cells (*cc*), it is safe to assume that these cells, probably only the sieve tubes, were involved in translocation of the tracer. The two labeled bundles of the cross sections obviously correspond to the two dark lines of the internode of Fig. 2B. These bundles were connected with the branch traces of the lateral shoot, and the branch traces were connected with the median trace of the treated leaf.

Portions of basal internodes of 15- to 26-month-old plants were fixed in a mixture of osmic and chromic acids for electron microscopy. Generally, sieve elements of the peripheral bundles appeared empty. The wall of the sieve element was lined with a plasmalemma and remnants of cytoplasmic membranes, possibly endoplasmic reticulum. Occasional small mitochondria and plastids with dense triangular inclusions, apparently typical of monocotyledonous sieve elements (*10*), were associated with the parietal membranes. The cell lumen contained a filamentous substance which appeared distorted or disrupted. A similar substance in *Elodea* sieve elements has been interpreted as slime (*11*). All sieve elements examined lacked nuclei. The sieve-area pores were lined with callose and occluded with dense masses of filamentous material. The distorted appearance and uneven distribution of the filamentous substance within the sieve elements, plus the presence of numerous inclusions free of the plastid membranes, suggest that the contents had undergone considerable deformation during manipulation of the tissue. The nucleate companion cells contained numerous mitochondria and vacuoles and were relatively undisturbed when compared with the apparently highly disturbed sieve-element contents. This difference emphasizes that intact sieve tubes probably have high turgor pressures.

Results of the present investigation provide evidence that at least certain sieve tubes of the primary phloem of perennial monocotyledons remain functional for long periods of time or as long as the plant part in which they occur remains alive.

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References and Notes

1. R. F. Evert, *Amer. J. Bot.* **49**, 659 (1962).
2. W. Holdheide, in *Handbuch der Mikroskopie in der Technik*, H. Freund, Ed. (Umschau Verlag, Frankfurt am Main, Germany, 1951), Band 5, Heft 1, p. 193.
3. E. L. Ervin, thesis, University of Wisconsin, Madison (1967).
4. M. V. Parthasarathy and P. B. Tomlinson, *Amer. J. Bot.* **54**, 1143 (1967).
5. P. B. Tomlinson, in *The Formation of Wood in Forest Trees*, M. H. Zimmermann, Ed. (Academic Press, New York, 1964), p. 65.
6. R. F. Evert, W. Eschrich, J. T. Medler, F. J. Alfieri, *Amer. J. Bot.* **55**, 860 (1968).
7. W. Eschrich, *Biochemie der Phenole* (Konf. Ges. Biol. Chem., Feldafing, Bayer, 1967), vol. 4; W. Eschrich and Th. Hartmann, *Planta*, in press.
8. W. Eschrich, *Planta* **70**, 99 (1966).
9. ——— and M. Steiner, *ibid.* **74**, 330 (1967).
10. H. D. Behnke, *Z. Pflanzen Physiol.* **57**, 243 (1967); *Naturwissenschaften* **55**, 140 (1968); ———, *Planta* **84**, 174 (1969).
11. H. B. Currier and C. Y. Shih, *Amer. J. Bot.* **55**, 145 (1968).
12. Part of a thesis work of W. Heyser supported by the Deutsche Forschungsgemeinschaft of the Federal Republic of Germany.

21 January 1969; revised 14 March 1969 ■

Lysergic Acid Diethylamide: Effects on the Developing Mouse Lens

Abstract. *High doses (5×10^{-6} gram) of LSD-25 given to Swiss-Webster females on gestation days 6, 7, 8, or 9 caused a high incidence of anterior subcapsular lens abnormalities. Accompanying this, the lens epithelium was often hyperplastic, and the lens bow was widened posteriorly in a fashion similar to cataracts induced by x-radiation. Confirmation of this effect of LSD-25 was obtained by a (duplicate) experiment 1 year after the observations reported.*

The teratogenic effects of LSD-25 on the fetuses of the rat (*1*), mouse (*2*), and hamster (*3*) have been reported, with results varying from a decrease in litter size (*1*) to malformations of the central nervous system (*2*, *3*). We now report the effects of LSD-25 on the developing lens. The abnormality has heretofore not been described; however, certain aspects of it are similar to lens changes induced by x-rays in mice (*5–7*), rats (*5*, *7*), and rabbits (*4*, *5*), and to anterior ocular inflammation in man (*8*).

