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Response of the Human Lens to a Sudden, Startling Stimulus.

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It has been shown, by means of skiascopy, that the rabbit's eye becomes more hypermetropic when the animal is startled or excited.[1] This reaction has now been found to take place in man under suitable conditions.

Observations have been made on 54 different human subjects. The subject's eyes were first "neutralized" by skiascopy, then while the "against motion" of the shadow was being observed, a slight electric shock from an induction coil was administered through electrodes held between the subject's thumb and forefinger. The shock was of sufficient strength to be distinctly felt but not strong enough to cause distress. The sending of the shock was controlled by the foot of the observer, the subject being unaware when the contact switch was being thrown in.

In 37 of the 54 subjects the eye under observation became more hypermetropic in response to the electric shock as shown by the sudden change of the skiascopic shadow from "against motion" to "with motion". In all except 2 the change was only a momentary one and quantitative measurement of it was impossible. In 2 subjects, however, the reaction was more sluggish and therefore measurable. In one the change was 0.50 D, and in the other 0.75 D. Judging from the speed of the shadow motion, the observer (M.W.M.) inferred that in all the subjects who showed the reaction, except the 2 just mentioned, the change was approximately 0.25 D.

One-third of the subjects did not show a reaction of the lens to the electric shock to the fingers, although in each case the pupil dilated. It was thought that this type of stimulus might be inadequate for some persons but a different stimulus might cause the reaction to appear. With the assistance of Dr. N. W. Shock and Mr. J. Pack, one subject of each group was subjected to a long series of auditory stimuli, such as a musical note from an oscillator, sounds from a shrill siren, a small bell, an automobile horn, a shot from a cap pistol, and a loud snap of a flat spring against a wooden panel. At the time that the shadow in the eye was being observed, change in size of the pupil was also noted and records were taken of skin re-

[1] Olmsted, J. M. D., and Morgan, M. W., Jr., *Am. J. Physiol.*, 1939, **127**, 602.

sistance (psychogalvanic reflex), pulse rate, and foot volume, *i. e.*, reflexes known to involve the sympathetic nervous system.

In the subject who had shown no lens response to the electric shock on the finger (a laboratory technician who is accustomed to receiving such shocks in repairing electrical apparatus) the pupil dilated to each change of auditory stimulus but not to a moderate one after being several times repeated; the skin resistance changed to 60% of the stimuli, the heart rate to 26%, the foot volume to 20%, and the lens to 33%. The siren and snap of the spring were the most effective stimuli, the automobile horn and cap pistol next. This shows that the lens response will occur with one type of stimulus although it may not with another.

In the subject (J.M.D.O.) whose lens responded to finger shock, the pupil dilated and the skin resistance gave large variations upon each auditory stimulus, no matter how many times repeated; the pulse responded to 30% of the stimuli, the foot volume to 26%, and the lens to 37%.

In both subjects changes in pulse rate, foot volume and lens appeared independently of one another but in about the same proportion of trials. The more sudden and startling the stimulus, the greater the likelihood of the appearance of more than one of these responses. The fact that all these reactions, except the lens response, are known to be effects of sympathetic stimulation strengthens the view previously stated that increase in hypermetropia attendant upon startling the subject must also be due to sympathetic stimulation.

Summary. Appropriate sudden stimuli, such as an electric shock on the hand or a loud noise, causes the human lens to become momentarily more hypermetropic. Since this effect is always accompanied by dilation of the pupil and may be accompanied by change in skin resistance, increase in heart rate, and decrease in foot volume, it, too, is thought to be a result of sympathetic stimulation.