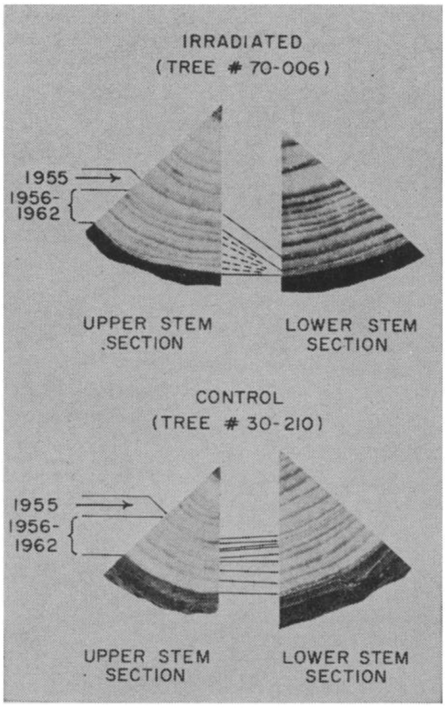

Fig. 1. Diameter increments of upper and lower stem sections from control and irradiated trees. The irradiated tree was receiving 3.0 r/day in 1955 and 4.4 r/day in 1961, when diameter growth ceased at the top of the tree.

the greatest drop occurring in years of high stress. In years of low stress recovery occurred, even when total exposure had increased in the interim. This relationship simply emphasizes the importance of environmental conditions in controlling the intensity of the radiation effect.

We also examined trees growing under different environmental conditions,

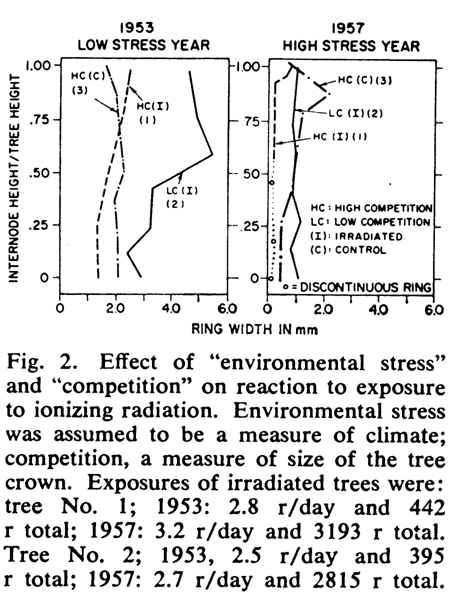

Fig. 2. Effect of "environmental stress" and "competition" on reaction to exposure to ionizing radiation. Environmental stress was assumed to be a measure of climate; competition, a measure of size of the tree crown. Exposures of irradiated trees were: tree No. 1; 1953: 2.8 r/day and 442 r total; 1957: 3.2 r/day and 3193 r total. Tree No. 2; 1953, 2.5 r/day and 395 r total; 1957: 2.7 r/day and 2815 r total.

arbitrarily recognizing two conditions which were called "high" and "low competition." Trees in the woods and with crowns extending one-third or less of the total length of the stem were said to be growing under high competition; trees along the margin of the woods or in the open and with living branches extending two-thirds or more the length of the stem were said to be growing under low competition. Radial increments of such trees differed by a factor of approximately 2, as shown in the graphs for 1953, a year of low stress (Fig. 2). In years of high stress, however, the tree with low competition produced a small radial increment throughout its length, despite a total exposure of 2815 r. The tree in the woods, exposed to about 3200 r, produced only discontinuous rings throughout more than half its length and a very small increment at the top of the tree, while a nonirradiated control, also under high competition, produced an increment throughout its length.

From these observations it is clear that the effect of ionizing radiation on radial growth is highly dependent on the size of the tree crown and on environmental conditions during irradiation. A tree with a large crown extending throughout most of the length of the stem may show little or no effect from low-level exposures even in years of environmental stress, while trees in the forest and with small crowns respond to total exposures as low as 2 r/day by failure to add radial increments in the lower part of the bole. This observation suggests that the primary site of damage lies in the crown and not in the stem, and agrees with other observations (*1*, *5*) which indicate that buds are probably the sites most sensitive to radiation damage. Since cambial activity appears to be initiated by auxin movement from these buds (*6*) damage to the sites at which auxin is produced may cause failure of initiation of cambial activity at points most distal from the buds. Such an effect would be confounded in this study with effects due to reduced production of carbohydrates by the radiation-damaged crown.

A second conclusion is that the interaction of ionizing radiation and stress in producing variations in the severity of the reduction in growth emphasizes the general principle that less than optimum conditions for one factor or set of factors may alter the tolerance of an organism for another factor, in this case ionizing radiation. It is quite probably true, therefore, that the interaction of ionizing radiation with the stresses normally exerted on plants in natural arrays will produce effects at lower radiation exposure levels than those necessary to produce the same effects in the laboratory or under controlled environment conditions (*7*).

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Estradiol: Evidence for its Direct Effect on Hypothalamic Neurons

Abstract. *When estrogen has been implanted in the arcuate nucleus of the hypothalamus of the rat, the size of the nucleoli of the neurons in this nucleus decreases, as determined by measurement of the mean diameters. These changes are accompanied by atrophy, similar to that caused by hypophysectomy, of the ovaries and uterus of the female or testes and accessory glands of the male.*

According to recent reports estrogen-sensitive centers are present within the hypothalamus (*1*, *2*), and highly localized implants of crystalline estradiol-17β result in the appearance in the gonads of atrophic changes similar to those caused by hypophysectomy. It was inferred that certain brain centers were operative in a feedback mechanism that monitored the amount of estrogen in the circulation and could influence the rate of release of gonadotrophin from the pituitary. This observation made further analysis of serial sections of the brain important,

Table 1. Mean diameters of nucleoli 30 days after implantation of estradiol-containing or empty 27-gauge stainless steel tubing into the arcuate or mammillary nucleus. Diameters measured in millimeters at a magnification of 5200.

