what aspects of the previous breeding experience are required in order that a bird should act like an "experienced" bird in this situation, what contribution is made by the purely hormonal aspects of the earlier events, what the exact details of the differences in behavior between experienced and inexperienced birds are, and so forth (*9*).

DANIEL S. LEHRMAN
ROCHELLE P. WORTIS*
*Institute of Animal Behavior, Rutgers University, Newark, New Jersey*

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* National Science Foundation Cooperative Graduate Fellow.

4 August 1960

## Thioctic Acid Contained in Visual Cell

*Abstract.* The D-α-thioctic acid content of the eye of the frog (*Rana nigromaculata*) was determined quantitatively. Outer segments of rods, whole retinas, and choroids contained, respectively 2.0, 8.6, and 13.0 mμg of D-α-thioctic acid per milligram (dry weight). DL-α-Thioctic acid had no accelerating effect on the regeneration of rhodopsin in vivo.

Several years ago, Strauss (*1*) proposed a hypothetical role of 6-8-dithioctic acid in vision. He assumed that rhodopsin should contain one molecule of 6-8-dithioctic acid per molecule of retinene and that the -S-S- bond of 6-8-dithioctic acid might be split by illumination. Since that time, however, there has been no report about this subject. In the experiment reported here the D-α-thioctic acid content of the dark-adapted frog eye (retina, choroid, and outer segments of rods) was measured, and the effects of DL-α-thioctic acid on the regeneration of rhodopsin in vivo were observed by means of the intraocular injection method (*2*).

To measure the D-α-thioctic acid content of the frog eye (*Rana nigromaculata*), 75 dark-adapted frogs were used. They were kept in a dark room overnight, and all operations were carried out under dim red light. The outer segments of rods were isolated, by Kimura's sugar flotation method (*3*) at 0°C, from 60 frogs. Retinas and choroids were separated from the rear half of eyeballs of 15 frogs at room temperature (about 15°C). To determine D-α-thioctic acid, tissues were homogenized in a Potter-Elevehjem homogenizer and were hydrolyzed with 6*N* $H_2SO_4$ for 1 hour at 120°C. For the microbiological assay of D-α-thioctic acid, *Streptococcus faecalis* (10 CL) was used.

Outer segments of rods, whole retinas, and choroids contained, respectively, 2.0, 8.6, and 13.0 mμg of D-α-thioctic acid per milligram (dry weight). According to Hubbard (*4*), the rhodopsin content of outer segments of rods in the frog is about 35 percent of the dry weight, and frog rhodopsin has a molecular weight of about 40,000 and contains only one retinene per molecule. If Strauss's hypothesis were correct, the thioctic acid content of the outer segments of rods might be about 1600 mμg per milligram (dry weight). However, only 2.0 mμg of D-α-thioctic acid per milligram (dry weight) was contained in the outer segments of rods.

Table 1 gives data for the effect of DL-α-thioctic acid on the regeneration of rhodopsin in vivo. In each experiment, ten frogs (*Rana nigromaculata*) were light-adapted for 2 hours under white light (2000 lux). A DL-α-thioctic acid solution (0.02 ml neutralized with NaOH, containing 400 μg of DL-α-thioctic acid) was injected into the vitreous humor of the left eye (*2*). The right eye was used as the control. After the injection, the frogs were placed in the dark at about 20°C for 1 hour. Then the outer segments of rods were isolated under dim red light at 0°C. For the quantitative determination of rhodopsin contained in separated outer segments of rods, Kimura's method was used (*5*). The DL-α-thioctic acid had no accelerating effect on the regeneration of rhodopsin in vivo, as shown in Table 1.

From these results it cannot be concluded that D-α-thioctic acid is directly related to the construction of rhodopsin. However, the observation that D-α-thioctic acid is found abundantly in the choroid as well as in the liver is particularly interesting, suggesting a possible relationship to the function of visual cells. Further studies are being carried out in our laboratory on the role of D-α-thioctic acid in vision.

Table 1. The effect of DL-α-thioctic acid on the regeneration of rhodopsin in vivo. All data are expressed as follows: $R = [\Delta E/\text{Dry wt. (mg) of separated outer segments}] \times 100$. Here $\Delta E$ is the difference in optical density at 500 mμ before and after illumination.

| Experiment No. | With thioctic acid | Control |
|---|---|---|
| 1 | 5.6 | 6.2 |
| 2 | 6.0 | 7.0 |
| 3 | 4.5 | 5.1 |
| 4 | 7.0 | 7.5 |
| 5 | 7.0 | 7.8 |

ISAO HANAWA
KIYOSHI KUGE
*Department of Physiology, Osaka City University Medical School, Abeno-ku, Osaka, Japan*
JUNITSU SAITO
*Osaka Research Laboratory, Fujisawa Pharmaceutical Company, Osaka, Japan*

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1 July 1960

## Brightness Scaling of White and Colored Stimuli

*Abstract.* Brightness scales for chromatic and achromatic test stimuli have been obtained by the methods of ratio production and magnitude estimation for the dark-adapted observer and conditions of brief foveal stimulation. All scales adhere to the form of a power law for brightness, and scales obtained under the differing psychophysical procedures agree.

There is now considerable evidence from several laboratories both here and abroad relating to the form of the brightness scale for the dark-adapted observer (*1*). The universal finding is that brightness is related to luminance by a power law with an exponent of about 0.3. That the results of studies obtained under widely different conditions should happen to agree might be attributed in part to biases associated with one or another scaling procedure, or to the interaction of the scaling method with a fortuitous choice of stimulus conditions for measurement. Earlier studies employed differing stimulus areas (Stevens, 3.3°; Hanes, 4.5°; Hopkinson, 2°), differing durations of test stimulus (2 to 3 seconds, or prolonged viewing), and differing means of controlling the effects of simultaneous contrast. These studies all employed stimuli large enough to stimulate extrafoveal areas and long enough to permit some local adaptation to the test flash. Hanes employed the method of ratio production, Stevens and Hopkinson the method of magnitude estimation.

The purpose of the investigation reported here was to compare brightness scales obtained by differing scaling