the hottest colors and slightly more than the four coolest colors.

The attribute of lightness influenced heat absorption. If the eye can barely distinguish a difference in lightness between two colors of the same hue and saturation, the darker of the two specimens will absorb 10 percent more heat than the lighter specimen.

The attribute of saturation likewise

(Continued on Next Page)

Miss Jones is Associate Housing Specialist in the Agricultural Experiment Station.

(Continued from Previous Page)

found to be closely associated with growth cracks and large tubers. In one study 56 percent of the potatoes with growth cracks had cat-eye. Also 43 percent of the tubers over seven-tenths of a pound had cat-eye while 17 percent of the tubers below that size were affected. This same relationship was found by growers and was used to a certain extent in grading out the tubers with cat-eye.

Rough Handling is Cause

With internal black spot, the most important factor is the handling after harvest. Mechanical injury, especially bruising, is considered the primary cause of this problem. Black spot appears only after the tissue is bruised. However, the potato tissue is made susceptible to black spot by certain environmental conditions during the growing period. California studies show that tubers coming out of a soil high in carbon dioxide are very susceptible. Conditions favoring a high soil carbon dioxide content, such as soil compaction, surface crusting and over-irrigation should be avoided.

By this brief review of two important potato problems we see the value of following proper cultural practices in growing, harvesting and handling potatoes. Maintaining a soil with good structure and well aerated, promoting a uniform steady growth, and handling the potatoes with care are essential even if these two defects are not a problem.

UA Will Send 10-Man Agriculture Team to Brazil

Darrel S. Metcalfe

The College of agriculture is going Brazil! Last October, at Washington, a contract was officially signed with the Agency for International Development (AID) for a program between The University of Arizona and the University of Ceara, Fortaleza, in the State of Ceara, northeast Brazil.

The contract, with a budget of $800,000, is for a two-year period, until April 1, 1966. In all probability it will be renewed at the close of that time. It calls for 10 UA College of Agriculture staff members to help the College of Agriculture at the University of Ceara improve its teaching, research and extension.

This all started in February, 1962, when AID asked The University of Arizona whether or not it would consider a contract with a university in Brazil, especially in the Northeast, since conditions are arid there and thus similar to the U.S. Southwest.

Survey Team Recommends

In June and July of that year a survey party composed of Dr. A. L. McComb, Head of Watershed Management, Dr. J. S. Hillman, Head of Agricultural Economics, and Dr. D. S. Metcalfe, Director of Resident Instruction, was sent by AID to study colleges and universities of agriculture in Brazil, make recommendations for their improvement and also consider possibility of a contract with a university or universities in northeastern Brazil. This survey team wholeheartedly recommended a contract with the University of Ceara.

The author is Director of Resident Instruction in the UA College of Agriculture.

Many months were spent in writing the contract and preparing a budget. Because of the large number of agencies involved, considerable consultation and correspondence was necessary.

As stated in the contract, objectives and scope of work are that: "The University of Arizona will provide technical advice and assistance to AID and to the cooperating country for improvement in agricultural productivity, increased efficiency in utilization of agricultural resources, and higher standards of living for the rural population through development of a "land-grant college" type of philosophy in education, research and extension.

Several Agencies Involved

"The University of Arizona will work in close coordination and cooperation with the College of Agriculture, the Institute of Rural Technology, and the Institute of Animal Science, University of Ceara, Fortaleza; the Superintendency for the Development of the Northeast; the Ministry of Education and Culture; Agencies of the Government of Brazil; and the U.S. AID."

Duties of The University of Arizona are spelled out:

1. Provide regular staff members to serve in the cooperative program of agricultural development.

2. Provide short-term staff members as consultants in specialized fields of agricultural teaching and research training.

3. Develop and provide trainee programs in the United States for selected staff members or other technicians designated by the University of Ceara to orient them to the US land-grant college philosophy and improve their capabilities as teachers, researchers and workers in agriculture.

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(Continued from Previous Page)

influences heat absorption. Desaturated colors absorbed substantially more heat than the brightest colors measured. Again, there was approximately 10 percent difference in the amount of heat absorbed by grayish and moderate colors. The difference became larger between moderate and moderately bright and decreased as the colors became brighter.

Color Affects Wear

Now, let us combine the three attributes into a familiar color such as a green asphalt shingle. This color was matched in paint. Since the pure inorganic pigment was brilliant green, it was grayed to a match with a black pigment. When the temperature of the grayed medium green was measured, the results showed that it absorbed 94 percent as much heat as the surrounding blacks. About the time that this experimental work was completed, a local roofing company reroofed a house which the company had roofed 11 years before. The original roof was of multicolored shingles. During the 11 years the green shingles had deteriorated and the red shingles were in good condition.

There are two methods by which brilliant colors may be grayed and made acceptable for general use. Another part of the experimental work was to compare the heat absorption of a group of colors which were grayed by each of the two methods. Pairs of the brilliant colors were grayed to a visual match. The member of each pair which was grayed with black absorbed about 90 percent as much heat as the adjacent blacks. The colors which were grayed with their complementary colors remained at about the same temperature as the brilliant color from which they were made. Colors which were grayed with their complement were as much as 30 percent cooler than the matching color which was grayed with black. The result of this work indicates that the rise of grayed colors is a function of black.

Nature's Colors Most Pleasing

Experiments on the visual aspect of this research are under way. Human subjects are being used. Eye comfort may not be possible in the arid land where the incident light exceeds 10,000 foot candles. Tolerance can be attained. While a complete analysis of these data has not been made, the results show that the desert colors — the earth and natural vegetation, rank at the top in eye comfort. If you want to purchase colors by reflectance, the upper threshold for tolerance of most hues is about 30 percent. The more highly saturated the mixture becomes, the less comfortable it is to the eye.

Is blue cool? Is blue comfortable to look at? Which of the many, many man-made blues are you referring to? Is it pure? How much lightness does it reflect? How much blue pigment does it contain in proportion to gray? How was it grayed? The answers to these questions are much more important than whether its first name is baby, sky, periwinkle, royal or China Sea.