posed of host rather than donor cells. In similar experiments by Wolff and Upton (personal communication) with C_3H and (101 X C_3H)F_1 mice, the regenerated thymus grew when transplanted in the parent host, although the percentage of such takes was low.

In the experiments reported here, the designation of these foreign rat cells as "thymus" tissue is based primarily on their location and histologic appearance. Accepting this, one may surmise the presence of a multipotent cell in the bone marrow capable of transforming into the varying cell types and elements, as evidenced by the presence of foreign red blood cells, granulocytes, and platelets in lethally irradiated-rat-marrow-treated mice. It is also conceivable that lymphoblasts in the donor bone marrow seed the thymus gland in the irradiated host. The degree of functional ability of these foreign thymus cells as contrasted to the other transplanted foreign hematopoietic tissues is, however, open to question in view of the incomplete recovery and secondary degeneration processes often observed in this organ.

Summary. Immunologic and cytologic tests indicate that the thymuses of lethally irradiated mice protected with rat bone marrow are repopulated by rat-type cells. The agglutination tests showed this repopulation of the thymus by donor cells to be 100% complete 30 days after treatment, and the cytologic analysis of dividing cells showed 100% rat-type cells 21 days after treatment. Although the histologic architecture of these thymuses was often normal, recovery of the thymuses in terms of weight was incomplete.

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Phosphorylase and Glycogen Levels in Skeletal Muscle of Mice with Hereditary Myopathy* (23587)

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The activity of the enzyme phosphorylase, determined in biopsy samples of skeletal muscles of man with progressive muscular dystrophy, is markedly lower than normal(1). The discovery of a strain of mice with a hereditary myopathy (dystrophia muscularis), and the observation that the myopathy is in some ways similar to progressive muscular dystrophy in man(2) suggested an investigation on muscle phosphorylase in these animals. This report concerns the determination of both active and total phosphorylase and of glyogen concentration in certain skeletal muscles of these mice.

Methods. Phosphorylase activity was determined by the method of Sutherland as previously described(3) but with minor

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TABLE I. Phosphorylase Activity in Dystrophic Muscles of Mice.

	No. of mice	Dystrophic mice μg P ± S.E. P-lase a	P-lase t	Ratio a/t × 100	Control mice μg P ± S.E. P-lase a	P-lase t	Ratio a/t × 100
Thigh musc.							
A*	10	298 ± 9.2	400 ± 8.7	75 ± 3.2	424 ± 12.8	518 ± 9.8	82 ± 2.1
B†	22	179 ± 8.8	229 ± 12.6	79 ± 1.5	269 ± 7.9	348 ± 6.6	77 ± 1.3
Fore-limb musc.							
B	6	204 ± 15.2	271 ± 12.5	75 ± 3.2	306 ± 4.2	373 ± 10.7	83 ± .9
Abdominal musc.							
B	6	119 ± 3.5	165 ± 11.1	73 ± 5.9	241 ± 1.9	333 ± 5.7	72 ± .6

* A—Mice 1 mo old, enzyme activity based on 10 mg of tissue homogenate.
† B—Mice 2 mo old, enzyme activity based on 5 mg of tissue homogenate.

changes; instead of measuring the amount of glycogen synthesized in the reaction tubes, the amount of P liberated from glucose-1-phosphate was determined. This decreases the time to make an assay. Smaller quantities of muscle homogenate were employed and the incubation period was for 10 minutes at 37.5°C. Both the active *a* and the total *t* phosphorylase (requiring the addition of adenosine-5-phosphoric acid) were measured and the ratios of phosphorylase a/t were calculated. The activity of the enzyme is reported as the net increase in μg of P per unit wet weight of tissue in 10 minutes of reaction time. Glycogen concentration was determined by methods previously described(4). Dystrophic mice of both sexes were obtained from the Roscoe B. Jackson Memorial Laboratory, each with a normal littermate control of the same sex. Paired littermates were assayed simultaneously and at autopsy, were either 1 or 2 months of age. The anterior thigh muscles were usually employed but in a few instances the muscles of the upper forelimb and the abdominal wall were studied. The muscles on both sides of the mice were occasionally pooled to obtain sufficient tissue, particularly in the smaller dystrophic animals.

