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THE PHYSIOLOGICAL APPROACH TO FITNESS *

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The question which I have been asked to approach from the physiological point of view is one of fundamental importance—the basis of national fitness. I suppose most of us will have our own ideas as to the exact connotation of the word “fitness.” The exact meaning we attach to the phrase will largely be conditioned by the question, Fitness for what? Obviously a man may be perfectly fit to carry on some occupation and yet be unfit physically or psychically for some other trade, occupation, or profession. Are we to confine our interpretation to mere physical fitness? Or is the word “fitness,” as it well may be, used simply as a synonym for perfect health? Or as a variant to connote a state of well-being or of good nutrition, of eutrophy? What are we looking for? What are we trying to attain? Personally my own reaction to and interpretation of the phrase “national fitness” is the building up of healthy human beings, well balanced physically and mentally and emotionally, who will be capable of all necessary adjustments to their immediate environment, be it of work or play.

The approach to this state of fitness which at the moment seems to be most in the public eye is that of physical training of some kind. The fact is, there is no single line of attack. Many factors besides physical activity are concerned. The provision of a diet adequate in both quantity and quality is of course one of the essentials, but again diet alone, no matter how perfect, will not achieve the desired end. Other factors, such as an adequate supply of fresh air, opportunities for sufficient sleep and for recreation, contentment of spirit, all play important parts. I shall confine my attention to the physical activity and dietary aspects of the problem.

The Aim of the Present Campaign

The aim, I believe, of the present campaign for physical fitness is to develop and perfect the potentialities which exist in all for the integration of the several bodily systems. As a result of this integration it is hoped to achieve a harmony of motion, a grace of carriage, a pride of body, a mental concentration and quickness of reaction, and a happiness and contentment which characterize the really fit.

And this training, as it has to take place in the leisure time of all those over school age, must be attractive; it must truly give a sense of *re-creation*. If it were only concerned with physical *re-creation* it might be regarded as a relatively simple problem, but the need of rebuilding

for the morrow may be as much psychical as physical. In fact it might be said to-day that with the ever-increasing elimination of heavy manual work from industry and the ever-increasing specialization of men to single operations the need for the *re-creation* of the spirit is greater than that for the body. Further, I do not think it is emphasized sufficiently in these days, when the sense of rights seems to transcend the sense of duty, that physical training, and indeed many forms of recreation, properly carried out, develop a true sense of discipline.

When we realize that inevitably a very large proportion of those who will be trained or are being trained will enter on industrial work it is obvious that it is our duty to think in terms of alleviation. It is probably true that the man or woman who had well-developed muscles and who could use them was in greatest demand not so long ago. To-day, when machine-minding becomes ever more prominent, we realize that although man may not yet have become, and we hope never will, the “machine-tickling aphid” envisaged by Butler in *Erewhon*, something more is required than mere brute force. The qualities on which there is a premium to-day are quickness, alertness, quick reaction time, intelligence.

No Short Cut to Perfection

There is no short cut to this desirable state of physical and mental perfection. To attain it no amount of help, no amount of direction, no amount of guidance will suffice unless the willing co-operation of the trainee is obtained. People must want to be fit. They must be prepared to pay the price. The price that so many are unwilling to pay is steadfastness and discipline. It is relatively easy to get Tom, Dick, and Harry, and still more easy to attract Mary, Jane, and Ann, to start, but it is difficult to get them to continue in well-doing. So many want the final result without the necessary effort. They want the balance of posture, the perfection of rhythm, without the labour which goes to the building up of smooth reflex movement. The only exercises in the end which will be of value in retaining the performers are those which are creative, which either allow the performer to express something innate by way of limb movements or give rise to the real belief that the systematic practice is creating a new body, a new control. The difficulty is to devise a suitable system. Of one thing we may be certain—that no one system will suffice for all. There must be exercises for the immature and the mature, for the vigorous and the non-vigorous alike. So far as the children are concerned I am satisfied that the system carried out under the Board of Education is sound. But

