DATE DUE.

27. JAN. 1951		
11 JUL 1951		
28 SEP. 1951		
25. APR. 1952		
24. DEC. 1952		
5. MAY 1953		
19. MAY 1953		
3. DEC. 1953		
13. JAN. 1954		
13. DEC. 1955		

TRAINING

AND HOW TO

KEEP ALWAYS FIT

BY

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EDINBURGH

E. & S. LIVINGSTONE

17 TEVIOT PLACE

1921

CONTENTS

INTRODUCTORY NOTE.

The following articles on "Training, and How to Keep Always Fit," which have recently appeared in "The Student" Magazine, were addressed to the present generation of Undergraduates in the University of Edinburgh.

They are now published in separate form in the hope, not only that others who run may read, but that even more who read may run.

CHARLES W. CATHCART.

October 1921.

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TRAINING

AND HOW TO

KEEP ALWAYS FIT.

INTRODUCTION.

IN the eyes of the present generation of students of the University it may seem to be somewhat strange, to say the least, that an old member of the Edinburgh University Athletic Club should venture to offer to them hints on training, when his own days of active athletics lie behind him in what must appear to his readers a dim and distant past. If that is so, an explanation is advisable, and it need not take long.

As a schoolboy at Loretto, in the '60's, I competed in the Inter-Scholastic Games. As a student in the University, in the '70's, I represented this University in several events in the Scottish Inter-University Sports, played forward three times for Scotland against England in Rugby International matches, and was captain of the University Rugger Team for two or three years. There was thus ample opportunity of gaining knowledge —practical and, so far as it went, theoretical—of the system of training then in vogue, and, not unnaturally, the interest in the subject thus acquired has never left me. In middle life further knowledge of a similar kind was gained from a very different standpoint. A nerve breakdown from overwork compelled me to study with eager interest all the factors which are necessary for healthy and vigorous life. As improvement set in under the new régime I realised what had been mistakes in physical training in youth, and in the management of health in later years. By degrees, too, a very simple conclusion was borne in upon me as I tested and sifted out various suggestions for improving health and vigour, and considered them in the light of medical knowledge. The

conclusion was this:—There is no real difference between the requisites for training for athletics in youth and the requisites for leading a vigorous and active life in adult years. The factors are identical. The only difference is in the proportion in which they are combined for individuals of either sex, at different ages, and under different conditions of life. For this reason I trust that the following suggestions for training—collected from various sources—which are offered to the young torch-bearers of the University just starting on their career, may be helpful to them both now in student days and later on in active adult life.

As these articles must be as concise as possible, references will be given to sources from which fuller information can be obtained by those who wish it.

So far as University athletics is concerned, the problem before us is not how a man with nothing else to do may qualify for the Olympic Games, but how a student with his day primarily devoted to University studies may yet keep himself at the maximum of physical fitness under the conditions in which he finds himself.

The subject can best be dealt with under the following heads:—
(1) Exercise and Breathing; (2) Fresh Air; (3) Food; (4) Alcohol; (5) Tobacco; and (6) Economy of Nerve Power.

Before discussing the details of any of these heads, three remarks may be made which apply equally to all of them. Nothing will be recommended which is not simple, easily carried out, and inexpensive. Everything that will be recommended will involve self-control and perseverance, but in return the reward which will come in the form of enhanced energy and vigour will be a hundred times worth while.

CHAPTER I.

EXERCISE AND BREATHING.

Exercise.—In a Report on the "Science of Ventilation and Open-Air Treatment," Part II., issued in 1920 by a medical research council appointed by H.M. Privy Council, the following short account (omitting the more technical expressions) of the benefits of exercise will form a very suitable introduction to this section. It says that exercise

"promotes increased blood-flow in, and supply of oxygen to, all parts of the body," and facilitates the removal of waste products. "It promotes metabolism and production of body heat, massages the belly organs, and causes the better absorption and utilisation of food, so that the bowels are kept open and free from excessive bacterial decomposition and toxic products arising therefrom. Thus the resisting powers of the whole body to disease are kept up, the brain is swept with a fast flow of well-oxygenated blood, and the mental faculties kept in good condition; the lungs are benefited by the deep breathing resulting from exercise," so is also the skin "by the enhanced circulation" (p. 117).

There is no need to dwell on these advantages of exercise for young people. They have been recognised in all public schools for many years, and their recent fruits in war time need no emphasis here. In Educational Authority schools, too, more and more use is being made of physical exercises. These definitely improve the physique of the children, even although such schools are not, as yet, provided with adequate playing fields for outdoor sports.

The University of Edinburgh, as we all know, has an excellent field for athletics at Craiglockhart, but, alas, no gymnasium, and no professor of physical education to ensure the adequate development of the bodies of the students while their minds are under training. Good though it is,

moreover, the University field is about two miles from the University, and our men's time is so occupied with classes, theoretical and practical, that they find it difficult—often impossible—to visit the field during the week. How, then, and where, is the exercise necessary for the bodily well-being of every student to be obtained, and how can our athletes keep fit? The answer to these questions is fortunately at hand. Both groups of students can obtain the exercise really necessary by carrying out Lieut. J. P. Muller's exercises every morning, and they can do so in their own bedrooms. I shall now explain.

About fifteen years ago, after trying various systems of home exercises, all with their good points, but none that quite met all requirements, I happened by chance to come upon Muller's account of "My System," as he calls it, in a bookshop. On glancing over it I became so interested that I bought the book (2s. 6d.), learned the exercises from it, and have performed them daily ever since. It would take too long to describe them here. The book itself must be taken as the guide. But we may briefly consider what seem to be the good points of the system. They require no apparatus, and involve no noise or shaking of the floor, which might disturb the occupants of a room below; they are well planned, so as to bring into action different parts of the body in suitable succession; they call forth, by muscular action of course, vigorous movements of the limbs, and more especially of the abdominal wall and back, which are not called into play in ordinary academic, business, or professional life. Thus muscles are exercised, joints kept supple, and ligaments stretched that usually suffer from want of work. Moreover, respiration is made to be a part of each exercise, and deep breathing comes after every one. When the muscles, the heart, and the lungs have been roused into activity after the night's rest, and the body has been thereby brought into a glow of warmth, a cold sponge bath is taken and is enjoyed, as I can testify, although without the previous exercise it would, in winter at least, make one shiver. After the skin has been dried, it is rubbed with the hands, in another series of exercises, with again deep breathing between each. The whole series takes fifteen minutes to complete, but less will serve

very well. The immediate result is a feeling of vigour and well-being, which to the beginner is most encouraging, and to the habitué seems almost indispensable, for it remains.

