of Eley and Myers (*10*), α, the proportion of energy absorbed by photosystem II at 482 or 647 nm must be only slightly greater than 0.5 and at 700 nm must be much less than 0.5, as Eley and Myers concluded. Furthermore, the shift in α at auxiliary wavelengths must be small and negative, whereas the shift at 700 nm can be either negative or positive but must be small, preferably zero. A second explanation of the variation in enhancement is that the mechanism of photosynthesis changes from a reaction that involves two photosystems in series to a simpler single photosystem perhaps similar to that proposed by Govindjee *et al.* (*8*) or by Hoch and Owens (*11*). This latter mechanism is operationally equivalent to the two-light mechanism for the special case in which $\alpha = 0.5$ and thus the two are not distinguishable on the basis of enhancement determinations alone. One factor in favor of the hypothesis of a controllable α is that it can be used to explain some of the observations of Knaff and Arnon (*12*). If α for the auxiliary wavelengths has changed enough so that it is less than 0.5, the wavelength that activates photosystem II will behave like the one that activates photosystem I and oxidize the cytochromes between the two photoreactions. Furthermore, there should be no enhancement, as Knaff and Arnon have reported. This kind of extreme change in α could have been caused by the isolation of the chloroplasts in a medium that contains a high concentration of sodium chloride which stimulates galactolipases (*13*) and promotes the generation of free fatty acids that are known to damage chloroplasts (*14*).

Regardless of the interpretation of the phenomenon, the finding of controlled photosynthetic enhancement means that most of the kinetic studies of individual components of oxidation-reduction reactions in chloroplasts should be redone to see whether the kinetic properties change as predicted. Finally, control of enhancement found in a vascular plant is most likely characteristic of many photosynthetic organisms because it has also been found in synchronized green algae grown in sufficient media (*15*). It may also be analogous to the environmental control of fluorescence (*9*), although the amount of prior illumination needed to decrease enhancement in these experiments is much greater than that used in studies of fluorescence by Bonaventura and Myers (*9*). The difference may be partly due to the influence of nutritional factors on the transformation occurring in higher plants.

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Stereoscopic Depth Aftereffect Produced without Monocular Cues

Abstract. *Random-dot stereograms when used as adaptation stimuli can influence the perceived depth of similar test stimuli. Adaptation for 1 minute is sufficient to evoke this three-dimensional aftereffect for several seconds. This aftereffect must occur after stereopsis because prior to stereopsis no relevant monocular cues exist in these adaptation and test stimuli.*

Ever since Gibson (*1*) discovered the tilt aftereffect the question of whether such phenomena may occur in the third dimension of perceptual space has aroused much interest. Köhler and Emery (*2*) found that prolonged observation of an object at one depth can change the apparent distance of objects seen afterward. These phenomena occur after one adapts to stereoscopic pictures, which suggests that they depend only on disparity cues. However, there remains the obvious possibility that the effects could be explained solely by the induction of monocular aftereffects of the type described by Gibson (*1*) and Köhler and Wallach (*3*). Different monocular changes in position, curvature, or orientation in the two eyes after adaptation could produce changes in stereoscopic depth. Köhler and Emery (*2*) tried to control for the problem of monocular aftereffects by adapting to stereograms with quick alternation between right and left eyes. They chose a high rate of alternation in order to produce adaptation but not so rapid a rate that stereopsis should ensue; and indeed no three-dimensional aftereffects occurred under these conditions. However, it is most likely that this procedure also abolished any independent monocular adaptation for the left and right pathways, respectively. So the question of genuine three-dimensional aftereffects is still open.

We wondered whether adapting to a random-dot stereogram (*4*) might afterward produce apparent changes in depth. This would indicate that there can be genuine adaptation of disparity-analyzing mechanisms and that monocular contour is not necessary for this adaptation (for such stereograms contain no monocular shape prior to stereoscopic combination). Random-dot stereograms do produce such a stereoscopic aftereffect (Fig. 1).

