

Tests of vocational aptitude. If a candidate satisfies the board to this stage of the examination he is regarded as physically fit and temperamentally suitable for aircrew duties. The third part of the examination is designed to reveal innate trends and natural ability, made manifest by a battery of twenty-three tests (Parry, 1948). This battery yields measures of aptitude for each aircrew category and enables prediction of suitability without wasteful training. For example, prediction for navigator is particularly accurate because of the high educational factor necessary in this branch of aircrew, and educational attainment is one of the easiest things to test. Pilot prediction, on the other hand, is particularly difficult, because there is no satisfactory yardstick to use as a measure; nevertheless, prediction excludes much wasteful training of aircrew pilots. All the prediction tests have been validated against training results, and have more than proved their worth.

The battery of tests comprises eighteen paper tests and five apparatus tests. As a result of the tests a candidate is selected for one of the five aircrew categories: pilot, flight engineer, navigator, air bomber and air gunner.

The factors tested include general intelligence, educational attainments, judgement, reasoning, aviation-information, general mathematics, table reading, mechanical comprehension, technical information, instrument comprehension, map reading and aircraft-silhouette recognition. The apparatus tests are largely designed to reveal co-ordination between hands, feet and eyes. The recording is entirely objective and is electrically controlled to eliminate the personal factor. The battery of tests is spread over a period of 2 days to eliminate fatigue which could create false recordings in otherwise suitable candidates.

On completion of the third part of the examination the board has all the information it requires to make its choice of aircrew.

REFERENCES

- Air Ministry (1948). Personal communication from Department of Science (3b).
 Flack, N. (1920). *Spec. Rep. Ser. med. Res. Coun., Lond.*, no. 53.
 Ishihara, S. (1932). *Tests for Colour Blindness*, 6th ed. Tokyo: Kanehara and Co.
 Kureton, T. E. (1947). *Physical Fitness, Appraisal and Judgement*. London: Henry Kimpton.
 Parry, H. W. (1948). Personal communication from Air Ministry, Department of Science (4).
 Tredgold, H. A. (1936). *The Medical Examination for Fitness for Flying*, A.P. no. 130, 4th ed. London: H.M. Stationery Office.

The Nutrition of Athletes

By A. ABRAHAMS, 86 Brook Street, Grosvenor Square, London, W. 1.

In order to provide a connecting link between scientific contributions and conclusions derived from practical experience of athletes, I suggest a consideration of three fundamentals:

- (1) To what extent is it necessary to provide athletes in training with a high calorie diet?
- (2) In the composition of such a diet should any particular foodstuffs predominate, and is any specific advantage derived from flesh foods and especially meat?

(3) Is there any reason to ensure a liberal provision of vitamins as a whole, or of any particular vitamin?

Tradition and superstition are responsible for misconceptions, for the most part eliminated by modern physiological precepts. Yet a certain residue survives, especially as any element of the mysterious is always attractive. One outstanding example is the belief that a man achieves by what he eats not by what he does, a belief particularly pertinent at the present day when it has been dogmatically asserted that our representatives in the forthcoming Olympic Games will be at a great disadvantage in comparison with their competitors from countries where a more liberal, indeed an unrestricted, dietary is available. The article by P. Schenk (Schenk, 1936) is frequently quoted. Schenk gives the enormous total of 7300 Cal. as the daily allowance of an Olympic athlete in training, a figure based on an inquiry into the dietaries of 4700 competitors comprising forty-two nations at Berlin in 1936. With due regard to national peculiarities and tastes, the average consumption he states as 800 g. of meat, 100–150 g. of butter, the same amount of sugar, 1–2.5 l. of milk, a variable amount of bread, and vegetables and fresh fruits more or less *ad lib.* This supplies 320 g. of protein, 270 g. of fat and 800 g. of carbohydrate.

I wonder how many who quote these stupendous figures in their arguments and protestations have taken the trouble to read the article, and if they have been more successful than I in understanding on what principle Schenk justifies them. I am not in a position to criticize his statements as facts as I have never studied the gastronomic customs of the athletes of other nations, but I have taken all my meals with our teams during four Olympic Games and I can testify that these approximate to the ordinary arrangements of healthy young men of the middle and working classes. Admittedly these were in the days before rationing and restrictions in both quantity and quality of food had been instituted, but the calorie value cannot have been more than one-half of Schenk's estimate and was probably less than that.

I appeal to the experts to reconcile Schenk's figures with the established principle, the relation of calorie requirement to the output of energy. His figures would be appropriate to men in training if they indulged in 4–5 hr. of violent exercise. In actual practice, the energy value of the Olympic athlete's daily training is probably within the range of 300–400 Cal. Even that of the Inter 'Varsity Boat Race oarsman rowing a full course (which is far above his average daily exertion) is not more than 600 Cal. The Marathon race we can put at about 2500 Cal. Competitors for this event certainly undertake occasional long-distance work in training, but—and this is a feature to which I shall shortly return—they eat remarkably little, far less than one would have anticipated, much less than their short-distance colleagues.

