and the duration of the feeding. Histological examination of the kidneys disclosed damage which did not occur before six months, and then only with the higher concentrations of protein.

Furthermore, our data show that the extent of the injury is greatly influenced by the type of protein fed, thus a diet containing 75 per cent of casein fed 8 months caused an average albuminuria of 0.2 per cent and 1100 casts in 24 hours, whereas the same amount of beef proteins for the same length of time, caused 0.6 per cent of albumin and 3200 casts. Finally 11 young rats that ingested the usual amounts of diet containing 75 per cent of lactalbumin, died, without exception, in 7 days or less. All of the urines examined contained large numbers of casts and albumin.

This is a preliminary report.

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1 Newburgh, L. H., *Arch. Int. Med.*, 1919, xxiv, 359.

2 Newburgh, L. H., and Clarkson, S., *Arch. Int. Med.*, 1923, xxxii, 850.

3 Newburgh, L. H., and Marsh, P. L., *Arch. Int. Med.*, 1925, xxxvi, 682.

3659

The Type of Fuel Used in Muscular Exercise.

DAVID RAPPORT AND ELAINE P. RALLI.

From the Department of Physiology, Western Reserve University School of Medicine

In recent papers from the laboratory of A. V. Hill, the moot question of the type of fuel used in muscular exercise has again been raised. The evidence obtained led, in an earlier paper,[1] to the tentative conclusion that "muscular exercise, of such short duration that it does not seriously affect the general metabolism of the body, may be paid for primarily by the oxidation of carbohydrates." In a later communication, Furusawa[2] states that whether the subject be on a carbohydrate or on a fat rich diet, short lived muscular exercise is performed only at the expense of carbohydrate. In more severe exercise, or in exercise of long duration, he postulates a conversion of fat to carbohydrate to replenish the depleted carbohydrate stores. The low respiratory quotients obtained during exercise on a high fat diet by Krogh and Lindhard[3] are, on this conception, due to the latter phenomenon, and would not, presumably, occur in mild exercise. The experiments of Anderson and Lusk,[4] who obtained R. Q.'s approaching those of fat in exercise during starvation, might conceivably, on this point of view, be explained on the ground that carbohydrate was no longer available.

We have recently determined the excess metabolism of exercise in 3 dogs, who were made to run on a horizontal treadmill. The total volume of CO_2 and O_2 exchanged was determined during a preliminary rest period, during the period of exercise, and during the period of recovery until the animal had returned to basal conditions (as shown by the gaseous exchange). The apparatus was accurate to within 2 per cent, as proved by repeated alcohol checks. The maximum deviations in the alcohol check R. Q.'s was from 0.654 to 0.677, the average being 0.664. In other words, the error of the R. Q. determinations in these experiments was hardly more than 0.01.

The dogs were given 3 different diets. The first, which for our purposes, we may consider normal, consisted of about 55 per cent carbohydrate, 30 per cent fat, and 15 per cent protein; the second, 90 per cent fat and 10 per cent protein; and the third, 90 per cent carbohydrate and 10 per cent protein. The latter two diets were not continued for more than 2 days before the experiments were performed. The exercise was carried out in the post-absorptive state, usually about 18 to 20 hours after food.

In some experiments, the animals walked on the treadmill for 45 minutes at from 1.2 to 1.6 miles per hour. Lest this exercise be considered too severe, it was reduced in most of the experiments, and consisted, in the latter, of walking for 15 minutes at the rate of 1.2 miles per hour, obviously a very mild exercise. The animals walked easily, once they had become accustomed to the apparatus. We had, in fact, to increase the speed of the treadmill beyond that of our original intention to permit the animals to walk efficiently.

The results have been summarized in Table I. It is clear that in a rough way the excess R. Q. of exercise and recovery corresponds

TABLE I.

The R. Q. of Muscular Exercise as Affected by Different Diets.

		Basal R. Q.*	Excess R. Q. of exercise and recovery*
Exercise: walking 45 minutes at 1.2—1.6 miles per hour.	"Normal" diet	0.82—0.85	0.86—0.95
	High carbohydrate diet	0.91	0.90
	High fat diet	0.74—0.76	0.72—0.74
Exercise: walking 15 minutes at 1.2 miles per hour.	"Normal" diet	0.85—0.91	0.79—0.91
	High carbohydrate diet	0.98—1.03	0.96—1.04†
	High fat diet	0.76	0.70—0.78

* Maximum deviations.

† Actual R. Q. of the exercise period in this experiment was 1.008.

to the basal R. Q. On the high carbohydrate diet, the excess R. Q. tends to approach unity, but is not necessarily unity even on this diet. On the "normal" diet, the excess quotient varies usually between 0.80 and 0.90. On the high fat diet, the basal R. Q. is in the neighborhood of 0.76 fairly consistently. The excess R. Q. goes as high as 0.78; in one experiment it was 0.72, in another 0.702, or practically the theoretical quotients for fat. It is difficult to regard this as coincidence, as a fortunate balance between the conversion of fat to carbohydrate with the subsequent oxidation of the latter, plus the burning of extra carbohydrate. Failing proof to the contrary, we are driven to the conclusion that fat is being burned directly. The fact that the R. Q. of a normal animal, exercising on any diet, never falls below approximately the theoretical value for fat, lends added support to this contention.

It appears that in the normal animal the proportion of fat and carbohydrate burned to supply the energy for muscular exercise is a function of the type of diet the animal has been ingesting, and that this holds true not only in severe exercise of long duration, but in a very mild exercise of very short duration as well.

This is a preliminary report.

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[1] Furusawa, K., Hill, A. V., Long, C. N. H., and Lupton, H., *Proc. Roy. Soc.*, 1925, xcvii, 167.

[2] Furusawa, K., *Proc. Roy. Soc.*, 1925, xcviii, 65.

[3] Krogh, A., and Lindhard, J., *Biochem. J.*, 1920, xiv, 290.

[4] Anderson, R. J., and Lusk, G., *J. Biol. Chem.*, 1917, xxxii, 421.

3660

The Influence of Ultra Violet Irradiation of Menotoxin and Pernicious Anemia Toxin.

DAVID I. MACHT.

From the Pharmacological Research Laboratory of Hynson, Westcott & Dunning, Baltimore.

The phytopharmacological studies by the author of menstrual blood and of blood from pernicious anemia patients have revealed that both menotoxin[1] and the toxin present in the blood of pernicious anemia cases[2] are very poisonous for plant protoplasm. A consideration of various physical and chemical properties of these toxins indicates that they are not of the same nature. One of the most