An important feature of Muller's " My System " is that certain modifications have been made in the exercises to adapt them respectively to women and to children, as well as to men, with a separate book for each. Moreover, the exercises themselves are graded in severity in each series, and in this way provision has been made for all degrees of strength, from the young child or delicate girl onwards to the fully-developed man even in his declining years.

The would-be athlete, however, needs something more than those indoor exercises, excellent though they may be, when his opportunities of practising on a field or running track are limited. For such as these, and for others besides, Muller has many useful hints to give. Thus, a man in his walks about town, instead of adopting a leisurely pace, may increase his speed at will, remembering that for every additional mile per hour beyond an easy walk he will multiply the exertion required by a rapidly increasing ratio. Haven't we plenty of steep streets and flights of stairs to test our wind in this town of ours if we go fast enough ? Try, for instance, the stairs from Market Street to St. Giles Street, taking them two at a time—a non-stop run—and if once is not enough, try it twice. Or, again, an opportunity may be taken to run home on the balls of the toes, and change and rub down afterwards. Muller, who is a Dane from Schlesvig, during fifteen years of office work, supplemented his indoor exercises by such methods as these, and although his opportunities for more regular athletic training were limited, he held for many years the first place as an all-round athlete in Denmark.

We see now that a great deal more can be done by students of this University themselves for physical development than seems at first sight possible, in spite of inadequate provision as yet at their disposal. There should be a spacious gymnasium and a skilled director of physical exercises, or a professor of physical education in all its aspects, educational and remedial, as there is in so many of the great American Universities

Take the University of Pennsylvania, for instance, with Professor R. Tait M'Kenzie, B.A., M.D., who there occupies the Chair of Physical Education. With a staff of assistants, he supervises the physical condition and development of 11,000 undergraduates, sets each one his or her allotted tasks in the gymnasium, swimming bath, or playing field, tests the physical progress from month to month, and has the right to hold back any undergraduate from graduation if the bodily progress has been unsatisfactory from neglect of opportunities.

It should be noted that Professor Tait M'Kenzie has written the standard work on his own subject in English, and was brought over from America early in the war to assist our military authorities in the physical training of recruits.

The University of Edinburgh has recently received most valuable help from a generous public, and new Chairs and Lectureships of the greatest value to the various faculties have been founded. If some generous intending benefactor would consider the vast importance of the physical well-being of the youth of Scotland and found a Chair, or even a Lectureship, of Physical Education, he would benefit not one group of students only, but every student, besides many more outside the University—not only of the present, but of future generations. Should such a post be established, there does not seem any immediate need for the erection of a new building to provide serviceable floor-space. The magnificent M'Ewan Hall, with its ample area and lofty ceiling, stands empty week after week. Were permission granted, and suitable arrangements made, it could be employed for indoor exercises when not needed for occasional concerts or addresses. And for groups of students exercising in the open air at stated times, have we not close at hand the George Square Gardens and the Meadows ?

Breathing.—A very important specialisation of muscular action is that concerned in respiration. The muscles which perform the work are numerous and large, and like others grow stronger and more efficient with exercise. By expanding the chest they suck fresh air in, and by aiding to compress it they help to drive the used air out again. When we

recollect that one-half of the blood in the body has to pass through the lungs in the same time that the other half traverses the whole of the rest of the body, and that while in the lungs, *and there only*, the blood acquires oxygen—a vital necessity—and parts with carbonic acid gas—a deadly poison—we need not wonder that for vigorous life efficient respiration is of primary importance. Further, the action of the heart is intimately associated with that of the lungs. For these reasons it is especially important that exercises prescribed for enlarging and strengthening the respiratory apparatus should be faithfully performed. Care should also be taken that no tight clothing should at any time hamper the respiratory movements of the chest and abdomen.

Books of Reference.

Privy Council Medical Research Council—"The Science of Ventilation and Open-Air Treatment." Part II. By Leonard Hill, M.B., F.R.S. 1920.

"Exercise—My System." By J. P. Muller. For Men. For Ladies. For Children. London: Ewart, Seymour, & Co., Ltd.

"Exercise in Education and Medicine." By R. T. M'Kenzie. Philadelphia and London: W. B. Saunders Co.

CHAPTER II.

FRESH AIR.

We have now considered why our respiratory apparatus should be both capacious and efficient, and have urged practice and effort to make it so. As a corollary to that, we naturally turn to the other side of the question, How can we secure the best quality of air, and that in its best condition, for use by this improved apparatus? Common sense tells us that pure and fresh air is as necessary as good lungs; but how many realise this, and how many act upon it? The answer is supplied by the tightly-closed windows of innumerable bedrooms where our fellow-citizens spend a third of their life; by the close, stuffy atmosphere of many class-rooms, reading-rooms, places of public assembly, and tramway cars, and by the foggy combination of stale tobacco smoke and carbonic acid gas which contaminates the stagnant atmosphere of most smoking-rooms.

One of the best ways of realising the value of fresh air is to consider its effect in the treatment of disease. Not many years ago consumptives were boxed up in close, warm rooms, with every crevice closed for fear of a draught, and from these rooms they were allowed out for gentle exercise, only on dry, sunny days, and then when well wrapped up. Night air was then considered highly injurious, even for healthy people, and for consumptives, almost certain death. Under this system the death-rate from consumption was terrible. By degrees, however, the practice has entirely changed, and the results are vastly better.

For consumptives now, the mainstay of treatment is the open air by day and especially by night, and—thanks to its use—hundreds, nay thousands, have recovered who would have died under the former system. No one has done more to advance the treatment of consumption in every

respect that Sir Robert Philip, and his views on "Aëro-therapy," or, in popular language, the "fresh-air cure," will carry weight anywhere. This is what he said of it in an address to the British Medical Association, held in Belfast in 1909. He calls it "The Great Principle of Aëro-Therapy."