The upper stereo pair (Fig. 1A) is for adaptation. In the center is a horizontal, white fixation bar raised in depth from the background. Above it is a square that stands out even closer to the observer and below is a square that is the same distance behind the fixation mark. All three objects are floating well in front of the background. The lower stereo pair (Fig. 1B) is similar but the fixation point and the two squares are all in the same plane. The reader can fuse this second stereogram to confirm that the two squares seem aligned in depth while he fixates the bar. (It is relatively easy to fuse these stereograms by crossing the eyes; however, a prism may aid fusion.)

Now look up at the adapting pattern and fuse the fixation point. Adapt for about a minute taking great care not to diverge or converge your eyes away from the white bar. You will probably notice that under such conditions of fixation the squares in depth rapidly start to fade out. To avoid this fading you should scan back and forth along the fixation bar. On transferring your gaze very quickly to the fixation point on the fused test pattern below, the two squares should seem at different depths for a few seconds. The lower one should seem closer and the upper one farther away. If, in the adapting situation, the lower square is made closer than the fixation point and the upper one farther away, then the direction of the depth change in the aftereffect reverses.

Even if one just looks at a flat random-dot pattern with no squares in it, after adapting to Fig. 1A, the region below one's fixation point seems to protrude slightly and the area above seems depressed. So the phenomenon does not require that the adapting and test patterns be similar in shape. This observation answers a possible objection that Osgood and Heyer (5) raised against the Köhler and Wallach aftereffect. According to this objection the cause of the aftereffect might be perceived size changes of the squares owing to their different depths. Although it is reassuring that this three-dimensional aftereffect is not the result of perceived size changes, one must realize that for random-dot stereograms the question of size cues is of no importance. After all, for random-dot stereograms these squares do not exist monocularly prior to the stage where stereopsis occurs. Thus, the processes responsible for the aftereffect must occur after stereopsis. Let us also note that the random texture is different in these two stereograms. There cannot possibly be any monocular explanation for this aftereffect.

We studied the phenomenon by projecting the stereograms of Fig. 1 on an aluminized screen to subjects wearing polarizers. After adaptation the test pattern was substituted with a delay of only about 0.1 second. The whole stereogram subtended 11 degrees of visual angle in width and had a resolution of 1000 × 1000 picture elements. Thus, each picture element subtended 40 seconds of arc. The fixation bar, which is shifted by ten picture elements, is therefore at a disparity of 6.7 minutes of arc in front of the background both

