$$S—CH_2—CH_2—NH_2$$
$$S—CH_2—CH_2—NH_2$$

It is pointed out that cystamine is given with the suggested meaning in *Beilstein Handb. org. Chem.* (1942), but that in the Merck Index, cystamin is given as a trade name for hexamethylenetetramine.

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The Brocken Spectre of the Desert View Watch Tower, Grand Canyon, Arizona

THE Watch Tower spectre is beautiful and is rarely seen. It forms only when the Grand Canyon at Desert View (southeast portion of the Canyon area) is filled to a proper depth with clouds that can act as a horizontal screen for the projected shadow of the tower. Charles Farmer, tower supervisor, stated that during his twenty years of duty at Grand Canyon he had never seen the spectre before 1952. During this year, it formed once in the spring (date unknown) and again during the afternoon of December 1. It was during this last appearance that I was able to make a brief study of the phenomenon.

The spectre consists of a series of colors which arc or bow around the shadow of the tower (Fig. 1). Yellow was innermost, with reds and purples forming the intermediate and outer bands. Cloud particles diffused the colors along their adjacent edges and formed many interesting blends. Later the same day, the spectre shifted and was centered over the shorter shadow of the kiva section of the tower.

When the tower and bow of colors were first noticed during the spring occurrence, it was about 9:00 A.M. The erect shadow of the tower, and the spectre were then projected on the clouds 200 feet below the north rim, which is about nine miles northwest of the tower. Elevation at the tower is 7452 feet and at the north rim it is about 8300 feet at the Canyon edge. According to Mrs. Farmer, who was on duty at the tower that day, the spectre stayed with the shadow as it was shortened by the rising sun and moved from the west toward the east. As late as 4:00 P.M., the spectre was still visible in a small side canyon lying about ENE of the tower; the shadow was then about 400 feet in length. The bows of color subtended angles (measured from the tower) of less than one degree near the north rim, to approximately ten degrees late in the afternoon of the same day. When the phenomenon was observed on December 1, it was about 3:00 P.M. The shadow at this time extended for about 500 feet NE of the 70-foot tower.

Colored photographs have been taken of the phenomenon by Virgil Gipson, local Fred Harvey photographer, and Charles Farmer of Desert View. However, diffusion by the cloud particles usually causes the pictures to have indistinct lines and fuzziness. Unlike true rainbows, the outer band of color is reddish violet instead of red. To further complicate matters and defy explanation, the innermost color is yellow, hence it is neither a true rainbow nor an inverted one.

According to Louis Shellbach, park naturalist at Grand Canyon National Park, a bow of colors formed around the projected shadow of Yaki Point during late January or early February, 1940 (time of day unknown). He had ridden a pony to the point and thought that he could even see his shadow in the middle of the display of colors. E. T. Christensen, assistant park naturalist, reports that he has seen bows of color form around the projected shadows of Yavapai Observation Station (two miles northeast of Yaki Point and about 17 miles west of Desert View) on several different occasions when the Grand Canyon was filled with clouds.

Similar displays of bows of color were reported by Frank Sylvester, headquarters district ranger at Grand Canyon, during plane flights over the South Pacific during World War II. Frequently such displays of color entirely circumscribed the shadow of his plane, when flying between the sun and a cloud. No data were available concerning the distribution of colors around the shadows of the airplane, Yaki Point, or the Yavapai Observation Station.

Some observers of the phenomenon at Desert View have advanced the theory that it is caused by the refraction of sunlight through the windows at the top of the tower. This is rather doubtful because these windows are only a few feet square and probably would not pass sufficient light to project the nine miles to the north rim. Another theory involves multiple diffraction of the sun's rays as they pass between the tower and Canyon clouds. This principle is

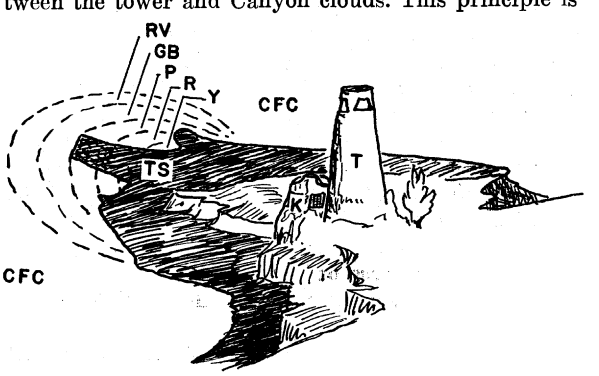

FIG. 1. Diagram of the brocken spectre, Desert View Watch Tower, and its shadow; not to scale. Symbols: CFC, cloud-filled canyon; GB, Greenish blue; K, kiva; P, purple; R, red; RV, reddish violet; T, tower; TS, tower shadow; and Y, yellow.

easily illustrated by shining a flashlight beam against the upright cap of a fountain pen and projecting the latter's shadow on a horizontal sheet of white paper. One heavy shadow and several lighter ones will be cast. Variations of the intensity of light of the minor shadows are due to the degree of reinforcement of the light rays (principle of Newton's rings). The actual breakdown of the sunlight into the various bands of color probably is accomplished by the moisture particles of the Canyon clouds.