"Indeed, there is not wanting support for the belief that the results obtained under open-air treatment are fully better during the colder than the warmer months of the year. Nor is it too much to contend that the application of aëro-therapy has completely changed the clinical features of pulmonary tuberculosis. Under proper aëro-therapeutic conditions, the classic type of disease, as described from generation to generation in the past, has ceased to be. The aspect of the patient is metamorphosed. The delicate pink and white colouring, or the hectic blush usually described, is frequently replaced by a ruddy look. Pyrexia disappears marvellously. Within a short time, temperatures that have been swinging for weeks tend to become normal. The rapid pulse is slowed, and blood pressure increased. Night sweating is practically unknown. Cough quickly lessens or disappears, and expectoration is correspondingly reduced. Appetite picks up and digestive disabilities disappear. Lassitude and disinclination for effort, physical and mental, pass away, and the patient becomes once more keen and fit for neuro-muscular expenditure. His entire physiology returns to a higher plane. . . ."

Then Sir Robert discusses three general propositions of much significance :—

1. "Aëro-therapy is a measure of universal applicability in all lands. . ."

2. "Aëro-therapy is of universal applicability in every sick-room. . . . It is utilisable in the bedroom of the ordinary dwelling-house, if only the principle of application be rightly apprehended. . . ."

3. "Aëro-therapy, while especially indicated in tuberculosis, is a measure of widest applicability in relation to disease. . . . It would seem, indeed, that the application of aëro-therapy is without limits, provided reasonable care be taken to preserve the warmth of the body. We are only awaking to the full significance of this great, cleansing, antidotal, and vitalising principle, whose applicability in medicine is no less far reaching than that of asepsis in surgery."

This latter view has been amply confirmed by surgeons in the treatment of tuberculosis of bones and joints, and of all septic complications of wounds in civil and in military practice. Even in the treatment of insanity, where the cause of mental derangement is often obscure, this remedial measure is considered of such importance that balconies and

verandahs for rest-in-bed treatment in the open air are now provided in the best asylums.

In warding off disease, too, fresh air seems to be of immense importance, for—

"What is capable of effecting the cure of definite tuberculosis is *a fortiori* capable of preventing its appearance."

In Sir Robert Philip's experience, the patients treated in the open air in the Royal Hospital for Consumption never take ordinary pneumonia, pleurisy, or bronchitis, and epidemic diseases do not affect them, in spite of their having weakened lungs and depressed constitutions from pulmonary tuberculosis.

If fresh air, then, has such power to restore the sick and protect even them from fresh infection, it will surely have the power to make the nominally strong, who only use it half-heartedly, much stronger when they use it with a will. That this is so has been proved by many of my former house surgeons who, during the summer months at least, and often in winter, used to sleep out on the balcony at the Residency in the Royal Infirmary. Their experience was that a relatively short sleep in the open air refreshed and invigorated them more than a longer sleep in the bedroom, even with door and windows open. Similar testimony to the value of fresh air is borne by the nursing staff of the Liberton Cottage Hospital (a branch of the Longmore Hospital for "incurables"), in which most of the tuberculous cases—medical and surgical—are treated, and in which, by the way, many of the "incurable" patients recover. The hospital stands on a hill, and through its open windows and doors the wind blows briskly round the wards and along the corridors from end to end. The probationers at first feel the cold a little trying, but soon become used to it, and they tell me that after a short residence they feel in better health and more inclined for active work that they ever did before. Their vigorous and healthy appearance quite confirms this statement. Moreover, this testimony is not confined to the younger nurses. On asking one of the sisters, for instance, I found that before coming to Liberton she had nursed in ordinary hospital wards—pre-

sumably well ventilated—for fifteen years, but that she never felt so well or so fit for work as she does now at Liberton. This both she and the younger nurses attribute to being so constantly in fresh air.

The strength of these various testimonies to the value of pure fresh air as an invigorating agent to healthy and sick alike is very striking, and its bearing on training for athletics and for everyday work is self-evident. When it comes to a race, the man whose blood is best supplied with oxygen has an advantage over others. Professor Leonard Hill has shown this by a simple experiment. He allowed runners to inhale pure oxygen just before the pistol fired, and found that they were then able to beat their own best previous records, because oxygen *eliminates* the waste products that bring on fatigue. Our sportsmen, therefore, who enlarge their chest capacity and breathe the freshest air obtainable, will give themselves a similar advantage, although to a lesser degree, without any artificial expedient.

Professor Leonard Hill has also explained why the fresh air treatment has been so beneficial. The advantages are due not merely to the purity of the air. Many of them turn upon the relative coolness or coldness of open air in this climate as compared with that usually found indoors. This coldness acts favourably on the lining membrane of the air-passages leading to the lung and of those in the lung itself. It stimulates respiration, cools the blood, and favours evaporation from the lung. Moreover, open-air treatment includes access of cool air to the skin of the face and neck, and leads by degrees to the wearing of lighter clothing than that generally adopted. In this way the cool air acts as a tonic on the whole body through the skin. Thus it further stimulates respiration, and calls out the action of the heat-regulating mechanism of the body. This mechanism includes certain parts of the nervous system, the organs and glands which digest the food, and those concerned with the making and upkeep of blood. Besides this, the cooling of the skin leads to a desire for muscular action and to increased power of exertion.

The beneficial effects of the cooling of the skin by the movement of air, which thus hastens evaporation, is illustrated by the empiric practice

adopted at boxing competitions. Between the rounds, as is well known, the competitors retire to their corners, and are vigorously fanned by the flapping of towels in front of their face and chest, which may be at the same time sponged. If fresh air from the outside were to be simultaneously introduced into the room, which is frequently overcrowded, the advantage would be still greater.

Already, fortunately, one sees that the value of fresh air playing about the head and neck is being appreciated by our young men, who leave their hats behind them in all weathers, and by our young women, who allow their uncovered necks to face the winter storms. Even babies in their prams are often to be seen bareheaded, and the healthy, bright looks of these little ones must reward the courage and wisdom of their mothers.

A few years ago it would have been said that only the robust could remain strong in spite of so much exposure to the open air. Now we know that if the hardening process be not developed too rapidly, and if the food supply be sufficient, the weak will be made strong, and the robust more vigorous, just because they have availed themselves of the stimulating properties of fresh air in all its native coldness.

How the fresh air is to be obtained will depend on circumstances. Few can sleep " in the open " in a town, but open bedroom windows at night are feasible anywhere, and the door should be kept open also to ensure a free current of air. Sufficient bedclothes should, of course, be provided to ensure warmth, and the amount required will vary with the individual. It is worth remembering that while all sorts of expensive tonics and patent remedies of doubtful value are being advertised, and doubtless purchased, the best and really universal tonic is waiting outside every window for a chance to come in—delivery free.

