This structure consists of skeletal muscle and dense connective and adipose tissue. In some species, it also contains peculiar cells with chordoid as well as chondroid features. The lyssa varies greatly in its composition, depending on the animal species (*7*). In the rabbit, I was unable to separate such a formation from the ordinary connective tissue septum, but it is quite possible that the mixed fibers represent traces of this structure.

A search for these peculiar fibers was made also in tongues of other species. In calves, hogs, dogs, and rats the search was not successful. This does not of course exclude the possibility that the fibers may have been present in small numbers and escaped observation, or that they occur only occasionally. Tongues of mice and of golden hamsters showed mixed fibers, but in smaller numbers and less distinctly than in rabbits.

It appears likely, therefore, that the mixed fibers do not represent merely a musculotendinous junction, but rather an irregularity in morphogenesis. On the other hand, it may be that the projections of connective tissue into the end of the muscle fiber proper, occurring at musculotendinous junctions elsewhere, should also be considered irregularities. This is supported by the morphogenesis as described by Long (*8*) and is in accordance with the recognized fact that structural irregularities tend to occur where different tissues meet.

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Histological Changes in the Tissues of the Hibernating Marmot Following Whole Body Irradiation

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The delay in the lethal processes following x-irradiation of the hibernating marmot has been described in another paper from this laboratory (*1*). Cytological studies of the blood of irradiated hibernating marmots failed to reveal any significant changes until after the termination of hibernation (*2*). The present study was undertaken to investigate the histological changes in the tissues of the irradiated hibernating marmot.

The induction and maintenance of hibernation, as well as the method of irradiation, have already been described. The only change in the procedure is an increase in the dose from 650 r to 750 r. This exceeds a previously reported lethal dose by about 100 r (*1*).

Seventeen animals were placed in a cold room at 4.5° C. Eight marmots were irradiated after they had been in hibernation for about 1 week, and the others were left unmolested. Two irradiated and 2 nonirradiated marmots were sacrificed after the fourth and after the eighth week of hibernation. The remaining animals were returned to room temperature to terminate hibernation after the eighth week. These marmots were sacrificed 2, 5, and 7 days after the end of hibernation. In addition, 4 nonirradiated nonhibernators and 3 irradiated nonhibernators were sacrificed at intervals during the experiment. The marmots were given a lethal dose of pentobarbital and autopsied immediately after the cessation of respiration. The lungs, liver, heart, spleen, adrenals, gonads, thymus, and sternal and rib marrows were removed, and the tissues were fixed, imbedded, stained with hematoxylin-eosin, and examined microscopically.

Table 1 summarizes briefly the changes observed in the thymus, testes, spleen, and marrow. Except for the ovaries, the other tissues did not show changes of significance.

The spleens of the irradiated and nonirradiated hibernators are similar except for the presence of scattered eosinophils in the peripheral areas of the Malphigian bodies of the nonirradiated spleen. These eosinophils disappear rapidly as the nonirradiated spleen returns to the nonhibernating status after the end of hibernation.

The bone marrows of the irradiated and nonirradiated hibernators are similar except for the presence of a high percentage of eosinophils in the nonirradiated marrow. This eosinophilia disappears as the marrow returns to the nonhibernating condition.

The thymus glands of the irradiated and nonirradiated hibernator are similar during hibernation. The nonirradiated thymus resumes the nonhibernating condition rapidly after the end of hibernation, whereas the irradiated thymus remains unchanged.

The testes of the nonirradiated hibernator are similar to those of the nonhibernator, whereas those of the irradiated hibernator show loss of spermatogonia and spermatocytes. The ovarian changes are omitted from the table because of an insufficient number of specimens. In general, the changes parallel those of the testes, with loss of the ovogonia and ovocytes.

The retardation in the development of radiation damage in the hibernating marmot resembles that observed in poikilothermic animals at low temperatures, but it is not comparable. Benedict and Lee (*3*) found that a rectal temperature of less than 3° C is fatal to the marmot, but that poikilotherms frequently survive near zero temperatures. They also determined that the heat production of the hibernating marmot is more than twice that of a large poikilotherm at the same temperature.

The seasonal variation in the marmot testes has

TABLE 1

HISTOLOGICAL CHANGES IN HIBERNATING AND IRRADIATED MARMOTS

	Spleen	Testes	Thymus	Marrow
Nonirradiated				
4 weeks of hibernation	No lymphopoiesis; few lymphocytes; eosinophils present	No change from nonhibernator	No active lymphoid tissue	No erythropoiesis; no megakaryocytes; many eosinophils
8 weeks of hibernation	No lymphopoiesis; few lymphocytes; eosinophils present	No change from nonhibernator	No active lymphoid tissue	No erythropoiesis; no megakaryocytes; few eosinophils
2 days out of hibernation	Beginning lymphopoiesis; rare eosinophils; many lymphocytes	No change from nonhibernator	Scattered areas of lymphoid tissue	Beginning erythropoiesis; few megakaryocytes; many young neutrophils
5 and 7 days out of hibernation	Similar to nonhibernator	No change from nonhibernator	Similar to nonhibernator	Similar to nonhibernator
Irradiated				
4 weeks of hibernation	No lymphopoiesis; few lymphocytes	No spermatocytes; no spermatogonia	No active lymphoid tissue	No erythropoiesis; no megakaryocytes; few myelocytes
8 weeks of hibernation	No lymphopoiesis; few lymphocytes	No spermatocytes; no spermatogonia	No active lymphoid tissue	No erythropoiesis; no megakaryocytes; few myelocytes
2 days out of hibernation	No lymphopoiesis; no lymphocytes	No spermatocytes; no spermatogonia	No active lymphoid tissue	Severe radiation damage; nearly aplastic
5 and 7 days out of hibernation	No lymphocytes; no lymphopoiesis	No spermatocytes; no spermatogonia	No active lymphoid tissue	Aplastic

been described in detail by Rasmussen (*4*). Our observations confirm his findings concerning the sustained spermatogenic activity during hibernation and the interstitial cell hyperplasia preceding the rutting period. Our hibernating animals were irradiated during midwinter while the interstitial cells were at a minimum. When the animals were sacrificed in the spring, the testes showed interstitial hyperplasia but complete absence of spermatogonia, spermatocytes, and spermatozoa. The radioresistance of the interstitial cells of the testes has been reported by many investigators (*5*), but the failure of the radiation to affect the rapidly dividing interstitial cells is unusual.

Eosinophils in the spleen and marrow, spermatogenesis, ovogenesis, and interstitial cell hyperplasia constitute the only evidence of cell division observed during hibernation. With the exception of the interstitial cells of the testes, the time course of radiation damage in these tissues was similar to that observed in the nonhibernator.

These observations are consistent with the hypothesis that the delay in the appearance of radiation change is closely related to the rate of cell division, and that interference with cell division is an important factor in the lethal process.

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