An even more likely explanation of the phenomenon is that advanced by W. J. Humphreys:[1]

> Glory or Brocken-Bow. . . . When favorably situated, one occasionally may see rings of colored light around the shadow of his own head as cast upon a neighboring fog bank or cloud. This phenomenon, to which several names have been given—glory, Brocken-bow, Brocken-spectre, mountain-spectre—is produced by the diffraction by particles comparatively near the surface of light reflected from deeper portions of the fog or cloud.

[1] *Physics of the Air,* 1920, p. 537.

The reflected light obviously emerges in every direction, but the nearer one looks along the path of incidence the larger the ratio of illuminated to nonilluminated particles in his line of sight. Indeed, at any appreciable angle from this special direction a considerable proportion of the droplets in one's vision evidently must lie in the shadows of others nearer the surface. Hence, not only will the shadow of one's head be surrounded by the brightest reflected light, like the "heiligenschein" one may see around the shadow of his head on a bedewed lawn, but it will also be the centre of the brightest and only perceptible glory or reflected halo, and that for the simple reason that the more intense the initial light the more brilliant its diffraction effects.

No appreciable difference was noted when the phenomenon was observed along the path of the incidence light forming the shadow, as from a horizontal angle of thirty or more degrees from this path.

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Book Reviews

Symposia of the Society for Experimental Biology, No. VII: ***Evolution.*** R. Brown and J. F. Danielli, Eds. New York: Academic Press, 1953. 448 pp. Illus. + plates. $7.80.

A symposium on "Evolution" was held under the auspices of the Society for Experimental Biology, in collaboration with the Genetical Society of Great Britain, at Oxford in July of 1952. The published volume contains contributions of 26 authors, 23 of whom are British, 2 American, and 1 Belgian. Nevertheless, the volume can hardly be said to represent a cross section of current British evolutionary thought. Several well-known figures are absent and, more important, no paleontologists are included. As nearly as one can classify the participants, 10 of them are primarily geneticists, 10 botanists or zoologists, and 6 physiologists and biochemists.

The symposium opens with an interesting though necessarily speculative discussion of the origin of life by J. W. S. Pringle. The formation of prebiotic organic compounds is attributed to branching chain reactions, rather than to ultraviolet radiations postulated by Haldane, Oparin, Bernal, and others. Perhaps the most general statements of modern views of evolutionary mechanisms are contained in the articles of K. Mather on The Genetical Structure of Populations, and of C. H. Waddington on Epigenetics and Evolution. Mather emphasizes that interbreeding Mendelian populations are important units of evolutionary change; Waddington stresses the homeostatic adjustments of the developmental processes brought about by natural selection.

To this reviewer, J. M. Thoday's discussion of the Components of Fitness is most thought provoking. Thoday defines the fitness of a unit of evolution (a Mendelian population or a species) as the probability that it will leave descendants after a lapse of a long period of time, such as 10^8 years. An increase of fitness is defined as evolutionary progress, and a decrease as retrogression. High fitness may be attained by development of genetic population structures which permit sufficient genetic stability together with some evolutionary plasticity, by increasing homeostasis, or by occupation of ecological niches which are preserved more or less intact for a long time. Adaptedness is, then, the ability of the organism to survive and to reproduce under contemporary environmental conditions. The difficulty, perhaps only verbal, with Thoday's definition of fitness is that, as far as this reviewer can see, the primordial virus must be adjudged to have been the fittest creature of all, since it has left most numerous as well as most diversified descendants. The evolutionary line leading to man need not be the most progressive one, since there is no compelling reason to believe that our species will have descendants living 10^8 years hence.

The work of H. Spurway on races and incipient species of newts is important and suggestive. The hybrids between these races show a heterosis in F_1, and a breakdown in F_2 generation and in backcrosses. Is the heterosis a direct consequence of heterozygosis for numerous loci? The hybrid breakdown indicates that the genotypes of the races are integrated adaptive systems which are shattered by recombination. The chromosomes of these races differ by translocations; the origin of the races is, accordingly, best accounted for by genetic drift interacting with selection. Origin of reproductive isolation by natural selection is indi-