Before leaving the subject of exercise and fresh air, perhaps I may be pardoned if I bear tribute to the inspiration given to me on these subjects by my dear old headmaster and friend, the late Dr H. H. Almond, of Loretto. He encouraged all forms of outdoor exercises and games for the beneficial influence they may, and did, under his guidance, exert upon

the character and physique of his boys. Long before the medical profession had realised the value of fresh, cool air, he was an enthusiast for it, and in school life insisted on light and loose clothing, free at the neck, with no headgear except as a protection against the sun. Windows stood open night and day throughout the school buildings. In more ways than can be enumerated here, he was a vigorous health reformer for the country at large, and gave valuable help to many schemes for improving the health and recreation of the people. Professor Leonard Hill in his report refers in several places to "Almond of Loretto" as an authority on exercise and fresh-air questions. Dr Almond went round the suburbs of Edinburgh with the then Secretary of the Edinburgh University Athletic Club in 1875, and helped him to find the Corstorphine field which for seventeen years kept the flag of the Edinburgh University Athletic Club flying. This field was chosen because it required no levelling, and could be rented, as no scheme more expensive could then be hoped for. It was leased, and soon afterwards equipped with funds raised at a bazaar organised with the powerful aid of Principal Sir Alexander Grant. Although somewhat difficult of access, it served its purpose well, and, by creating a public opinion, it made possible the purchase of the present University field for all time coming.

Books of Reference.

"Address in Medicine." By Sir Robert W. Philip, M.A., M.D. At Seventy-Seventh Annual Meeting, 1909. *Brit. Med. Journal*, Vol. II., 1909.

"Atmospheric Conditions and Efficiency." Leonard Hill. Manchester University Press, 1919.

CHAPTER III.

FOOD.

In my young days the question of food for men in training, and to some extent also for boys, was considered of very great importance. The rules guiding the choice of food were mostly derived from those in use by prize fighters and professional pedestrians. We were encouraged to take increased quantities of meat—lean and underdone—to cut down fatty foods and butter, to substitute bread—toasted, if possible—for potatoes, to take plenty of fresh vegetables, and, of course, to avoid pastry and rich dishes of any kind. Coffee or tea had to be weak—I forget about alcohol and tobacco. The general object in view was to get rid of superfluous fat ("external and internal"), increase muscle, and keep the liver in good order. There were many mistakes in this system, and we often had to desist from it for a time; still, and probably on that account, we managed to carry on fairly well. We trusted our instructor's wisdom so implicitly that when one of our best athletes gave out that he never changed his dietary while in training, we simply refused to believe him. I believe him now. In these days we depended on the maxims of uneducated men with no science behind them—men who often lived with reckless self-indulgence between their periods of training. Our choice of food was limited, but we could eat it as we liked. Now, in considering the diet question, we can refer to dietary experiments and physical exertion tests which have been conducted with scientific accuracy and checked by physiological research. As the result I shall try to show that there is good reason for saying that the sphere of self-control has been shifted from the choice of food to the manner of eating it. This has come about in the following very interesting way:—

Towards the end of last century Mr Horace Fletcher, an American

business man, at the age of forty-five had been for some years in poor health. He was subject to dyspepsia, rheumatism, breathlessness, and general incapacity for mental and bodily work. Numerous physicians had been consulted in vain, and two Insurance Companies had refused to insure him. Having to wait in Chicago for some months, with little to do except watch the progress of a mercantile transaction, he resolved to put in time by dallying over his meals in the restaurant. Accordingly, he masticated his food very slowly, and by degrees to his surprise found that he became satisfied with less. Moreover, he felt less hungry between meals, and began to lose weight and gain health. Encouraged by this result he went on, and in a few years had not only lost several stones in weight, but had completely regained his health, and with it a power of enduring physical fatigue that astonished himself no less than his friends. At the age of fifty, for instance, starting on his bicycle early on a summer's morning with an expert cyclist of thirty as a companion, he rode 190 miles before evening, and after sleeping well, covered 50 miles next day. The younger man had been done up after 100 miles on the first day. Mr Fletcher's results were at first doubted by most members of the medical profession, but after much perseverance he succeeded in finding support from several eminent physiologists. The late Dr Michael Forster, Professor of Physiology at Cambridge, was one of the first. He kept Fletcher under observation at his department for six months in the winter of 1901-02, and being convinced that the results obtained in the way of increased power of work, with diminished consumption of food, were very remarkable, decided that further inquiry was called for. Accordngly, in his capacity of permanent President of the International Congress of Physiology, he issued a report in which he recommended a full inquiry into the subject at an international laboratory. In this report he expressed his regret that—

"For this fuller study the Cambridge laboratories do not possess at present either the necessary equipment or the funds to provide it."

The report concludes—

"The scientific and social importance of the question is clearly immense, and it is greatly to be desired that its study should be encouraged."

Returning to America after leaving England, Mr Fletcher found another practical sympathiser in Professor Bowditch, of the Harvard University Medical School, and he in turn introduced Mr Fletcher to Professor Chittenden, of Yale, then President of the American Physiological Society, and one of the most eminent physiological chemists in America. At Yale Mr Fletcher, for physical exertion tests, was put under Dr Anderson, Director of the Yale University Gymnasium, and while undergoing these tests the chemical analyses of his food and waste products were conducted by Professor Chittenden and his assistants. When this investigation was finished, Professor Chittenden issued a report and with it included one from Dr Anderson. From this combined report a few extracts may now be quoted. Professor Chittenden begins :—

"The writer has had in his laboratory for several months past a gentleman (H. F.) who has for some five years, in pursuit of the study of human nutrition, practised a certain degree of abstinence in the taking of food, and attained important economy with, as he believes, great gain in bodily and mental vigour, and with marked improvement in his general health . . . In using the word abstinence, possibly a wrong impression is given, for the habits of life now followed have resulted in the disappearance of the ordinary craving for food. In other words, the gentleman in question fully satisfies his appetite, but no longer desires the amount of food consumed by most individuals."

As the result of laboratory observations in a thirteen days' test, the Professor goes on to say :—

"It will be observed here that the daily amount of proteid food[1] taken was less than one-half that of the minimum Voit Standard,[2] and it should be mentioned that this apparent deficiency in proteid food was not made good by any large consumption of fats or carbohydrates."

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[1] Proteid or nitrogenous food is supplied in the flesh of animals, from shell-fish upwards, and in milk and eggs; it also occurs in varying proportion in the seeds, nuts, and some fruits of plants. It is distinguished from starchy foods. These are found also in nuts and seeds, as well as in the roots and stems of certain plants. Animal and vegetable fats and oils are well known.