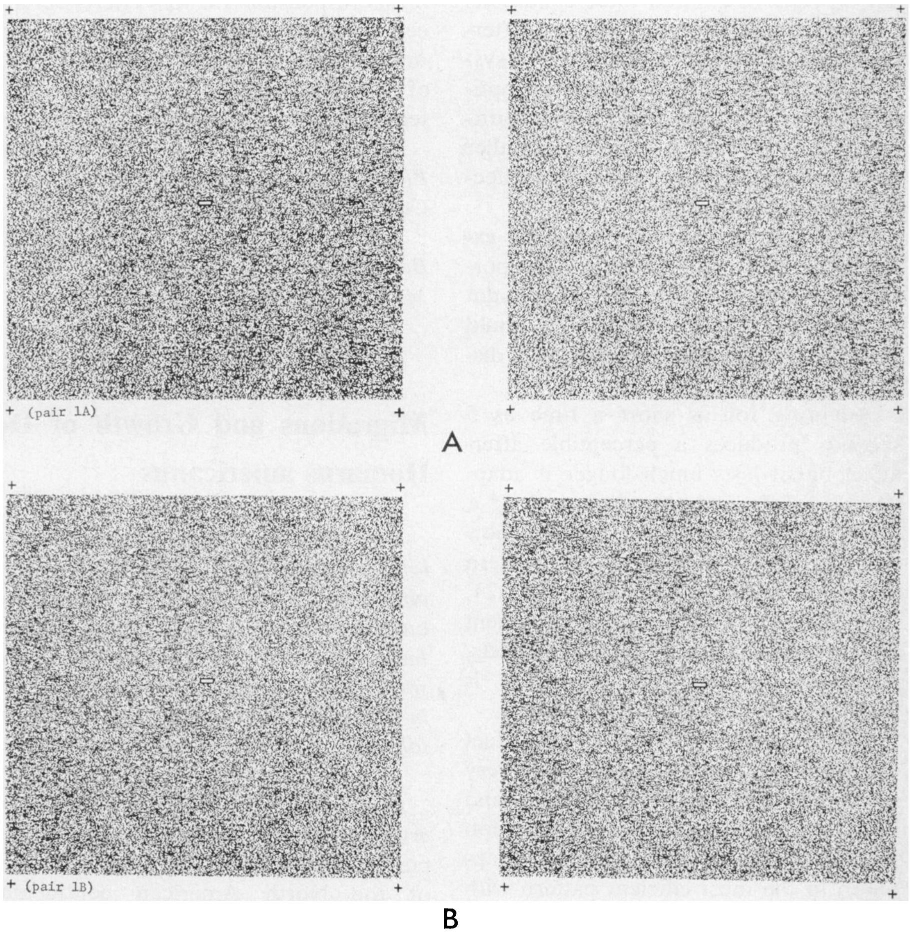

Fig. 1. Random-dot stereograms. (A) Adaptation stereogram with fixation mark and two squares at different depths. (B) Test stereogram with same fixation mark and two squares at the same depth. When reader stereoscopically fuses Fig. 1A and fixates at the center marker for about 1 minute and then quickly fuses Fig. 1B, keeping fixated at the center marker, the squares appear at different depths for a few seconds.

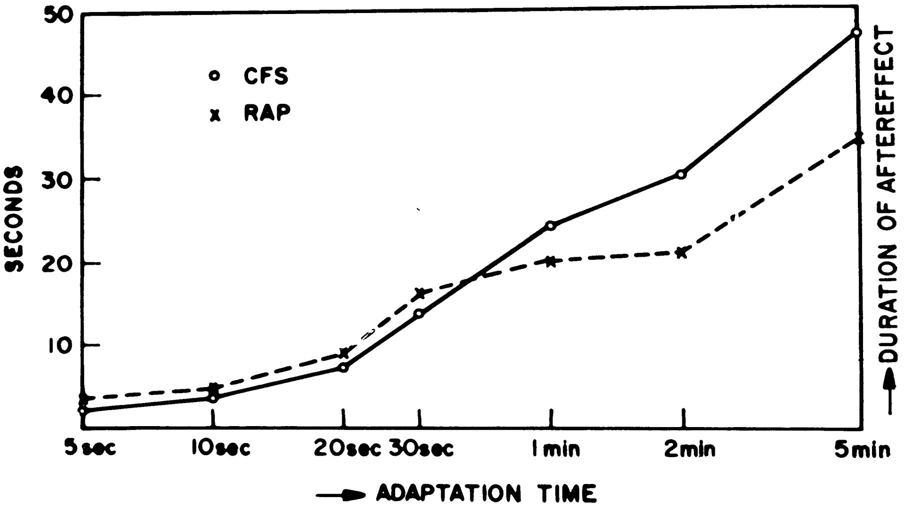

Fig. 2. Duration of aftereffect in seconds as a function of adaptation time for two subjects. Each point is the average of four measurements.

in Fig. 1A and B (*6*). In the adapting pattern the upper square is a further disparity of 2 minutes of arc (three-element shift) in front and the lower square is the same disparity behind the fixation point. In the test pattern the squares are at the same depth as the fixation bar. We found these conditions to be optimum for inducing the aftereffect. Although we did not explore systematically the conditions for an optimum aftereffect, we observed that differences in disparity larger or smaller than 2 minutes of arc yielded less effective adaptation stimuli.

A number of observers tried the experiment informally. A small proportion had difficulty in fusing random-dot stereograms, but all those who could fuse the stereograms experienced a distinct aftereffect.

Adapting for as short a time as 5 seconds produces a perceptible aftereffect but it lasts much longer if adaptation is prolonged. An observer held a stopwatch and simply estimated how long the two squares in the test pattern appeared to be misaligned (Fig. 2). Despite the difficulty of this judgment results were similar in different subjects. It is evident that the aftereffect is lengthened by prolonged adaptation.

