

depression on one face, probably the facies distalis of Stradner (1) (Fig. 4). The other face, probably the facies proximalis of Stradner, possesses a rhomboidal raised area instead of a depression (Fig. 5). The "pores" are bordered by a raised area extending from the center of the pentolith along the right suture of each plate, then curving halfway around each "pore." The edge of the pentolith is clearly serrate, with about six serrations per plate. The edges of the serrations correspond to the edges of calcite rhombs, and all rhombs in one plate have the same orientation.

The members of the genus *Micrantholithus* are usually five-pointed star-shaped pentoliths. The type species of the genus, *Micrantholithus flos*, is composed of five triangular plates with raised edges along the sutures (Fig. 6). The specimen shown in the electron micrograph is badly corroded in places, so that the symmetry is no longer perfect. However, the raised areas bordering the upper right suture can be seen to have almost exactly the same width, and the species, when viewed in the light microscope, appears to be absolutely symmetrical.

The coccoliths with the pentamerous symmetry discussed above appear to be quite distinctive but the electron micrographs reveal that they are made of the same structural elements. The differences between them are differences chiefly of ornamentation; their structural similarity implies a close genetic relationship.

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Acute Radiosensitivity in Mice of Differing *W* Genotype

Early in the study of the responses of animals to the effects of ionizing irradiation, the existence of a spectrum of radiosensitivity became apparent. Species differences were noted (1, 2), and strain differences were established in mice (2-4). Sex differences (5) and differences with age (4, 6) were reported. In the studies reported here (7) it was found that single gene differences

Table 1. Thirty-day mortality, after whole-body x-irradiation of mice differing in *W*-series genotype and in genetic background.

Geno- type	Mortality (dead/total) of mice exposed to x-ray at levels indicated (r)						LD _{50/30} (r)	95% confi- dence limits (r)
	540	595	650	715	785	864		
<i>WC</i> × <i>C57BL/6</i> females								
<i>WW</i> ^o	7/7	13/13	6/6				280*	
<i>W</i> ^o <i>w</i>	0/11	3/13	8/21	14/18	16/20	10/10	663	635-692
<i>Ww</i>	0/10	3/12	12/23	17/19	10/17	10/10	665	†
<i>ww</i>	0/8	1/23	1/16	14/28	31/36	9/10	715	690-740
<i>WC</i> × <i>C57BL/6</i> males								
<i>WW</i> ^o	15/15	9/9	4/4				240*	
<i>W</i> ^o <i>w</i>	1/9	6/12	12/16	26/26	25/26	4/4	595	559-634
<i>Ww</i>	2/16	6/12	14/18	18/18	26/27	8/8	600	573-628
<i>ww</i>		3/18	6/21	38/56	14/17	5/5	680	656-704
<i>WB</i> × <i>C57BL/6</i> females								
<i>WW</i> ^o							350*	
<i>W</i> ^o <i>w</i>	0/10	2/10	4/15	6/10	15/20	9/9	692	646-740
<i>Ww</i>	0/11	2/13	3/13	11/14	14/20	8/8	690	651-732
<i>ww</i>	0/10	0/10	0/8	2/10	9/20	11/11	765	735-795
<i>WB</i> × <i>C57BL/6</i> males								
<i>WW</i> ^o		3/3					340*	
<i>W</i> ^o <i>w</i>	0/5	1/7	10/19	12/12	13/13	4/4	635	610-660
<i>Ww</i>	0/9	1/12	6/21	13/14	12/12	5/5	655	625-685
<i>ww</i>	1/15	0/13	3/11	13/20	18/24	13/14	725	696-754

* LD₅₀ estimated from mice x-irradiated with 200, 250, 300, 350, or 450 r; six mice exposed per dose. † Not determined because of poor curve fit.

can also alter the ability of an organism to survive an exposure to a single large dose of x-rays. This report also presents evidence that the substitution of mutant alleles of the *W*-series for the normal *w* in mice clearly decreases the animal's resistance to radiation.

The *W*-series genes studied in these investigations induce manifold pleiotropic effects. They affect fertility, coat-color pigmentation, and size and number of red blood cells. Consequently, each of the *W*-genotypes studied can be distinguished phenotypically. Hematologically, animals of the *WW*^o genotype are severely anemic, *W*^o*w* animals are slightly anemic, and animals of the *Ww* and *ww* genotypes are normal (8).

The experiment was designed to minimize other variables which influence radiosensitivity. To this end, intralitter comparisons were made, and animals of two different genetic backgrounds were used for confirmation. The mice used in these experiments were hybrids prepared by crossing animals of inbred strains WB and WC of the genotype *Ww* with mice of the genotype *W*^o*w* made congeneric with mice of strain C57BL/6J by repeated backcrossing (the lowest backcross generation used in these experiments was b.c. 30). Diagrammatically these crosses may be represented thus: WB-*Ww* × C57BL/6-*W*^o*w*, and WC-*Ww* × C57BL/6-*W*^o*w*. It is obvious that the genotypes resulting from these matings would be *WW*^o, *W*^o*w*, *Ww*, and *ww*, all segregating in

the same litter and, for practical purposes, genetically identical except for the *W*-gene substitution.

The mice were separated at weaning according to sex, housed separately according to litter, maintained on laboratory mouse chows, and given free access to water from the time of weaning to the termination of the experiments 30 days after irradiation. All the animals were 60 to 90 days old at the time of exposure to x-irradiation. All members of a segregating litter were exposed simultaneously so that small variations in x-ray dosage would be equivalent for all categories of genotype, sex, and so forth. Local differences in field density were offset by the use of a motor-driven plywood exposure chamber which revolved horizontally in the x-ray field at the rate of 18 rev/min. X-rays were delivered from a General Electric Maxitron unit operated at 250 kv (peak) and 20 ma with added filtration of ½ mm of Cu plus 1 mm of Al. The distance from target to specimen was 56 cm, and the dose rate was approximately 70 r/min.