[2] For the sake of comparison the two dietary standards, to which reference is made, are here given in technical terms :—

	Proteid.	Carbo-hydrate.	Fat.
Voit's diet scale	118 gm.	500 gm.	56 gm.
Chittenden's diet scale ...	55 ,,	280 ,,	28 ,,

Professor William Russel, in his lectures to nurses in the Royal Infirmary, has described the Voit Dietary as the "nineteenth century scale," and the Chittenden Dietary as the "twentieth century scale." I venture to agree with him.

During this test the body weight (165 lbs.) remained unchanged.

"The diet consumed was quite simple and consisted merely of a prepared cereal food, milk, and maple sugar. This diet was taken twice a day for seven days, and was selected by the subject as giving sufficient variety for his needs, and quite in accord with his taste. No attempt was made to conform to any given standard of quantity, but the subject took each day such amounts of the above foods as his appetite craved. Each portion taken, however, was carefully weighed in the laboratory, the chemical composition of the food determined, and the fuel value calculated by the usual methods."

At a later test, continued for seven days, the intake of food was compared with the nitrogen output, and

"there was a close approach to what the physiologist calls nitrogenous equilibrium."

In other words, Mr Fletcher consumed a quantity of nitrogenous (or proteid) food sufficient to make good all the waste by wear and tear of his tissues while in action, and no more. The contention is that a superfluous intake of this material clogs the machine, so to speak, and induces fatigue.

During these seven days Dr Anderson tested Mr Fletcher's powers of enduring physical fatigue, and reported as follows :—

"On the 4th, 5th, 6th, and 7th of February 1903, I gave to Mr Horace Fletcher the same kind of exercises we give to the 'Varsity crew. The exercises he was asked to take were of a character to test the heart and lungs, as well as to try the muscles of the limbs and trunk. I should not give these exercises to Freshmen, on account of their severity."

"There is no evidence of distress after or during the endurance test, *i.e.*, the long run. The heart is fast but regular ; it comes back to its normal beat quicker than does the heart of other men of his weight and age."

Dr Anderson sums up as follows :—

"My conclusion, given in condensed form, is this—

"'Mr Fletcher performs this work with greater ease and with fewer noticeable bad results than any man of his age and condition I have known and worked with. To appreciate the full significance of this report, it must be remembered that Mr Fletcher had for several months past taken practically no exercise other than that involved in daily walks about the town.'"

Professor Chittenden concludes :—

"The problem is far-reaching. It involves not alone the individual, but society as a whole ; for beyond the individual lies the broader field of the community, and what proves helpful for the one will eventually react for the betterment of society, and for the improvement of mankind in general."

In considering the value of endurance tests it is well to recognise clearly the difference between muscular endurance and muscular strength. Endurance means the number of times a relatively easy muscular action can be repeated; while strength means the utmost power that a muscle or group of muscles can exert at a single effort. There seemed no doubt that Mr Fletcher had attained to a remarkable degree of *endurance* while living on a diet much below Voit's previously accepted "Standard Diet," especially as regards protein or albuminous food. The question of *strength* was then tested by Professor Chittenden in another way. He took a group of eight young soldiers who had had no previous course of training in the gymnasium. He put them upon a measured diet in which the reduced scale of relative quantities of essential foodstuffs was similar to that adopted by Mr Fletcher. At the end of a five months' course of training in the gymnasium with this (to them) new diet scale, the result was found to be as follows:—

"Without exception we note a phenomenal gain in strength which demands explanation."

Briefly, the explanation offered was that their gain in strength was due to the training, but was in no way hindered by the diet. This he says—

"is in harmony with the principle already discussed, that the energy of muscle work comes primarily from the breaking down of non-nitrogenous material, and consequently a diminished intake of proteid food can have no inhibitory effect, provided, of course, there is an adequate amount of proteid ingested to satisfy the endogenous requirements of the tissues."

i.e., provided that there is sufficient building-up material for muscles as they enlarge in response to the stimulus of exercise.

So much, then, for Mr Fletcher's powers of endurance under a low diet attained by slow mastication, and for the young soldiers' gain in strength from muscular training under a similar diet calculated for them. Professor Irving Fisher, Professor of Political Economy at Yale, went a step further. He wished to see if Fletcher's results as to diminution in quantity and altered proportion in quality of food, along with increased power of endurance, could be obtained by others besides Mr Fletcher. He had discussed the subject in his lectures, and a group of nine young men studying at the University volunteered to follow out the slow mastication

method while carrying on their usual studies, and to submit themselves to endurance tests before, during, and after the prescribed period, which extended from January to June 1906.

The endurance tests employed were these :—(1) Rising on the toes and sinking again ; (2) deep knee bending and rising again ; (3) while lying on the back on the floor, raising the legs to the vertical and lowering them again ; (4) raising a 5-lb. dumb-bell in each hand from the shoulder to above the head and lowering it again ; and (5) holding the arms horizontally out from the shoulder as long as possible, with one involving also strength, *i.e.*, (6) raising a 25-lb. and a 50-lb. dumb-bell from a hanging position up to the shoulder by bending the elbow and lowering it again.

When eating, they were to be guided by certain directions which may be epitomised as follows :—*Mastication* was to be continued until the food practically melted away in the mouth, and was swallowed involuntarily, liquid food being sipped and tasted, not swallowed like water. Attention was to be directed to the tasting and enjoyment of the food, and not to the number of chews, to the length of time it was held in the mouth, or to any constraint of the tongue or other procedure which might make eating a bore. Swallowing was to become an involuntary function like breathing.

With regard to the quantity and quality of their food, they were to *follow instinct*, thus they were not to eat unless hungry, even if one or more meals were skipped. Of available foods they were to choose the kinds to which instinct guided them, and they were to take only the amounts which Nature seemed to indicate as advisable. No past habit, consideration of courtesy, or theory of any kind was to be allowed to interfere with obedience to the prompting of Nature.

Later on a third direction was given : they were to *use reason when instinct was in doubt.* To make this easier, a large choice of foods was placed at their disposal, and each kind was served in known quantities (in 100 caloric units, in fact). Then two lists of these foods were given to them :—

"One was arranged in a tentative order of merit, beginning with fruits and ending in alcohol, and the other in the order of the proportion of protein.

The men were then asked when, and only when, the appetite was *entirely willing* to choose the better foods, and the low proteid foods in preference to those high in protein."

