cates the need of both clinicians and research investigators for a less subjective yet simple means of estimating skin color. Technical improvements in optical instruments have stimulated the use of photometric and spectroscopic mechanisms by medical investigators interested in cutaneous pigmentation. It is now generally admitted that the combination of photometry and spectroscopy in spectrophotometry provides the fundamental method for measurement of color. Visual spectrophotometry has been found to be too time-consuming. Although photoelectric spectrophotometers will undoubtedly become the standard instruments eventually, such an apparatus is at the present time too expensive and not sufficiently portable for most investigators interested in human skin color.

One characteristic of skin colors is that they are not highly saturated. For this reason, the writer was advised by Professor Arthur C. Hardy, of the Massachusetts Institute of Technology, that a trichromatic colorimeter would serve the writer's needs satisfactorily, would be portable and could be constructed for a relatively moderate sum. Funds were secured from the National Research Council, Medical Division, in the form of a grant-in-aid and such a colorimeter was built at the Massachusetts Institute of Technology under Professor Hardy's direction.

The essential element in this skin colorimeter is a Martens polarization photometer, the eyepiece of which is sufficiently modified to permit the insertion of three color filters. These are respectively:

Red	Wratten A (No. 25)
Green	Wratten B (No. 58)
Blue	Wratten C (No. 49)

An integrating sphere, approximately fifteen centimeters in diameter, is set onto the objective end of the photometer. At the pole of the sphere opposite to the photometer, an aperture thirty-two millimeters in diameter is placed. Four automobile headlight bulbs of six volts each illuminate the concavity of the sphere as well as any object placed at the aperture. The lights may be run with standard electric current using a transformer, but the writer prefers to employ a small automobile storage battery. A snap switch insures against wasting of current and undue heating of the sphere when the instrument is not actually in use. The instrument is about thirty-three centimeters long and weighs less than two kilograms. It is easily portable in a wooden case.

In operating the colorimeter to obtain a skin color reading, the instrument is first calibrated for each filter by placing the window of the sphere over a freshly scraped piece of magnesium carbonate (obtainable at most drug stores), balancing the brightness of the two halves of the photometric field, and recording the scale reading. Next, the aperture of the colorimeter is set against the skin, and readings are again taken through each of the filters.[1] The reflecting power of the skin relative to that of the standard white magnesium carbonate is then determined for each filter by calculating the ratio of the tangent squared of the angle read on the skin to the tangent squared of the angle read on the magnesium carbonate.

Using a recording spectrophotometer, Professor Hardy determined for each of the three filters of the colorimeter the respective spectrophotometric curves showing the transmission of these filters as a function of wave-length. This was done in order that the data obtained with this particular colorimeter can be transformed subsequently into any terms that may seem desirable. The state of color science at the present time does not justify an attempt to do this and hence these curves are merely for record purposes, to be used if a standard method of color specifications becomes universally adopted.

The colorimeter as above described is now being used by the writer. It is easy to use, and check readings are consistent. Data obtained through use of this colorimeter will soon be ready for publication.

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PREPARING QUICK-DRYING CANADA BALSAM

CANADA balsam is undoubtedly the most universal medium used for the mounting of slides in microscopy. However, one of the most serious objections to it is the time required for hardening. In biological work the slides must be kept in a horizontal position for several days, while in petrographical work the solid stick balsam necessitates a heating of the thin rock slices in order to receive the cover slips. In both cases the degree of inconvenience could be lessened by using a type of liquid balsam which hardens relatively rapidly.

In the making of thin sections of rocks, after following the usual procedure[1] of grinding to thinness (0.02–0.03 mm), the real hazard comes in mounting the cover glass. The disadvantages of the hot mounting method are: the formation of bubbles under the rock slice, the formation of bubbles under the cover glass, breaking of friable sections by pressing on the

[1] Due to the fact that skin colors are not highly saturated, the color difference in the two halves of the field is ordinarily small and readings are but little affected by anomalies in the observer's visual mechanism.

