PROGRESSIVE DEVELOPMENT UNDER PINEAL TREATMENT

	Ears Opd.	Teeth Erupt.	Fur Appd.	Eyes Opd.	Testes Descd.	Vagina Opd.
Controls	2½–3½	8–10	16	14–17	31–40	55–72
	(3)	(9.0)	16	(15.5)	38	65
F_1	2–3	8–10	7–16	12–17	12–36	32–56
	(3.3)	(9.0)	(13.0)	(14.9)	(22.0)	(45.0)
F_2	2–3	7–11	6–17	12–16	6–26	30–39
	(2.8)	(9.0)	(12.0)	(13.8)	(15.0)	(37.0)
F_3	2–3	5–8	5–12	5–13	5–12	29–39
	(2.3)	(6.9)	(9.0)	(9.8)	(10.0)	(32.0)
F_4	1–3	3–5	4–8	4.8	4–9	23–26
	(2.0)	(4.0)	(5.0)	(6.0)	(5.0)	(24.0)

The number of rats constituting the basis for the weight curves is as follows: For the controls, 301 rats, for the F_1 Generation, 138 rats, for the F_2 Generation 543 rats, for the F_3 Generation 155 rats and for the F_4 Generation 41 rats.

size and in the rate of growth and development of individual members of a litter is striking. Because of this variability, the range of values, as well as the average, is presented in the accompanying table.

The compiled data on both the growth and development, as expressed in tables and curves, reveal the same step-like progression in succeeding generations under treatment as was evidenced in our thymus-treated strain of rats. However, in the pineal studies there appears a paradox, a dissociation of the effects on growth and differentiation. The progressive accruing effect is in two or possibly three directions, retardation in growth accompanied by acceleration in gonadal development and also in bodily differentiation.

Caution must be exercised in interpreting these biological effects as indicating the functions of the pineal gland. If such were the case, then one should expect pinealectomy to result in enhanced growth and retarded development. Such, however, is not the case to date in the majority of instances in a small series of rats subjected to pinealectomy in our institute by Dr. N. H. Einhorn. Further studies in this connection are desirable.

From the foregoing it is evident that our results in the study of many hundreds of rats do not conform entirely to any of those reported in the literature. It is true that in common with the majority of workers we have observed little of significance in the first generation under treatment. In the subsequent generations we have found consistently "dwarfism," rather than overgrowth. Precocity, however, has been observed in all our animals from the third generation on and this concerns both gonadal and bodily development. The resulting animal is small, usually half or less than half the normal size, during the early weeks of life, precocious in development, with gonads suggesting the macrogenitalism seen clinically in certain types of tumor of the pineal gland. In addition the animals are physically weak and appear more irritable and nervous than normal, and eye anomalies abound.

CONCLUSIONS

Pineal extract (Hanson) has retarded the rate of growth and accelerated the rate of differentiation and has hastened the onset of adolescence in the offspring of treated parents. The end result is "dwarfism" with precocious development and relative macrogenitalism.

The injection of succeeding generations of parent rats has resulted in the amplification of these biologic effects in succeeding generations of their young.

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ARTIFICIAL CONTROL OF NUCELLAR EMBRYONY IN CITRUS

THE supernumerary embryos, other than those of seminal origin, which develop from seeds of most species of citrus and related genera were identified as cases of nucellar embryony by Strasburger,[1] a form of sporophytic budding.[2] It has been repeatedly noted that the number of embryos developed from individual seeds may vary from one to many in any particular lot of seeds.[3] This would indicate that, although the tendency to produce nucellar embryos is inherited, the environment may materially influence the number of such embryos actually developed under any particular set of conditions. This tendency to produce supernumerary nucellar embryos is a serious handicap to any effective study of progeny in citrus-breeding experiments. The observation with reference to the variability in the number produced, however, pointed to a possible method of solving the problem. A working hypothesis was formulated on this basis and definite experiments initiated to test it.

The original hypothesis, formulated in 1932, was that the initiation of such nucellar embryos might be inhibited or that such embryos might be rendered inactive or destroyed after formation by decreasing the food supply ("starving" the entire pericarp). Since 1932 the hypothesis has been amplified as to the nature of the environmental factors which may be operative—the nature and amount of food supply, moisture supply, temperature, age of seed, seed maturity, desiccation of seed, etc.

The specific method used in the initial attempts to decrease the food supply available to the developing pericarp was to keep it and the surrounding leaves covered until maturity with three thicknesses of cheese-

1 E. Strasburger, *Zeitschr. f. Naturwiss*, 12: 654–678, 1878.

2 L. W. Sharp, "An Introduction to Cytology," 2nd Ed., 1926.

3 H. J. Webber, *Hilgardia*, 7: 1–79, 1932; *Calif. Agr. Expt. Sta. Bul.*, 317, 1920; *Jour. Hered.*, 11: 291–299, 1920. Howard B. Frost, *Hilgardia*, 1: 365–402, 1926. H. J. Toxopeus, *Landbouw* (*Buitenzorg*) *Jrg.*, 64: 1930–31.

cloth, and in addition to reduce the leaf area on the twig bearing the fruit. Such fruits when harvested were pale yellow and weighed only about one third as much as untreated fruits. The seeds were germinated during the winter 1933–34 in flats in the lath-greenhouse. The number of seeds producing more than one embryo was from 51 per cent. to 100 per cent. below expectancy: *Sweet orange,* Lamb ♀ × Valencia ♂, 51 per cent.; Lamb ♀ ♂, 51 per cent.; Hamlin ♀ × Temple ♂ 75 per cent.; Hamlin ♀ × Ruby ♂, 85 per cent.; Temple ♀ ♂ 100 per cent.; *Sour orange,* Bittersweet ♀ ♂ 95 per cent.; *Grapefruit,* Triumph ♀ ♂ 66 per cent.