"In this way the men gradually shifted their diet upward in the two lists, and thereby pursued a little faster the same direction in which they had already been found to be unconsciously moving under the influence of thorough mastication and implicit obedience to appetite."

The results confirmed those previously arrived at by Mr Fletcher and Professor Chittenden.

Professor Fisher states that :—

"The phenomena observed during the experiment may be summarised as a slight reduction :[1] of total food consumed, a large reduction of the protein element, especially of flesh foods, a lessened excretion of nitrogen, a reduction in the odour, putrefaction, fermentation, and quantity of the fæces, a slight loss of weight, a slight loss of strength, an enormous increase of physical endurance, a slight increase in mental quickness. These phenomena varied somewhat with different individuals, the variations corresponding in general to the varying degree in which the men adhered to the rules of the experiment."

With regard to the "slight loss of strength," it must be remembered that in this experiment no form of muscular training—upon which, as we have already seen, increase of strength depends—was undertaken ; the men, in fact, abstained from even the endurance exercises in the interval between the tests, so as to exclude any improvement due to practice. Besides, during the five months in question they were, most of them, studying hard and sitting up late at night—rather more than usual, because they felt more inclined for mental work.

Before leaving the subject of slow and thorough mastication, it may be well to draw attention to other advantages which result from it besides those already mentioned. Thus dentists tell us that the chewing of hard or firm food strengthens and develops the jaws in young people and hardens the enamel ; the flow of saliva which accompanies it not only digests starches in the mouth, but by its alkalinity neutralises the acids caused by fermentation there, and so protects the teeth against decay. Moreover, mastication has a remarkable influence over digestion in the stomach in more ways than one. It allows the starchy food, saturated

[1] The previous standards were not mentioned.

with saliva, to go on being digested for some time after it reaches the stomach ; it breaks up the meat and other proteid food which the stomach digests, and thus facilitates the action of gastric juice upon it. In addition, through the nervous system it stimulates the movements of the stomach wall, which are essential to the digestive process.

Perhaps the most wonderful effect of all has been left to the last, although it is perhaps the first in time. Through the nervous system the taste and smell of the food, even the thought of it, besides the mechanical act of chewing, cause a flow of digestive juice in the stomach while the food is still in the mouth. Hence the time taken up in chewing is time gained, and more than gained, in the later stages of digestion.

A beautiful demonstration of the value of mastication in assisting digestion has been furnished by Professor Francis Boyd. It was described by him in an address "On the Influence of the Buccal Cavity on Primary Digestion," delivered to the Odonto-Chirurgical Society of Scotland in 1912. Stated in popular language, the following was the nature of the demonstration :—

"On two days two patients got the same amount of food : ¾ lb. meat, 10 oz. bread, and 100 gm. contrastin (*i.e.*, an inert powder opaque to X-rays). On the first day the food was very finely divided and was swallowed as a mushy mass. The peristaltic waves occurred in one patient in 1 min. 35 sec., in the other patient in 1 min. 25 sec. ; on the second day the same food was taken as grilled steak and toast. In each patient there were ten peristaltic waves (*i.e.*, progressive rings of contraction of the wall) in 35 secs."

The first meal required no chewing, the second did require chewing, "the constituents were the same, the influence on gastric peristalsis was pronounced." When the X-ray pictures were taken immediately after the meal, the whole of the bolted food was seen to be in the stomach, while of the chewed food, about one-third or one-fourth (judging by the size of the shadow), having left the stomach, had passed into the first (small) part of the intestine. Six hours later X-ray photos were again taken. Then a considerable part of the bolted food remained in the stomach, and the rest was still in the small intestine, but the chewed food had not only left the stomach, but had passed through all the 26 feet of

small intestine, and had reached well into the shorter and larger "large intestine."

The more rapid passage of well-chewed food through the stomch and intestines is an indication of its more rapid digestion, and must tend to maintain a healthier state of the lining membrane of those parts in so far as it prevents the stagnation of fermenting material in parts not apparently designed to act as reservoirs.

It is easy to understand, from what has been said in favour of mastication, why food-bolters suffer from dyspepsia and other alimentary ailments from which thorough mastication might have saved them. This is an interesting illustration of the old proverb, " the more hurry the less speed." All people, however, who eat more food than they need, and who do not chew it well, do not suffer from indigestion. Some suffer from gout. Others have such excellent digestions that their surplus nourishment is partly stored up as fat, and partly excreted as a waste product. Both of these methods of disposal, however, are injurious. The stored fat in well-to-do people only accumulates under the skin, round and in the heart, and inside the abdomen. The mere bulk and weight of it hampers respiration, circulation, and active muscular exercise, while the waste matter in the blood leads to degeneration of the blood-vessels. Those who wish to maintain the normal extent of active work for healthy people, and to enjoy life in the best sense of the word, should see to it that their weight does not increase with their years. If it does, the cause must be attributed to excess of food over the actual requirements for *their* constitution and physical output, apart from the standard required for other people.

To some, perhaps, it may seem that too long a time has been spent over the question of mastication, and too little over the foods themselves. The reason, however, for this has been that there are abundance of popular books about food, but very little reliable information about the value of thorough mastication.

To sum up these remarks on food in relation to training in its widest sense, I hope that good ground has been given for believing that the fol-

lowing consequences will follow from deliberate and thorough mastication: There will be no need to restrict the choice of foods overmuch, nor to measure out the quantities (these questions of supply may be left to instinct if appeal be really made to it); a considerable diminution is likely to take place in the total quantity of food eaten over the previous allowance; there will probably be a drift towards simpler foods as a whole, and especially towards a diminution in the proteid (or albuminous) element; while not unlikely a preference will arise for vegetable rather than for animal forms of proteid food.

While these changes are taking place by degrees in the dietary, there will be no check to an increase in muscular strength if the exercise necessary for this increase be given to the muscles. Even without exercise the power of enduring physical fatigue will be marvellously increased; digestion will be maintained at a high level; there will be a general feeling of well-being and a clearer intellect.

These are gains which seem well worth a little trouble, and if scoffers arise to make light of our efforts, let us quote the Aberdeen motto: "They say, what say they, let them say."

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CHAPTER IV.

ALCOHOL.

From the nature of our inquiry we may rule out of the present discussion any of the numerous bad results which follow an excessive use of alcohol. What concerns us is the physiological action of alcohol on the various organs and systems of the body, so that we may know whether in strictly limited quantities it is calculated to serve any useful purpose or not for the man in training or for the person engaged in mental or physical work.