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what have we to offer the adolescent and the adult of all ages? Recently the Board of Education has issued two suggestive handbooks. Obviously the many exercises contained therein must be chosen with care by leaders, courses must be suitably adjusted from them. This demands skilled and discerning leaders. It is perhaps not within my province to discuss the nature of the exercises, but I should say that free standing exercises with a fair amount of apparatus work would be best for the male from post-school age to, say, 30 or 35, the amount of apparatus work being reduced for the majority as age advances. In the case of young women, unless they so desire—and a certain number do exhibit a preference for apparatus work—the exercises should be all of the free-standing and floor-agility type. For both sexes after the age of 30 to 35 the exercises should be confined to the free-standing type. Generally speaking, I would endorse the classification of Lindhard as a guide to training, particularly of the “keep-fit” type. His classification is:

1. Exercises the chief object of which is to discipline, to rouse, to educate in the general sense of the word:

- (i) Order exercises.
- (ii) Exercises of deportment.
- (iii) Walking exercises.

2. Exercises the chief object of which is a systematic training of muscles and joints:

Corrective exercises. Head and neck, trunk, arm, and leg exercises.

3. Exercises the chief object of which is the development of nervous co-ordination. Balance exercises.

4. Exercises that aim in the first place at developing strength, endurance, and resolution:

Marching, running, jumping, games, and sports.

Lindhard's Scheme as a Basis

I feel convinced myself that if this scheme of Lindhard be adopted as a basis, the necessary choice of exercises being made from the books issued by the Board of Education and adapted to the age and the vigour of the pupil, whether of 16 or 60, a course could be developed which in a relatively short time might simply transform the appearance of the average citizen. I would lay special stress on the corrective exercises. It falls to the lot of very few to carry out their several avocations in such a way as not to distort to some degree their physical frame. Keeping fit does not merely mean the retention of health and vigour in any kind of framework. The ideal is to get the frame, as well as the organs it contains and the muscles which bind it, as nearly balanced as possible. The child at school, despite the provision of anatomically correct equipment, tends to adopt bad posture; the clerk at his desk, the worker at his machine, the labourer in the field, everywhere we turn—often, from the very necessity of the case, even the fact that the majority are right-handed and not ambidextrous encourages wrong position—bad posture and unilateral development are the rule. The bad posture tends to become permanent. Surely one of the main purposes of the whole “keep fit” and physical training movement is to correct by suitable exercises such faulty developments and to restore to the frame whilst still pliable the resiliency and the beauty that are its right and proper heritage.

Posture and Carriage

There is no question about the physiological gain to be obtained by the healthy organism from muscular

activity, but I do not propose to deal with its effects in detail. These may be found in, for example, Bainbridge's *Physiology of Muscular Exercise*. Very few of our complicated muscular movements are inborn; they are the result of practice. We assume too often that we have good control of our muscles until we try some new form of activity. Most have passed through the humiliations of golf. When we see a master of the game play it all looks so effortless and easy—till we try it. We realize the same is true of any game, any art—for example, singing, piano-playing, or even of dealing cards at bridge—which demands exact co-ordination of muscle. The obvious gain from constant exercise of muscles is a greater range of rhythmic movement, of better balance, of more accurate judgment, a greater resiliency of the body as a whole, a better carriage, better posture. Our initial judgment of our fellow men is most often by their posture or carriage. To quote from Lindhard's book on the *Theory of Gymnastics*: “It seems as if on seeing a person with a good carriage we do not expect to find in him good physical qualities merely, but also good psychical ones: bravery, courage, energy, firmness, well proven, a noble mind. It is as if it shows us the free man as opposed to the cowed bent slave.” And on the whole I think it true to say that we do find some, if not all, of these extra attributes in individuals with good carriage.