But there is a danger of over-simplification. We may reject 'Gargantuan figures while conceding that an athlete does require a generous dietary. How do we explain the paradox that the long-distance runner appears to require less food than his colleague who attempts short distances and feats of agility? I have been particularly impressed by the meagre dietary of long-distance racing cyclists. As I see it we have to distinguish between eating and feeding. The habit of eating may bear no relation to the body's demand for nourishment. The long-distance performer is essentially placid and un-

emotional: he has to be. Consider the mentality that can reconcile itself to, and indeed revel in, the discomforts inseparable from pedalling at the rate of 20 m.p.h. for many hours, sometimes overheated, sometimes frozen, and enduring the monotony of an environment limited to the spectacle of the top of his front wheel. Such a type is independent of stimulations and anodynes and indifferent to the pleasures of the table. He is almost invariably a non-smoker and a very moderate drinker of alcohol, if not a total abstainer.

In contrast, the track athlete and the oarsman are highly strung. It may be that under the influence of anxiety and apprehension the constant or frequently recurring muscular tension causes a rise in basal metabolism. I say this may be so, I do not know if specific investigations have been conducted to support or refute such an idea. Again, the bugbear of the athlete in training is staleness, which is surely a mental affair and avoided by attention to temperamental demands. Any contributions to comfort and the sense of well-being are desirable. A monotonous, uninteresting diet is a cheerless feature in a life which is temporarily divorced from relaxations and indulgences. The prospect of a generous, appetizing meal accompanied when desired by beer and an occasional bottle of champagne makes a profound difference. From this point of view I appreciate a generous dietary whilst I cannot subscribe to gross modifications based on either calorie requirements or the principle that a special provision of animal protein is necessary for muscular exertion. And in regard to protein, is there any good evidence of some special quality in meat? From time to time the advocates of so-called vegetarianism claim an example so distinguished in the world of sport as to encourage a belief in some special advantage of their dietetic heterodoxy. I say advisedly 'so-called vegetarianism', because nobody supposes that an athletic career is possible on a purely vegetable regime. In actual practice the only abstention is from flesh foods. With plenty of bread, milk, butter, eggs, cheese, fresh fruit and vegetables, there is no difficulty in ensuring a liberal, well-balanced diet. But is there in meat some peculiar virtue, in its proteins or possibly some other constituent not represented in other animal foods? For such a decision control experiments are not feasible. Confusion of cause and effect is hardly avoidable. The 'he-man' type who is a hearty meat eater may assume that his prowess results from his dietetic partiality, whereas it may really be that the man of this type is constitutionally attracted by meat, which on account of its sapidity as well as its satisfying property appeals to the majority of mankind.

What of sugar, approbated as a readily available source of energy to be taken before a contest? It is conceivable that in a very protracted effort the reservoirs might be exhausted and hypoglycaemia occur. But that a special sort of explosive material can be advantageously applied for a maximum effort I do not believe. It is perfectly true that I have given sugar with results that encouraged the men to accord no little credit to its service. But the highly strung athlete is so suggestible that he will be powerfully influenced by anybody in whom he has confidence, in which case it is immaterial what he is given. I have been convinced of this psychological element with substances simpler than sugar and sometimes quite inert.

On the subject of vitamins I invite two inquiries. First, is it likely that even with all present-day restrictions there is any danger of subnormal provision? Secondly, is there

any reason to suppose that muscular activity increases the demand, or that any one vitamin may play a part in athletic efficiency so that a generous supply should be deliberately administered?

The world has become vitamin-conscious, an attitude of mind sustained by skilful advertising of synthetic preparations. Not only is the most preposterous pseudo-scientific nonsense bandied about, but even scientific application is far from satisfactory. We recall the series of experiments during the War, some advancing evidence of improved health, well-being and enhanced physical efficiency as a consequence of their routine administration; others at least equally authoritative proving the entire absence of any advantage.

There may be elusive substances not yet isolated which contribute to athleticism. If so, I am inclined to think that Nature will express this need by an instinctive craving for some foodstuffs in which they are present. With this possibility in view a trainer ought to sympathize with idiosyncrasies rather than reprobate them as he is inclined to do on traditional lines of training dietetics.

Those who are infatuated with the potency of nutrition, and in particular with the vitamins, advance these as an explanation of the athletic records that have been continuously created in the last half-century. I do not believe that present-day athletes are at all physically superior to their predecessors of, say, 60 or 70 years ago. The creation of records is, in my opinion, satisfactorily explained, partly by improvement in technique, but much more by the vast increase in competition and the extension of the cult of athleticism throughout the world. In this way naturally gifted performers are discovered or, shall I say, reveal themselves, sometimes in the most unexpected situations. No doubt records will continue to be broken although to a diminishing extent. All this has nothing to do with food, it is simply natural selection.

REFERENCE

Schenk, P. (1936). *Münch. med. Wschr.* 83, 1535.

Some Practical Aspects of the Nutrition of Athletes

By R. N. A. LEYTON, 10 *Harley Street, London, W. 1*

The problems involved in the consideration of the nutritional side of the training of athletes are both many and interesting. So far as this country is concerned rationing has added to the difficulties of all trainers, making adequate preparation almost impossible.

When considering the question of body nutrition and training it is essential first to make clear the fact that the amount of food required varies greatly with individuals. One man will require 3000 Cal. for even light work whereas another will not lose weight under normal conditions with a diet as low as 2200 Cal. This must clearly be taken into account when deciding what added nutrition is required for training purposes. The same differences are apparent as far as the time of meals before a race is concerned.