For many years past this subject has engaged attention in all civilised countries. Careful researches, have been carried out by physiologists and physicians, and observations have been made and recorded by supervisors of labour and, among others, by officers of the Army and Navy. One of the most recent and authoritative reports on the effects of alcohol in moderate doses is entitled "Alcohol: Its Action on the Human Organism." This has been issued by an advisory council appointed in November 1916 by the Central Control Board (Liquor Traffic) "*to consider the conditions affecting the physiological action of alcohol,*" especially in relation to health and industrial efficiency, etc. Lord D'Abernon was chairman, and with him were associated eight members, each an expert in some department of knowledge which bears on the inquiry. Among others may be mentioned the names of Professor A. R. Cushny, now of Edinburgh, Sir Frederick Mott of London, and Professor Sherrington of Oxford.

The report is not long, and will well repay perusal; but for our present

purpose we need not go beyond the chairman's "Summary of the Principal Conclusions." These are :—

"(*a*) That the main action of alcohol (apart from the effects of its continued excessive use) is confined to the nervous system ;

(*b*) That alcohol is narcotic rather than stimulant in action ;

(*c*) That its nutritional value is strictly limited ;

(*d*) That its habitual use as an aid to work is physiologically unsound ; and

(*e*) That the ordinary use of alcohol should not only be moderate, but should also be limited to the consumption of beverages of adequate dilution, taken at sufficient intervals of time to prevent a persistent deleterious action on the tissues."

In addition to this conjoint authoritative statement, a few references from other sources as to the effects of alcohol in practical life will be instructive.

From the point of view of an Arctic traveller watching men engaged in severe physical work, in extreme cold, the following quotation, borrowed from Horsley and Sturge's comprehensive book on alcohol, is enlightening.

Sir I. Ross says :—

"I was twenty years older than any of the officers or crew, yet I could stand the cold better than any of them, who all made use of tobacco and spirits. I entirely abstained from them. The most irresistible proof of the value of abstinence was when we abandoned our ship and were obliged to leave behind us *all* our wine and spirits. It was remarkable to observe how much stronger and more able the men were to do their work when they had nothing but water to drink."—"Voyage to the Arctic Regions," 1892-93.

Then with regard to the effect of alcohol on accuracy of aim in gunfire, another extract borrowed from the same source as the last will give useful information from a competent authority :—

"As regards straight shooting, it is every one's experience that abstinence is necessary for efficiency. By careful and prolonged tests the shooting efficiency of the men was proved to be 30 per cent. worse after the rum ration than before it."—Admiral Sir J. R. Jellicoe.

We may next turn to Alpine climbers to hear what their estimate of alcohol is in connection with strenuous feats of climbing in the mountains.

In 1910 a translation of Dr Schynder's account of collective investigation ("referendum") into this question was published, and the information elicited is important.

He framed a set of questions to bring out various points about which he, as a scientist, although neither a climber nor an abstainer, desired information.[1] He publishes many, if not all, of the actual replies, and then refers in general terms to the results as follows ("Alcohol and Alpinism," p. 57) :—

"Is it possible to extract from this referendum certain general principles on the subject of the use of alcohol in mountain climbing ? To begin with, there is complete agreement upon the question of the preventive rôle of alcohol against fatigue. It will never enter the thoughts of any serious Alpinist to take alcohol before the climb, or at its commencement, with the object of increasing the capital of his strength. It is generally recognised that upon an unfatigued person, in possession of all his means of action, alcohol can only have a depressing, paralysing influence. It is this action which makes the Alpinist so often say : 'Alcohol takes my legs from me !' The unfatigued person who has taken alcohol, in view of an effort to be accomplished, places himself in a notoriously inferior position in relation to the man who, well rested, and well nourished, has abstained from taking it. The unfavourable effects of alcohol manifest themselves even over a period of time, and in numerous replies we have seen the use of alcoholic liquors is formally proscribed the day before a climb, or even during the days which precede it. During the climb itself the proscription of alcohol is almost unanimous as long as the effort to be accomplished is still of long duration. 'No alcohol on the ascent !' Such is the phrase which comes as a refrain in a great number of replies ; and what is to be seen in this cry of alarm if not the verification of the paralysing action of alcohol upon the muscular force ?"

Since the demand made on the physical endurance and strength of Alpine climbers is similar to that made on men engaged in various forms of athletic exercise, this general conclusion, based on the opinions of many independent observers, will naturally carry great weight.

The preceding observations dealing with the influence of alcohol on the endurance of hardships and fatigue in the Arctic regions, on the accuracy

[1] The sets of questions were sent "to about 1200 members of Alpine Clubs, Swiss and Foreign, the majority known as proved mountaineers." Of the papers sent out 578 were returned, "conscientiously filled in."

of fire in big gun shooting in the Navy, and on the efficiency of mountaineers engaged in Alpine climbing, will help us better to estimate its value or otherwise in athletic sports. So far as British athletic clubs and University rowing crews are concerned, no decided opinion on one side or the other seems to have been expressed with official sanction at least. So long as the quantity of alcohol used may be considered moderate, the individuals under training seem to be free to decide for themselves whether to be abstainers from alcohol for the time being or not. The case is different, however, in many athletic clubs in America. In 1915 Professor Irving Fisher, of Yale University, published a short paper on "The Attitude of the College Man towards Alcohol." Along with other aspects of the question, he dealt specially with the relation of alcohol to athletics, after having ascertained what views were held on the subject in some of the large American universities. The whole paragraph is worth quoting :—