It should be emphasized, however, that there is no standard posture for all ages and both sexes. The style of normal posture varies with the change in body build from babyhood to old age. Still, there is a type of male posture at rest which should be aimed at: where the whole figure, while not being stiff and rigid, should “bear the stamp of controlled force.” In the case of women the stance should be lighter but well poised, and should suggest repose in oneself. Far too many of the attitudes assumed as correct posture contain too much of the costly static effort. In everyday life, in common with all our other bodily activities, our posture and movements are subject to emotional control. We do recognize that “the ringing step of confidence, the halting pace of fear, the expansiveness of joy, the drooping air of grief serve to remind us of the pervasive quality of emotion.”

Physiological Effect of Muscle Activity

But muscular exercise does more than build up the nerve muscle control. Probably the majority of the capillaries which exist in our tissues are only, so to speak, potential capillaries which open up to full activity when, for instance, the muscles are used. Krogh has given a dramatic example of this state of affairs. As he pointed out, in a piece of muscle no thicker than a pin there are some 700 capillaries and 200 muscle fibres. When the muscle is at rest there is, however, comparatively little blood flowing through it, there are few patent capillaries, but as soon as it is active the latent or potential capillaries come into action to meet the enhanced needs. The increased metabolism of active muscle demands an increased oxygen supply, and at the same time there is the need for more rapid removal of waste materials, including increased heat loss. Moreover, with the increase in skeletal muscle activity there is, as a necessary result, increased cardiac activity, increased respiratory rate. It comes to this: that even a most limited form of exercise brings about a flushing and refreshing of the whole organism.

It is perhaps not commonly appreciated that in almost all forms of muscular activity three separate phases of effort may be recognized: positive, negative, and static,

each differing in energy-cost to the organism. When we, for example, throw up an arm we perform positive work against gravity; when we let it fall again back to our side this is negative work. If we cease movement, say in the upward swing, and hold out the arm steadily from the body, this is called static effort. It is the degree to which the static component enters into all types of muscle effort which determines its severity in regard to the organism as a whole. Hence it follows that any type of muscle work can be made more easy or more severe according to the amount of the static effort permitted to enter in. If, on the other hand, however, the static element be reduced too much, rhythmic exercises, for example, may degenerate into mere dangling of the limbs. Also the severity can be increased or diminished according to whether the displacement of the centre of gravity of the body as a whole is marked or not.

Medical Supervision

There is no question in my mind about the propriety of medical supervision in some form. But what are the standards to be, since the type of physical exercises available are so very variable? Apart from gross lesions, how are we to decide whether an individual should or should not participate in some form of exercise? There is the further difficulty that if a formal medical overhaul is made a *sine qua non* before permission to participate even in the relatively simple "keep fit" exercises this may act as a deterrent—so many people fear a medical overhaul. If a medical examination were instituted the ultimate value might be even greater than that which accrued direct from the actual physical training. There would be the further advantage that as the result of such a medical examination some indication might be given to the examinee regarding the type of more strenuous exercise for which he would be fitted. If a single test of fitness has to be adopted it seems to me that some form of the heart-tolerance test would be the best. We are far too apt to assume that the average pulse rate and blood pressure are "normal" rates and pressures, and that they play no part in or afford no guidance to the type of exercise for which an individual is suited. According to the potentialities of a particular physique for particular exercises there seems, so to speak, to be the appropriate cardiovascular equipment. In a study of Olympic athletes made by Bramwell and Ellis these differences (average values) are very clearly, especially with regard to the pulse rate, demonstrated in the case of runners:

Type	Age	Weight (kilos)	Pulse	Blood Pressure		Pulse Pressure
				Systolic	Diastolic	
Sprinters ..	22	64-65	66	116-119	75-81	38-40
Mid-distance	23		63			
Long-distance	24		61			
Marathon ..	27	60	58	123	78	45

As in other forms of long-sustained strenuous effort, so in marathon races, the younger men seem to lack the necessary stamina for feats of endurance.

The cardiovascular equipment of weight-lifters was interesting. Nine out of fifteen examined had resting pulse rates of over 80 per minute. They had high systolic pressures, five out of fifteen had diastolic pressures of over 100 (the average for the whole group was 90), and six had pulse pressures of 60 and over.