The progeny from treated ("starved") self-pollinated grapefruit and sour orange fruits segregated for leaf characters. In the first case distinctly sweet orange and grapefruit types, as well as intermediates, are in evidence; and in the second case sour orange, intermediates and sweet orange types are observable. These two varieties are commonly considered as naturally occurring hybrids with the sweet orange, and this segregation of leaf characters tends to confirm this belief, and also indicates that the progeny is in most cases apparently of seminal origin.

Additional work is being done on an extensive scale, but this will require experiments covering several years. It is especially desirable to carry through the progeny to the fruiting stage. Histological study of treated and untreated material also will be of importance in attempts to check the results. These preliminary results, which may or may not be firmly established by experiments now in progress, are published now as a suggestion of possible value to others faced with the same problem in citrus breeding.

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THE ERGOT ALKALOIDS. THE ULTRAVIOLET ABSORPTION SPECTRA OF LYSERGIC ACID AND RELATED SUBSTANCES

THE fact that the four ergot alkaloids—ergotinine, ergotoxine, ergotamine and ergotaminine—give almost identical ultraviolet absorption spectra has already been determined by Harmsma,[1] who devised a spectrophotometric method for the determination of these substances. In connection with our own investigations of the structures of the ergot alkaloids, we have had occasion to study the ultraviolet absorption spectra of lysergic acid and several of its derivatives. The resulting curves are shown in the accompanying plate. On inspection, it will be noted that both dihydrolysergic acid and the alcohol, α-dihydrolysergol, give similar curves, whereas, in the case of lysergic acid, the bands and maxima are considerably displaced. The curve for α, β-dimethyl indole was also found to be very close to those of the above dihydro derivatives. Finally, the carboline derivative, 3, 4, 5, 6-tetrahydro-3-methyl-4-methyl-4-carboline-5-carbonic acid, obtained by the condensation of abrine with acetaldehyde gave a curve also closely approaching these. It is therefore apparent that the structure which all these substances have in common and which appears mainly to be responsible for the observed effects is the indole nucleus. In the case of lysergic acid, the displacement of the bands is apparently due to the double bond which is removed on hydrogenation to the dihydro derivatives. The strong influence noted indicates conjugation of this double bond with one of those contained in the indole nucleus.[2] There is a close resemblance between the lysergic acid curve and those derived from the ergot alkaloids by Harmsma.[3]

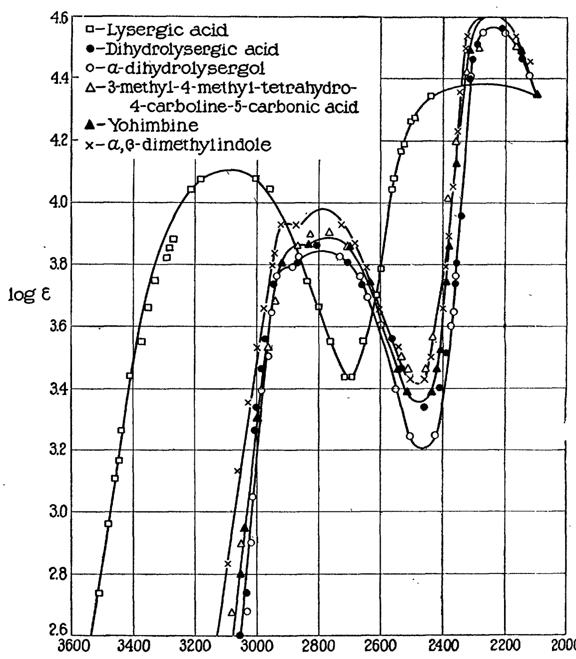

FIG. 1. ε is the molecular extinction coefficient. Alcohol with a slight excess of ammonia was the solvent used.

Recently Kharasch, Stanger, Bloodgood and Legault[4] have attempted an interpretation of the structure of lysergic acid from similar absorption spectra studies made with ergotocin and its derivative. Be-

[1] A. Harmsma, *Pharm. Weekbl.*, 65: 1114, 1928.

[2] Ramart-Lucas and P. Amagat, *Bull. Soc. chim.* (4) 51: 965, 1932. A. Hillmer and P. Schorning, *Z. physik. Chem.*, Abt. A, 167: 407, 1933; 168: 81, 1934.

[3] A similar curve was observed with ergotinine by V. Brustier, *Bull. Soc. chim. d. France* (IV) 39: 1538, 1926.

[4] M. S. Kharasch, D. W. Stanger, M. D. Bloodgood, and R. R. Legault, SCIENCE, 83: 36, 1936.