equal volumes of an appropriate serum on a slide. Penicillinized red cells were then added, and the mixtures were observed for agglutination. As may be seen in Table 1, the solutions containing the higher concentrations of penicillin completely inhibited the agglutination reaction.

Similar inhibition was demonstrated by means of the antiglobulin method. Equal volumes of a buffered solution of penicillin G and of a suitably diluted sample of an appropriate serum were incubated 15 minutes. This mixture was then tested against penicillinized cells by the antiglobulin technique. There was negligible agglutination in this tube, whereas in the tubes in which the buffer or AB serum was substituted for the solution of penicillin G, agglutination was marked.

Among approximately 2000 sera studied thus far, 25 have reacted specifically with "penicillinized" erythrocytes. All individuals from whom reactive sera were obtained have at some time in the past received penicillin therapy. Only a minority have demonstrated any clinical penicillin sensitivity. The significance of the antibody is currently being studied.

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Notes

1. The antibiotics used in this study were kindly supplied by Dr. Henry Welch, Division of Antibiotics, Food and Drug Administration, Washington, D.C.
2. Penicillinase was kindly supplied by Dr. Bruno Puetzer, Schenley Laboratories.

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Color Coding of Stroboscopic Multiple-Image Photographs

The advantages of multiple-image photography for analyzing movement have been recognized ever since Marey developed "geometric chronophotography" in 1883 (*1*). The method has remained essentially the same, though in recent years it has been refined by the introduction of stroboscopic recording (*2*). A pattern for study is marked off on the subject in electric lights or reflecting material. The shutter of the camera is left open, and as the subject moves, the light source is interrupted at regular intervals. The movement is recorded as a time-space pattern on a single film. From the record, instantaneous displacements can be read directly, and velocities and accelerations can be obtained by differentiating.

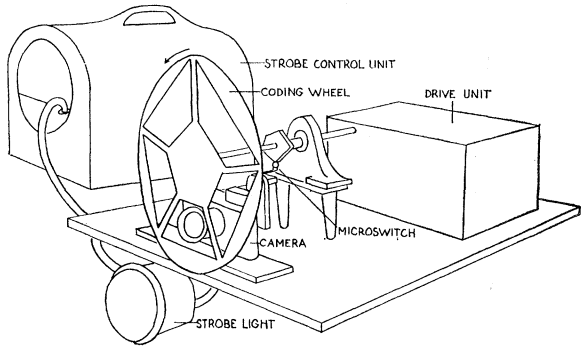

Fig. 1. Apparatus for color coding multiple-image photographs. Each aperture of the coding wheel is covered with a gelatine filter of a different color. As successive apertures come into place in front of the camera the microswitch is actuated, and a synchronized flash is emitted from the strobe.

Black-and-white photography is satisfactory for recording patterns that are relatively simple. As the patterns increase in complexity, however, interpretation becomes uncertain. The direction of movement is not given by black-and-white photography. (The movement pattern for standing-to-sitting, for example, cannot be distinguished by inspection from that for sitting-to-standing.) And when there is more than one trajectory in the pattern, it is sometimes impossible to determine which images are simultaneous. Neither problem is completely solved by the conventional method of omitting one flash from the cycle or altering its intensity.

Much of the confusion in a complex "stick pattern" can be eliminated by taking the photographs on color film and using a coding wheel to record successive images in different colors. If three or more colors are used in constructing the wheel, the direction of movement for each trajectory throughout the pattern will be recorded on the photograph. Simultaneity can readily be determined, since color automatically sorts out the images that belong together. With the help of color, the meaning of a complicated pattern can often be read at a glance. [Another type of coding may be obtained by varying the color of the reflecting material itself in order to distinguish one trajectory from another (*2*).]

We have used color coding as an aid in the analysis of human movement. A pattern for study is marked on the subject in Scotchlite reflecting tape (Silver No. 3270), and pictures are taken by coded flashes from a strobe unit. The apparatus is illustrated in Fig. 1.

The light source is a General Radio Strobolume with its lamp fastened directly below a Robot Star camera, which rests on a steel platform supported by a heavily built tripod. In front of the camera is a light aluminum wheel with a pentagonal center and five apertures, 5.5 cm at the greatest width. Each aperture is covered with a gelatine filter of a different color. A pentagonal cam on the shaft operates a microswitch so that, as successive apertures of the color wheel are centered in front of the camera, the Strobolume is actuated and a flash is emitted from the lamp. The wheel is driven by an 1800 rev/min synchronous motor at speeds of 1, 2, or 4 rev/sec, selected by a system of reduction gears. Pictures are taken on Ektachrome or Anscochrome film with an *f* stop of 4 when the camera is 12 feet from the subject.

The Strobolume operates at two intensities, high beam and low beam. The high beam, which has a flash duration of 40 μsec, cannot be operated for more than a few seconds at a time. The low beam has a flash duration of only 20 μsec and can be operated almost indefinitely at any of the rates we have used. So far, we have been able to record satisfactorily only with the high beam. With the faster color films now on the market it should ultimately be possible to record with the low beam. This would extend the range of movements that can be recorded by the method and add greatly to its usefulness.

Once the apparatus has been set up, a transparency can be made with little trouble or expense. It provides a permanent movement-record that is easy to obtain, easy to interpret, and convenient to file (*3*).

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References and Notes

1. E. J. Marey, *Compt. rend.* 96 (25 June 1883); *La Nature* (29 Sept. 1883).
2. F. P. Jones and D. N. O'Connell, *Phot. Sci. Tech. Ser. II* 3, No. 1, 11 (1956).
3. The method of color coding was developed under grants from the Carnegie Corporation of New York and the U.S. Public Health Service (R.G. 4836). An example of the method is reproduced in color in *Life* (17 Feb. 1958).

13 January 1958.