The Question of Athletics for Girls and Young Women

Reference must, I feel, be made to the constantly debated question as to the extent to which girls and young women should be encouraged or permitted to take part in the more athletic types of exercise, either in the gymnasium or in the sports field, especially in forms of exercise which involve more or less heavy landing on their feet. A great many opinions have been expressed, but very little, if any, real evidence has been produced to show that such activities do give rise to uterine displacements. So far as I am aware the best paper on the subject is that of McCloy. The conclusion reached by this writer is that the anatomical evidence would point to there being no real reason why girls or women whose pelvic floors are uninjured and who have no pelvic infection should not jump. The shock of landing is, for the pelvic organs, negligible. Obviously physical education departments should see that those taking part in such activities are adequately supervised.

This question as to whether or no girls and young women should be permitted to jump is quite apart from the question as to whether they should participate in athletic exercise during the menstrual period. Here, of course, opinions have been many and varied—from the recommendation that no abstinence from sport should take place, to the recommendation that no form of activity should be indulged in throughout the period. Probably the *via media* of abstinence during the first day of the flow is to be preferred. It is a question which it is impossible to dogmatize about, as the effect of the period varies so greatly in different individuals. Too often it seems to be forgotten that menstruation is a normal physiological process. Such evidence as exists would point to the view that the influence of normal menstruation is not greater than other influences of an accidental nature which might have affected the performance of the various tests at other times. It is well to make it clear, however, that in some women the menstrual period may apparently bring about greater efficiency—a result probably of purely psychological origin.

The Dietary Aspect

I shall now turn to a very brief consideration of the dietary aspect of this problem of fitness. The spotlight is focused at the moment on diet, not altogether to its advantage. Too many seem to imagine that if only this or that be added to the diet all will be well, that the root cause of malnutrition is poverty and lack of proper food. No doubt these are potent factors, but they are certainly not the only ones. Emerson, who has made a most intensive study of the problem of malnutrition in children, cites in his book, *Nutrition and Growth in Children*, the causal factors in their order of importance. They are: (1) physical defects, especially nasopharyngeal obstructions; (2) lack of home controls; (3) overfatigue; (4) improper diet and faulty food habits; (5) faulty health habits. It will be noted that in Emerson's opinion diet occupies only the fourth place in order of importance.

IS MEAT ESSENTIAL?

Of course it is perfectly true and perfectly obvious that anyone who is going to reap the full benefit of training must be adequately fed. But adequate feeding does not mean elaborate feeding. So far as our knowledge goes at the moment, a diet consisting of brown bread, milk, butter, cheese, fresh fruit, and salad could provide all the essentials. As, however, we are, in part at least, concerned

with physical training the inevitable question arises as to whether meat is an essential constituent. There is no scientific evidence to show that meat is essential. The breakdown of the protein-containing tissues, particularly of muscle, during the performance of muscle work, provided there is an adequate supply of fat and carbohydrate or, in other words, of the energy-giving foodstuffs, is negligible. Yet if one examines the great majority of training diets meat is a prominent constituent. Practically all of the athletes at the Berlin Olympic games were large consumers of meat. Evidently the appetite or tradition or a real *pica* demands the presence of meat. Why this demand if there be no marked breakdown of muscle to repair? The explanation may in part lie in the fact that the extractives of meat are stimulating and have a definite and to many an attractive flavour. The presence of the flavour may help in the consumption of larger amounts of the, on the whole, flavourless fats and carbohydrates which are required for energy production. On the other hand, it must not be forgotten that strict vegetarians have shown themselves to be record-breakers in sport and to be capable of immense endurance. I think the conclusion to be reached must be that the presence of meat is not essential.

