recovery of a patient with hypoglycaemia on swallowing a lump of sugar. This is the only type of energy that can be given to an athlete during the contest, and it is one which many at the present time have taken when feeling the effects of exertion.

The effect of diet on staleness must not be left out of consideration. A varied diet may make all the difference between keenness and the feeling of lassitude which is the first sign of this condition, which it is almost impossible to cure without a complete break in training.

It is perfectly true that the nutritionist has a place where athletes' training is concerned. But one is forced to the conclusion that probably the body itself is as good a judge as any of what it requires in the broad manner; it is just in the finer points that the scientist can help.

In Britain to-day trainers do not have an easy time to provide the necessary total calories in the right proportions, and neither can the body always get what it feels it wants. For that reason more than any other one thinks that the expert, with his knowledge, can be a very useful adjunct to a man preparing for an important contest.

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Summing up

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Fifty years ago the relation of disease to nutrition was generally ignored; it is remarkable that the importance of diet in the training of athletes was, as it now appears, exaggerated. Since then we have gained a much fuller understanding of the processes that take place in a muscle during contraction and of the essentials of an adequate diet; can anything about the feeding of athletes be learnt from these advances?

Needham (1948) and Eggleton (1948) have discussed the sources of energy in muscular contraction. Creatine phosphate serves as a reserve of energy; creatine is made from arginine, which is one of the essential amino-acids. But is there any evidence that the supply of arginine is ever a limiting factor in muscular work? Bourne (1948) has reviewed experiments bearing on the effect of vitamins on muscular exercise. The evidence is conflicting, and it is doubtful whether, in ordinary conditions, athletic performances are improved by supplements of vitamins.

Eggleton (1948) dealt also with the blood supply to muscles. The amount of energy that can be expended by muscles in a given time depends not only on the muscle

fibres themselves, but also on the rate at which the heart can supply blood to the muscles and the lungs can supply oxygen to the blood.

Rumball (1948) discussed the qualities needed for a type of performance in which skill and judgement play a large, and expenditure of muscular energy a very small, part. This leads to another aspect of athletics. Excellence in athletes does not depend so much on the energy output by muscles and the rate at which this output can be maintained, as on the skill with which this energy is used. Even in the simplest movements it is essential that, as one set of muscles contracts, the opposing muscles should relax to the right degree and no more. The muscles that are used for breathing are used also to maintain the necessary rigidity of trunk. These conflicting claims on the same muscles must be harmonized. The very best high jumper could not jump more than 4 ft. if he did not rotate his body about a horizontal axis, so that the minimum was below his centre of gravity as he cleared the bar. This rotation calls for great skill, but little expenditure of energy. Can this skilled co-ordination of muscular contractions be influenced by diet?

Abrahams (1948) pointed out that many forms of athletics involve little extra expenditure of energy. Training for long-distance running adds appreciably to the day's requirements; but long-distance runners are, as a rule, small eaters and are not particular about their diet. Sprinters may eat large amounts; this may be because they are excitable people living in considerable strain. Abrahams questioned the importance of diet in the training of athletes, except in so far as attractive food gives interest and pleasure.

Leyton (1948) drew a distinction between the requirements during preliminary training, when food is required for maintenance and repair, and the immediate requirements before and during a performance. When muscular exertion is prolonged, the efficiency of the muscles may be limited by the fuel (glucose) content of the blood rather than by its oxygen content or by the rate of supply of blood to the muscles.

Abrahams thought that the steady improvement in athletic performances during recent years was due to technique and not to changes of diet.

However, training diets of the past were worse than the ordinary diets of the time; their monotony caused staleness and they contained very little vitamin C. There was also a tendency to attempt to reduce weight by cutting down the amounts. In my experience it does not matter what one eats so long as one gets enough; but to eat too little is fatal. Modern knowledge has removed these faults even if it has added nothing to meet special needs of athletes.

Nothing new has been said about the large amounts of meat eaten by athletes, when they can get it. It is not a matter of first-class protein; dried milk will not take the place of meat. It seems that athletes eat meat because they like it and are debarred many of the pleasures of life, and not for the sake of any special nutritive value of meat after absorption.

We all can remember those very rare occasions on which everything seemed to go right; when we could do with ease things that usually were difficult, when we seemed to be able to go on indefinitely without fatigue. This rare and felicitous state must be

due to something external; it may be something in our food. But we are left realizing the gaps in our knowledge of the relations of food requirements to chemical processes in the body on the one hand and special activities on the other.

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