Sex	No. of rats	Mean diameter ± S.E.M.	t-test
		Estradiol→arcuate	
F	11	10.1 ± 0.1	P< 0.001
		Empty tube→arcuate	
F	8	11.2 ± 0.4	
		Estradiol→arcuate	
M	8	10.2 ± 0.2	P< 0.01
		Empty tube→arcuate	
M	6	10.7 ± 0.2	
		Estradiol→mammillary	
F	4	9.6 ± 0.3	*
		Empty tube→mammillary	
F	2	11.7 ± 0.3	*

* No *t*-test run for groups of less than five.

in order to demonstrate any changes in the neurons of those nuclei in which hormone implant had resulted in atrophy of the gonads. Nucleolar size varies significantly depending upon the activity of the neuron (*3*). Therefore, measurements of the mean nucleolar diameter may be considered a valid criterion of hormonal influence on the neuron.

In the female rat atrophic changes in the gonads occurred when estradiol was implanted in either the arcuate or mammillary nucleus, while in the male similar changes only occurred from a hormone implant in the arcuate nucleus. Measurements were made, therefore, on the nucleoli of these cell groups, and the nucleolar diameters for experimental and control groups were compared.

The data presented in Table 1 demonstrate that implants of estradiol in the nucleus arcuatus resulted in a significant decrease in mean nucleolar diameter in both male and female rats. In the female rat there was a similar decrease in nucleolar size as a result of hormone implants in the mammillary nucleus. Although this series was too small to permit statistical analysis, the trend is apparent. Implants of estradiol at sites in the hypothalamus other than the arcuate nucleus never resulted in significant change in the nucleolar diameter of arcuate neurons.

The nucleolar measurements were made on sections from the brains of the animals described in our 1960 paper (*1*). In all cases 27-gauge hypodermic tubing containing crystalline estradiol within the lumen, or similar empty tubing, had been stereotaxically implanted in one of the hypothalamic nuclei of adult, intact, male or female rats; the implants remained for 30 days. After autopsy the brains were paraffin sectioned at 15 μ and stained with thionine.

For each animal, between 60 and 100 nucleoli, while magnified under an oil immersion lens, were photographed with a 35-mm camera, on high-contrast copy film. This film was studied in a microfilm reader and the mean diameters of the nucleoli were measured with an accurate rule graduated in half millimeters. This method of measurement yielded a linear diameter of 5200 times the actual size. Analysis for significance was by Student's *t*-test for groups of unequal numbers.

The data thus indicate that hypophysectomy-like atrophy (*1*) of the reproductive tract of the rat, following estradiol implant in the hypothalamus, is accompanied by a significant decrease in the size of the nucleoli of either the arcuate or mammillary neurons. Since the gonadal atrophy presumably results from a deficiency of gonadotrophin in the circulation, the arcuate and mammillary nuclei in the rat must play an important role in the release of gonadotrophin. Ifft (*4*) has measured nucleolar size for most of the hypothalamic nuclei of rats that were subjected to varying scheduled periods of light and dark and treated with a number of different pharmacological agents. The only nucleus in which changes in nucleolar size could be consistently correlated with the stage of the estrous cycle was the nucleus arcuatus.

Recently, extracts have been prepared from stalk-median eminence material of the rat. Such a tissue extract should include all the neurons of the arcuate nucleus and probably some of the mammillary nuclear area as well. Intravenous injection of this tissue extract resulted in depletion of ovarian ascorbic acid (*5*), which indicated the presence of a factor that releases luteinizing hormone (LH) (*6*). When the pituitary of a rat in which normal ovulation had been blocked by pentobarbital was infused with a similar extract the rat ovulated (*7*); this demonstrates that a definite link in the ovulation process is contained within this region.

Although there is no striking anatomical evidence for direct links between the neurons of the arcuate nucleus and the anterior pituitary, the above data strongly suggest that this region of the brain regulates the physiological state of the gonads and the process of ovulation through the rate of release of some neural substance(s). When estradiol is implanted in this area the significant decrease in nucleolar size is strong indication that these neurons are directly responsive to the amount of estrogen circulating in the system. Furthermore, the increased estrogen results in a decreased synthesis of some humoral substance by the arcuate and mammillary neurons (*8*).

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Isotopic Fractionation of Uranium in Sandstone

Abstract. *Relatively unoxidized black uranium ores from sandstone deposits in the western United States show deviations in the uranium-235 to uranium-234 ratio throughout a range from 40 percent excess uranium-234 to 40 percent deficient uranium-234 with respect to a reference uranium-235 to uranium-234 ratio. The deficient uranium-234 is leached preferentially to uranium-238 and the excess uranium-234 is believed to result from deposition of uranium-234 enriched in solutions from leached deposits.*

Natural variations in the ratio of U^{234}/U^{238} have been discovered recently. Activity ratios of U^{234}/U^{238}, 1.7 to 2.3 in carbonates, from pluvial Lake Bonneville, Utah, were measured by Thurber (*1*) by means of an alpha spectrometer. On the basis of alpha-particle measurements, Russian scientists have reported several variations in U^{234}/U^{238} activity ratios: 1.2 to 1.6 in eight bone samples (*2*); 3.1 in schroekingerite mineral (*3*); 1.11 in a uranium-enriched water sample (*4*); 7 to 8 in surface water samples; and a ratio of greater than 4 in a bone sample (*5*). Previous radiochemical disequilibrium