FATS AND CARBOHYDRATES

The protein problem has, it is true, aroused most discussion, but some very interesting facts are available regarding the consumption of fat. As long ago as 1866 Frankland had noted that men engaged in really laborious work consumed for preference fat-rich diets: "thick slices of bread surmounted with massive blocks of bacon in which mere streaks of lean were visible." Lavonius, who studied the food intake of professional Finnish wrestlers, found that calories derived from fat formed about 45 per cent. of the total intake, whereas those from protein only accounted for about 17 per cent. It has also been noted that in the diets of lumbermen and others engaged in hard work under severe environmental conditions the consumption of fat is high. If other lines regarding the need for fat be followed it is becoming increasingly evident that fat, or at least certain fatty acids, play a more important part than mere sources of energy.

There is no question about carbohydrate being the most readily available source of energy for the performance of muscle work. But, contrary to general belief, the recent work of Krogh *et al.* shows that there is no evidence during an hour's observation that glucose given during work, although it may cause a prompt rise in the blood-sugar level, well above resting level, is utilized. Apparently the carbohydrate has first to be converted into glycogen. Thus these authors maintain that in sporting events there ought to be about two days' rest before the contest, "to secure a complete filling up of the glycogen stores; and it appears that this cannot be done by taking large amounts of carbohydrate just prior to work."

I have cited some of the work relating to protein, fat, and carbohydrate simply as examples of the profundity of our ignorance of the whys and wherefores of somatic chemistry. If we know relatively little about the fundamental problem of the three energy-giving materials which have been intensively studied for many decades, we know considerably less, both quantitatively and qualitatively, about the action of mineral salts and vitamins.

Diet Not the Only Factor in Malnutrition

It may be thought that I am overstressing the negative side of the importance of food, that I am not giving it the importance which it so manifestly demands. If that

be so I desire most categorically to deny the interpretation that I under-estimate its value. I have worked far too long at the problem. But I do most emphatically desire to bring home the point of view that diet alone is not the only factor involved in malnutrition. Far too many people take the path of least resistance. Seizing on the very fact that diet is important, they shut their eyes to all other possible factors or, if they do not wholly ignore them, they belittle them or do not explore their potentialities. There would possibly be no harm done if they stopped at the proclamation of their appreciation of an adequate dietary, but when they go on to promise all sorts of miracles which will happen if and when the average diet is altered in this way or that a very real danger arises. The majority of these miracles cannot and will not happen. The faith of the "man-in-the-street"—the man we all wish to help—in science and the scientific worker will be undermined.

Conclusion

We require to keep a broad and open mind on the problem of how best to achieve fitness. Just as there is no one cause of unfitness, so there is no one solution. It is a problem of many facets with as many lines of attack. It will not be achieved merely by the satisfaction of the somatic needs. Malnutrition of the spirit is quite as common as malnutrition of the body. The one reacts upon the other. In these days when the raucous enunciation of rights threatens to extinguish the still small voice of duty, it should not be forgotten that fitness demands discipline. Discipline is essential for right living. Right living means health. As Amiel said: "Health is the first of all liberties, and happiness gives us the energy which is the basis of health."

SKIAGRAPY OF THE CHEST*

BY

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The use of skiagrams as an aid to diagnosis may well be regarded as the greatest advance in medicine during the present century, worthy to rank with the discovery of antiseptics and anaesthetics. Skiagraphy of the chest has become a most important and, indeed, an indispensable adjunct in diagnosis. Its routine application has often enabled a diagnosis of pulmonary disease to be made, even when the symptoms were referred to some other organ—for example, cases of so-called indigestion and gastritis or suspected appendicitis.

In the training of medical students it has long been customary to emphasize the importance of a careful examination of patients, based upon history, symptoms, and the routine use of the standard methods of physical examination. By such means the careful and experienced practitioner can accurately diagnose a fair proportion of the diseases of the chest from which his patients are suffering, while the consultant's wider experience of particular conditions will raise the standard of diagnosis still further. Indeed, some experienced physicians have in the past, by clinical methods alone, achieved a remarkable degree of accuracy in diagnosis. Their clinical instinct,

* Read in opening a discussion in the Section of Tuberculosis at the Annual Meeting of the British Medical Association, Plymouth, 1938.