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MUSCULAR ACTIVITY AND CARBOHYDRATE METABOLISM[1]

THE PROBLEM: INTRODUCTION

IT has long been discussed whether the breakdown of carbohydrate, rather than of other substances, is primarily responsible for the provision of energy in muscular contraction. It is known and accepted that work may be done, in the general melting-pot of the body, by the use of any kind of foodstuff. We are now concerned, however, specifically with the *primary* process of muscular contraction. In the complete chain of processes involved in long-continued exercise, this primary process may be disguised, or even apparently obliterated, by simultaneous transformations which take place between the different food constituents. Considering the internal combustion engine, it is obvious that petrol and benzole may be used indiscriminately for providing power and driving the machinery. In the same way, however, as we ask whether carbohydrate is the specific fuel of muscle, or whether fat may be used in an identical manner, so we might query whether petrol or coal can be used in an internal combustion engine. The obvious answer is that coal must be prepared beforehand by distillation, before it can be used in the engine, while petrol can be used directly; and that in the preparation of coal to form benzole for use in the engine, a considerable proportion of the energy of the coal is wasted, as regards its work-producing power. Putting our problem in terms of the modern theory of muscular activity and assuming that the initial process in contraction—that which causes the mechanical response—is an entirely non-oxidative one consisting of the formation of lactic acid from glycogen, we are asking now whether the recovery process by which the lactic acid is restored to its precursor can go on at the expense of *any* oxidation, or *only* of that of carbohydrate. *May the recovery mechanism, so to speak, be driven by any kind of combustion, as a steam engine may be, or is it necessary specifically to combust carbohydrate?*

THE RESPIRATORY QUOTIENT

It has long been known that the respiratory quotient during prolonged steady exercise is not unity. It varies with the diet. That, however, does not an-

[1] A lecture delivered at the request of the Mayo Foundation, at Rochester, Minnesota, and at the Universities of Iowa, Nebraska, Minnesota, Wisconsin and Michigan, in October and November, 1924.

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