Radiosensitivities were calculated as LD_{50/30} values by the method of Litchfield and Wilcoxon (9).

The data given in Table 1 clearly indicate that (i) homozygous anemic mice (*WW*^o) are extremely radiosensitive; (ii) the two heterozygous varieties (*W*^o*w* and *Ww*) are similar to one another in radiosensitivity but less radio-resistant than homozygous normal mice

(*ww*); (iii) the LD₅₀ values for females are significantly higher than for males; and (iv) genes other than those specifically investigated in this study also play a role in determining radioresistance, since differences between the two hybrid types WB × C57BL/6 and WC × C57BL/6 are conspicuous. Genes in strain WB that differ from those in strain WC increase survival at all radiation levels regardless of sex or genotype.

These findings in general fit well with the observations of other investigators, where comparisons are possible. As mentioned earlier, several groups of workers (5) found differences between the sexes in radiation-induced lethality, and similar strain and hybrid differences are reported by numerous other investigators (3, 4, 10).

Our results are also basically in accord with Doolittle's recent findings (11) of changes in radioresistance attributable to single gene substitutions. Doolittle studied the following genes: short ear, and its normal allele (*se* and *Se*); black and tan (*a'*); non-agouti (*a*); hairless, and its normal allele (*hr* and *Hr*), chinchilla (*c^{ch}*); and albino (*c*). He used as his measure of radiosensitivity the number of days to death for mice exposed daily to 70 r.

Unfortunately, Doolittle's data are rather difficult to interpret in view of the fact that genetic background markedly influenced gene expression. Such variability, while confounding analysis, is not unexpected, since modification of gene action through interaction with other genes or gene products undoubtedly is the rule rather than the exception. Although his data and ours are for different genes and his method of determining radiation sensitivity was different from ours, independent investigation has led us to essentially the same conclusion—namely, that single gene substitutions may indeed affect resistance to radiation.

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References and Notes

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Amygdalectomy in the Kitten

Abstract. Kittens sustaining bilateral amygdalectomy failed to show behavioral changes seen in the adult after subjection to similar lesions. No growth deficits or hypopituitarism occurred in the kittens. A certain level of neuroendocrine maturation may be necessary for the effects of amygdalectomy to be manifested.

Removal of the amygdaloid nuclei and overlying pyriform area in the adult cat produces a number of behavioral changes. In several previous reports (1, 2) we have classified these changes in two distinct stages. In the early postoperative period, which may last from 1 to 3 weeks, the cats are stuporous and unresponsive to surrounding stimuli, they do not groom, and they must be fed by force. In the second stage the cats become somewhat hyperactive, are more docile, less responsive to noxious stimuli, and show an increase in oral activity and sexual behavior. With time these changes may decrease in intensity, but rudiments of this behavior may persist for several years. In the male cat, after a year or so, we have found degeneration of the spermatid tubules with maintenance of the interstitial cells (2). Factors which may influence the development and maintenance of this syndrome include lesions of the medial hypothalamus (1) and castration in the male cat (3). In addition, an increase in aggressive behavior may occur in the female cat, possibly as a result of an increase in gonadal hormones.

Koikegami (4) has reported that amygdalectomy in infant animals results in panhypopituitarism, lack of growth, early inanition and death.

My experiment compared the effects of amygdalectomy in the kitten with the syndrome in the adult and compared

the development of these kittens with the development of normal and neocortically damaged kittens.

Sixteen kittens, six males and ten females, were used. All kittens were born in the laboratory from six different litters. At the time of operation the cats were 53 days old. Five kittens sustained bilateral removals of the amygdala and overlying pyriform cortex and five sustained lesions of the neocortex lateral to the rhinal sulcus. Six which were 60 days old remained unoperated. Body weights at the time of operation for the three groups were 698 ± 95 (mean ± standard deviation), 636 ± 85, and 847 ± 150 g, respectively. Lesions were made aseptically under sodium Nembutal anesthesia. Tissue was aspirated under direct exposure. This is the same procedure that was used in the previous studies of the adult cat (1). Figure 1 shows projection drawings through the greatest extent of the lesion for each kitten. The lesions in the amygdala included both medial and basolateral groups with the exception of kitten No. 1, in which the ventral portions of the medial and basal nuclei were spared on one side. Kitten No. 8 had unilateral neocortical injury while the remaining four in this group had bilateral damage to temporal neocortex.

After the operations, each cat was housed in an individual cage and fed a diet of raw horse meat and milk. The cats were placed in a 4- by 8-foot room

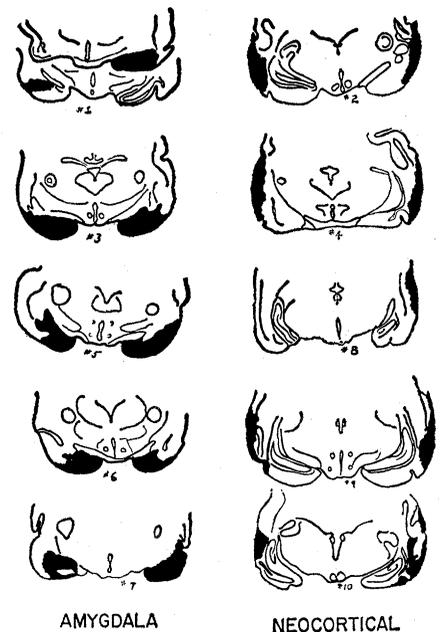


Fig. 1. Projection drawings through the greatest extent of the lesion for the amygdalotomized group (left) and the neocortical group (right).