Pregnant Swiss-Webster mice in groups of six were given single interperitoneal doses of 5×10^{-6} g of LSD-25 on gestation days 6, 7, 8, or 9; embryos were killed on day 18. The equivalent human hallucinogenic dose would be about 0.17 μg per 25 g of body weight. Our dose of 5 μg was 30 times this amount. Because we did not know the effects of high doses of LSD-25 on fetal survival, embryos were removed on gestation day 18 to check for resorptions. Control animals were in two groups: the first consisted of subgroups of five mice treated with 1×10^{-6} of sodium potassium tartrate (the carrier of LSD-25) on days 6, 7, 8, or 9, and the second consisted of eight pregnant females not treated. All embryos were killed on gestation day 18, and whole heads were fixed in cold Carnoy's solution for at least 72 hours. After the whole heads were dehydrated in alcohol of increasing concentration up to 100 percent, they were then placed in methyl benzoate and benzene,

Table 1. Percentages of abnormal lenses in fetuses of LSD-treated mice.

Gestation age	Females* (No.)	Fetuses (No.)	Eyes examined (No.)†	Abnormal/ total	Percentage of abnormal lenses
		Experimental group—LSD-25			
6	3	13	26	21/26	81
7	5	54	99	64/99	65
8	5	21	31	17/31	55
9	5	32	61	48/61	79
		Control group—treated			
6	4	34	32	0/32	
7	5	41	53	0/53	
8	6	61	71	0/71	
9	5	44	62	0/62	
		Control group—untreated			
	8	61	122	0/122	

* The discrepancy in the number of animals treated in each group and the number listed in this table is due to nonpregnant animals. † The disparity between the number of fetuses and number of eyes examined is due to difficulties in processing.

for 24 hours each, to avoid excessive hardening. They were then infiltrated with paraffin (three 3-hour changes). All sections were made in the horizontal plane.

Our first experiments revealed that high doses of LSD-25 had no effect on fetuses treated on gestation day 4 or 5. Fetuses treated with high doses on gestation days 6, 7, 8, or 9, before closure of the neural tube and before formation of the eye, however, reacted dramatically (Table 1). Animals injected with LSD-25 (5×10^{-6} g) on day 6 showed an 81 percent incidence of subcapsular lens abnormalities (abnormal lenses/total lenses) compared to the controls. Animals treated on day 7 showed 65 percent subcapsular abnormalities; on day 8, 55 percent; and on day 9, 79 percent. In contrast, the control series consisting of one group of untreated mice and another group treated with sodium potassium tartrate showed no ocular abnormalities in 241 embryos. In addition, there were no histologic malformations of the central nervous system in either the experimental or control groups.

The subcapsular defect (Fig. 1, b–d) was an accumulation of a finely globular, eosinophilic substance (that did not stain with periodic acid Schiff reagent) (Fig. 1d) outside the anterior lens epithelium and under the capsule. The defect varied in extent on the surface of the lens. In approximately 50 percent of the abnormal eyes, the accumulated substance covered the entire anterior surface of the lens (Fig. 1c) from one equatorial region around to the other. The remaining lenses had a more localized abnormality on the anterolateral surface over the germinal zone of the epithelium (Fig. 1b). In comparison to the normal (Fig. 1a), these subcapsular accumulations were always accompanied by a distortion of the lens (Fig. 1, b and c). The lens capsule, stretched by the subcapsular accumulation (Fig. 1d), showed no consistent thickening compared to controls.

The lens epithelium was commonly hyperplastic in the germinal zones, especially in those lenses with the more localized anterolateral defects. In many cases the lens bow was widened posteriorly and the cells migrated posteriorly (Fig. 1, b and c) instead of anteriorly, as seen in the normal controls (Fig. 1a). The nuclei of the lens epithelial cells remained small and darkly stained compared to the controls, even after migration. Inflammatory cells, suggesting an inflammatory reaction, were not found around the lenses in our experimental series.