Results. Table I indicates that phosphorylase *a* and total phosphorylase *t* activity in the thigh muscles are both significantly lower in the mice with muscular dystrophy, ($P < .01$). However, the phosphorylase activity ratios a/t are remarkably similar with no statistically significant difference between those found in the dystrophic and normal mice. A more concentrated muscle homogenate preparation was used with the 1 month old mice and although the same general results were obtained in both age groups, no conclusion can be drawn in regards to differences in enzyme activity due to age.

The choice of the thigh muscles seemed logical at first because the dystrophic mice in walking tend to drag their hind legs and it might be expected that any differences in the enzyme activity would be readily noted. Since these mice use their forelimbs more extensively, a few determinations were made on the muscles of the upper forelimb and also on the abdominal muscles, for comparison. Table I shows a significant decrease in phosphorylase in these muscles of the dystrophic mice ($P < .01$) with no alteration in the activity ratios. The numbers of experiments are too few to comment on the relative enzyme activity among the different muscle groups except to note a rather low amount of enzyme activity in the abdominal muscles of the dystrophic mice.

Glycogen determinations were made on the thigh muscles of 11 dystrophic mice and 11 controls in the 2 month old group. The glycogen concentration expressed in mg % with the S.E. of the mean 489 ± 36 for the dystrophic mice and 352 ± 24 for the controls. The difference is statistically significant, $P < .01$.

Observations on the body weights showed that the mice with muscular dystrophy weighed on the average, 30% less than their littermate controls. This suggested a further observation on the skeleton, in particular, a measurement of the width of the tibial epi-

physeal cartilage as an index of the growth status of the mice(5). Using the method described by Geschwind and Li(5), the tibias of 7 pairs of mice were split, stained and examined. The average width of the tibial cartilage in the control was 98 $\pm$ 4.5 μ as compared to 67 $\pm$ 6.4 μ in the dystrophic mice which is significantly different, $P = .02$.

Discussion. Concomitant with the decrease in muscle mass in the dystrophic mouse, there is a decrease in the activity levels of muscle phosphorylase. Similar results are found in the abdominal muscles of man with progressive muscular dystrophy(1). Some enzymes are reported less active in the muscles of dystrophic mice while others are more active(6). Dreyfuss *et al.*(1) believe the changes in these enzymes are secondary to the atrophic changes in the muscles and that the decrease in enzyme activity does not necessarily represent a primary biochemical lesion. Further work is necessary to substantiate this belief.

The phosphorylase activity ratios are similar in the dystrophic and control muscles and on the basis of calculations from the data of Dreyfuss *et al.*(1), similar ratios are also found for normal and dystrophic muscle in man. The constancy of this ratio in spite of the myopathy is in contrast to the effect of denervation injury to muscle wherein there is a decrease in the a/t ratio as well as in the activity levels of phosphorylase(7). Phosphorylase activity ratios are readily decreased by induced contraction of muscle hence care must be taken in handling the muscles prior to analysis(3).

The higher concentration of glycogen seen in the thigh muscles of the dystrophic mice as compared to that in the controls is surprising and difficult to explain although the relative inactivity of these muscles in locomotion might account for it. However, these results conform to previous findings in that there is no correlation between the amount of glycogen present and phosphorylase activity in a muscle(3).

The casual observation on the difference in width of the tibial epiphyseal cartilages in the mice suggests that some hormonal disturbance may be involved which may or may not be independent of the alterations in the associated muscles. Further investigations on the skeleton as well as muscle seems appropriate since both systems are involved in the characteristic weight loss in the dystrophic mice.

Conclusions. In skeletal muscles of mice with hereditary *dystrophia muscularis,* (1) the "active" and "total" phosphorylase activities were significantly less than normal, (2) the phosphorylase activity ratios were normal, (3) the glycogen concentration was higher than normal. The body weights and the width of the tibial epiphyseal cartilages in the dystrophic mice were less than normal.

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