To measure the strength of the effect we used test stereograms with very small disparities for the upper and lower squares and in the same direction as those in the adapting pattern. Adaptation to the most efficient pattern with a disparity of ± 2 minutes of arc would just flatten out a test pattern with a disparity of ± 30 seconds of arc, which made the two squares momentarily seem aligned in depth. Thus, the strength of the aftereffect is in the order of a change of 30 seconds of arc in disparity, well above the limit of stereo acuity. This value was obtained for 2-minute adaptation time. Further increase of adaptation time did not markedly influence the strength of the aftereffect.

The finding that the duration of the aftereffect is markedly influenced by the adaptation time, but not its strength (provided the adaptation time exceeds about 2 minutes), is interesting, but not restricted to this aftereffect alone. Among the recently discovered aftereffects (*7*), those of Blakemore and Campbell and Blakemore and Sutton have this same property.

The finding that random-dot stereograms produce an aftereffect in depth has several implications. First, it shows that textures without large monocular contours (except for small edges at the boundaries of the granules) can evoke a three-dimensional aftereffect. But, more importantly, the fact that the stimuli for adaptation only exist at a site where global stereopsis is processed demonstrates that the neural mechanisms responsible for this aftereffect are central. Random-dot stereograms are uniquely suited to this kind of tracing of information flow in the visual system (*8*).

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Migrations and Growth of Deep-Sea Lobsters, Homarus americanus

Abstract. *In distinct contrast to the restricted movements of coastal stocks of lobsters* (Homarus americanus), *those inhabiting the outer continental shelf undertake extensive seasonal migrations. Of 5710 tagged lobsters released on the outer continental shelf off New England from April 1968 to June 1969, 400 had been recaptured by April 1970. The distribution of the recoveries demonstrated shoalward migration in spring and summer and a return to the edge of the shelf in fall and winter. Deep-sea lobsters have a faster rate of growth than coastal lobsters; growth increments at molting and the frequency of molting are greater.*

Commercial concentrations of northern lobsters, *Homarus americanus*, occur to depths of 700 m along the edge of the North American continental shelf and slope from Georges Bank, off Massachusetts, southward to the latitude of North Carolina (*1*). Over the past decade these stocks have become an increasingly important part of the valuable lobster fishery of the United States. Landings by offshore trawlers have averaged over 5 million pounds (1 pound = 0.453 kg) annually for the past 5 years and now constitute over 15 percent of the total U.S. lobster landings. The migration of these lobsters is being studied by the U.S. Bureau of Commercial Fisheries Laboratory, Boothbay Harbor, Maine, to establish the degree of interaction with endemic populations of the coast of New England. Other approaches to the problem of stock identification include biochemical studies, parasitological studies, and morphometric comparisons. This report describes the seasonal migration of deep-sea lobsters, based on recapture of tagged specimens.

Table 1. Summary statistics of lobster releases and recoveries.

Release location	Releases			Recoveries			
	No. tagged	Females (%)	Mean carapace length (mm)	No. and percent recaptured	Females (%)	Mean carapace length at tagging (mm)	Mean radius of dispersion (km)
Georges Bank	46	50.0	128.7	6 (13.0)	50.0	129.0	28.0
Corsair Canyon	975	65.2	141.1	68 (7.0)	62.8	140.2	65.2
Lydonia Canyon	223	61.9	116.5	21 (9.4)	42.9	118.5	58.1
Southwest Georges	521	41.8	105.9	38 (7.3)	28.9	100.1	59.2
Veatch Canyon	2412	47.9	84.8	154 (6.4)	45.2	82.7	48.3
Atlantis Canyon	530	67.2	91.0	52 (8.8)	71.1	90.1	43.9
Block Canyon	857	53.2	92.6	53 (6.2)	64.1	88.7	76.9
Hudson Canyon	146	53.4	80.2	8 (5.5)	75.0	80.9	77.9