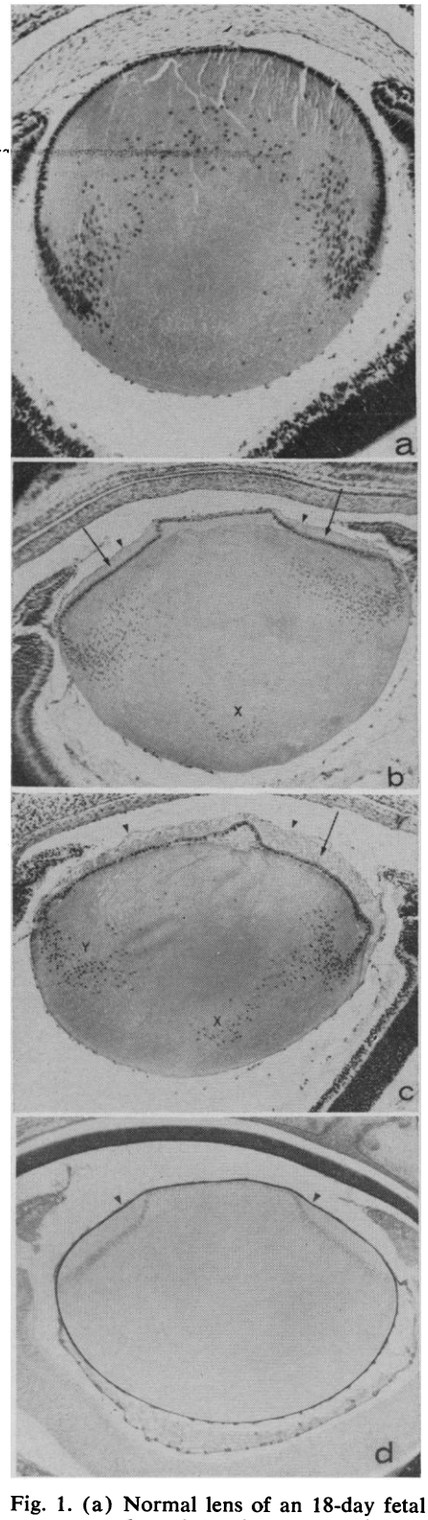

Fig. 1. (a) Normal lens of an 18-day fetal mouse cut lateral to the equator in the horizontal plane (× 48). (b, c) Similar sections through the lenses of 18-day fetal mice treated with LSD-25 early in gestation. Arrow heads indicate the capsule; arrows, the subcapsular accumulation; X, the abnormal posterior migration of cells; and *Y*, the widened lens bow (× 38). (d) Similar horizontal section through the lens of an 18-day fetal mouse treated with LSD-25; periodic acid Schiff stain. Arrow heads indicate the capsule (× 45).

Signs of early hydropic degeneration of the anterior subcapsular lens fibers were seen in only a few cases (Fig. 1c).

High doses of LSD-25, therefore, can cause a subcapsular lens abnormality associated with abnormalities of the lens epithelium. We hesitate to call this subcapsular accumulation a cataract because it is not associated with definitive changes in the lens fibers and was not allowed to develop beyond the late embryonic stage.

The lens epithelium reacted abnormally in many cases. Hyperplasia was common in the germinal zone, particularly under the localized anterolateral defects, and the nuclei of the epithelial cells remained small and dark staining. The lens bow in many cases was distorted and cells migrated into the posterior as well as anterior regions of the lens. This was found in both midequatorial and lateral sections and was not a section artifact. The abnormal widening of the lens bow posteriorly and the posterior migration of cells are similar to the initial stages of cataract formation in response to x-irradiation (*4–7*). In that our embryos were not permitted to survive beyond day 18, the subsequent development of this early abnormality was not determined. The hyperplasia of the lens epithelium suggests an association with an overproduction of the proteinaceous substance secreted under the capsule. Many large subcapsular accumulations, however, were accompanied by a normal epithelium.

Confirmation of the effect of LSD-25 on the developing mouse lens was recently obtained by a duplicate experiment made 1 year after the observations reported here.

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References and Notes

1. G. J. Alexander, B. E. Miles, G. J. Gold, R. Alexander, *Science* **157**, 459 (1967).
2. R. Auerbach and J. A. Rugowski, *ibid.*, p. 1325.
3. W. F. Geber, *ibid.* **158**, 265 (1967).
4. L. von Sallman, *Arch. Ophthalmol.* **45**, 149 (1951).
5. ———, *Amer. J. Ophthalmol.* **44**, 159 (1957).
6. T. C. Evans, R. D. Richards, E. F. Riley, *Radiat. Res.* **13**, 737 (1960).
7. C. Hanna and J. E. O'Brien, *ibid.* **19**, 1 (1963).
8. M. J. Hogan and L. E. Zimmerman, *Ophthalmic Pathology: An Atlas and Textbook* (Saunders, Philadelphia, 1962).

20 February 1969