[1] A. Johannsen, "Manual of Petrographic Methods," p. 595, 1918.

cover glass, breaking of the cover glass, and unless the consistency is just right there is difficulty in pressing down the cover glass evenly, frequently necessitating reheating. The advantage of the hot method is the quick cooling allowing immediate use of the section. The cold mounting method obviates all the disadvantages of hot mounting but requires several days for the balsam to dry. This disadvantage has been overcome by the use of a specially prepared liquid Canada balsam.

The preparation is rather simple and involves no unusual materials. Heat the liquid balsam in an evaporating dish slowly (for several hours) until it has a decided orange color and test for brittleness by placing a few drops in cold water. The balsam should be very brittle when cold. Then pour the molten balsam in cardboard boxes and let stand till cold. When it has hardened break away the cardboard and shave the block of balsam with a razor blade or powder it, then dissolve in a small quantity of xylol. Enough balsam should be added to thoroughly saturate the xylol, and the solution should have the consistency of thick honey. Place in the usual Canada balsam bottle, with the ground glass cover, and it is ready for use. If properly prepared, the solution should harden sufficiently in a few hours to render slides usable. By allowing to set overnight the slides can be safely filed in a vertical position, with no fear of the cover glasses moving.

In petrographic practice this method of cold mounting has proven successful and even after a year's time no ill effects have been noticed in the mounts. It is probable that the use of a liquid balsam which will harden overnight will be of as much value to biological microscopic technique as it is in petrographic methods.

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SPECIAL ARTICLES

BACTERIA AS FOOD FOR VERTEBRATES

THE rôle that bacteria directly play in the food supply of the higher forms of animal life, particularly the vertebrates, is not definitely known. That they serve as an important source of food supply to some of the protozoa has been well established experimentally. There is some evidence that bacterial cells can be utilized as food by some of the many-celled invertebrates. The latest evidence is that presented by MacGinitie, who has demonstrated that certain marine worms can utilize a species of Pseudomonas as food.[1] His report does not indicate that the worm can subsist exclusively on a diet of Pseudomonas. Bottom-feeding vertebrates, such as the tadpole, whose mouth parts have a mopping up effect on the bottom, and even such fishes as the sucker, carp, etc., which feed on organic matter on the bottom undoubtedly ingest great numbers of bacteria. The experiments described in this paper were designed to determine whether such bacteria are utilized as food.

In April, 1932, the freshly deposited eggs of *Rana pretiosa* and *Hyla regilla* were gathered. These soon hatched and served as a supply of tadpoles of the two species. They were kept in pans containing water plants of various kinds.

A few preliminary experiments demonstrated that the larval forms of *Hyla regilla* were much more sensitive than those of *Rana pretiosa* to factors other than the food supply and consequently were abandoned as the experimental animal. Both forms died when the bacterial flora became too concentrated, but the larval form of *Rana pretiosa* resisted this condition better. No attempt was made to determine whether death resulted from the reduced oxygen content or from toxic products produced by the bacteria. The animals in one flask died after receiving the bacterial washings from slants several days old.

The procedure adopted after the preliminary experiments was as follows: The tadpoles were placed in 50 cc tap water in 1,000 cc flasks. A 24-hour mixed culture of bacteria taken from the pans containing the stock of tadpoles served as the food supply. The water in the flasks was changed daily or oftener. Some fatalities occurred when too heavy a suspension of bacteria was placed in the flasks. Part of the time a heavy suspension of bacteria was placed in a flask and the tadpoles permitted to feed during the day when they could be watched. At evening they were placed in fresh bacteria-free water and thus were without food during the night. Successful results were obtained by using the bacteria washed from two to three potato extract agar slants as the daily food supply of 4 to 6 tadpoles. The amount of food needed and the concentration of bacteria resisted varied somewhat with the size of the animals. The tadpoles could be seen feeding on the bacteria as these settled on the glass. The turbidity of the suspension cleared as the feeding progressed. In some of the flasks there was sufficient organic matter introduced with the bacteria for bacterial multiplication. When too many bacteria were present, either as the result of being introduced or multiplying, the tadpoles did not thrive.

The first series of flasks were started on April 26, 1932. One flask received only tap water and served

[1] G. E. MacGinitie, "The Rôle of Bacteria as Food for Bottom Animals," SCIENCE, 76: 490, 1932.