"That alcohol increases fatigue is now commonly recognised by athletes. Alcohol gives no increase of muscular power. It is not what we can properly call a stimulant, but a depressant. It is *apparently* a stimulant, because it puts to sleep nerves that indicate fatigue, so that the person thinks himself relieved of fatigue. What it does is to make one unconscious of his fatigue. Various kinds of tests and exercises have proven that alcohol is a decided hindrance to muscular or athletic power. Army marching tests, Marathon races, and walking contests have shown these results. Mr C. F. Stoddard, who has collected some telling data on this point, says: 'In recent years, the managers of the Boston Marathon Races have absolutely forbidden the use of alcohol before and during the race.' He also points out that Connie Mack, manager of the Philadelphia Athletics, said, in 1910, of the team which won the world's Baseball Championship, that fifteen of the twenty-five players 'did not even know the taste of liquor.' Ted Coy, one of Yale's captains of a few years ago, put the ban on all forms of alcoholic drinks for his team. At present there seems to be no strict rule, either at Yale or Harvard, regarding the use of alcohol by athletes, although only the lighter alcoholic drinks are condoned, such as ale. Apparently this remnant of the idea of alcohol as a help in athletics is due to the influence of old English training traditions. Director Young, of Cornell, has recently written me: 'Neither alcohol nor tobacco is used at any of the training tables at Cornell, and the use of either by men in training for the athletic teams is strictly tabooed.' Mr George W. Ehler, Athletic Director at the University of Wisconsin, says: 'We prohibit alcohol entirely to men in training. All of our coaches are quite

agreed that it is of no value.' Professor A. A. Stagg, Yale '88, famous in baseball and football, and now the Physical Director at the University of Chicago, says: 'We have no training table at the University of Chicago, . . . For twelve preceding years we did have a training table at the University of Chicago, but at no time and in no respect was alcoholic liquor of any sort in use.' The reply from California is: 'No liquor at training tables.' Minnesota says: 'So far as we know, athletes in training for teams do not use alcohol.' At Princeton, 'Men who are in training for athletic teams are forbidden to use alcohol.' I have been informed that 'No alcohol' is also the rule at the University of Michigan, and at most of our universities farther west. Doubtless what little use of alcohol is still allowed at some colleges will be dropped before long."

We have not, however, as yet considered any evidence as to the action of alcohol on the mind. Since mental alertness is certainly a necessity in many athletic sports, and is of primary importance in after life, the following paragraph from the report of Lord D'Abernon's committee will be read with interest (p. 37):—

"It may be added that a review of the many laborious attempts made in recent years to determine by the methods of the laboratory the effects of alcohol on the mind and nervous system, shows that such observations harmonise well with these general conclusions;[1] for, although some of the earlier workers on these lines believed they had found evidence of an initial stimulating effect of alcohol, this appeared in all cases to be of but small effect and duration; and later work throws doubt upon the validity of this interpretation of the evidence, and supports the conclusion that the direct effect of alcohol upon the nervous system is, in all stages and upon all parts of the system, to depress or suspend its functions, that it is, in short, from first to last, a narcotic drug."

This view, *i.e.*, that alcohol is at every stage of its action a narcotic, as expressed in the preceding paragraph, must be puzzling to many, because to all appearance excitement of the mind and body is a symptom of an early stage of alcoholic intoxication. This apparent anomaly, however, can be explained in more ways than one. In the first place, an immediate quickening effect is produced on the action of the heart by any agent which stimulates the mucous membrane of the mouth, nose, or throat.

[1] That the nerve cells associated with the higher nerve centres were attacked by alcohol before those associated with the lower nerve centres.

The vapour of ammonia does this, whether as strong smelling salts, or when produced by the proverbial burnt feather. Sal volatile has a similar effect, and so has hot tea, and so has strong alcohol, especially if they are sipped, but the result in all these cases is now acknowledged to be brought about by surface irritation acting through the nervous system, or even also by the mere act of swallowing, not by any agent acting in the circulating blood. In the second place, we must remember that the influence of the brain upon the organs and systems of the body is twofold. It restrains and controls as well as excites them. The first centres to be paralysed by alcohol in the blood are those which restrain, and when these are thrown out of action the exciting centres have more free play, and an irregular form of excitement results. Later on the exciting centres are in turn overtaken by the drug, and a general depression results. In the third place, anyone influenced by alcohol has his intelligence blunted at first, and his powers of self-criticism lessened. His mental powers are impaired, but he does not realise this, and is fully persuaded that he is mentally improved by the alcohol, whereas the exact opposite is the case.

All these are sources of fallacy which must be understood if we wish to estimate correctly the early action of alcohol on mind and body.

With regard to the continued action of alcohol, we must not forget that there are great differences of opinion as to what is or is not a moderate quantity. One quotation only seems necessary in this connection. It is borrowed from " How to Live," a book expressing the views of a body of American experts whose authority is beyond question.

" If laboratory and clinical evidence shows that alcohol in so-called moderate quantities (social moderation) produces definite ill effects, such as lowering the resistance to disease, increasing the liability to accident, and interfering with the efficiency of mind and body, and thus lessening the chances for success in life, to say nothing of any toxic degenerative effect upon liver, kidneys, brain, and other organs, the excess mortality that unquestionably obtains among moderate drinkers as compared to total abstainers must be ascribed chiefly to alcohol " (p. 237).

To sum up: the opinions expressed by the foregoing competent authorities seem to justify the following conclusion regarding alcohol:—

There is no reason to believe that alcohol will be of any direct assistance either in training for bodily or mental work, or when a special effort is required; and further, that if used at all, great care must be taken lest it should act as a hindrance.

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CHAPTER V.

TOBACCO.

Like Alcohol, Tobacco is considered by experts to be a narcotic drug; but unlike it, the symptoms caused by even fairly large doses are not obvious to an onlooker as those of alcohol are, nor are the deleterious effects produced by its habitual excessive use so widespread or so serious.

Tobacco, however, contains certain very potent poisons; and although they are much diluted in the form of tobacco smoke, there seems good reason for believing that in the quantities frequently used, tobacco may have more serious effects on the system than is usually supposed.

About forty years ago the late Professor Sir Thomas Fraser delivered a very interesting popular lecture on " Alcoholic Stimulants and Tobacco " to the Edinburgh Health Society. He spoke as a moderate user of both. As regards alcohol, he arrived at views of its results, from a practical standpoint, similar to those spoken of in our last section, although some of the theoretical views as to the mode of action of alcohol, then held, have since been modified. On the subject of tobacco, he thought it necessary to utter serious warnings; and in the early stages of the late war, in 1915, I think, he repeated these warnings in the public Press. Drawing attention to the risks of injury to the health and efficiency of our soldiers from over-smoking, he protested against the indiscriminate distribution to them of cigarettes by many well-meaning people, and he appealed for caution.

In his health lecture Sir Thomas, after referring to the action of tobacco on the heart, continued as follows on a point which concerns our present inquiry :—

" I have said that breathlessness is one of the accompaniments of the bad effects of smoking upon the circulation. This is well known to men who

are in training for athletic contests, and it is the invariable custom of them to refrain altogether, or almost altogether, from smoking, for they know very well that if they do not refrain, they would have a poor chance of winning a race."

Subsequently he drew attention to other well-known effects of tobacco-smoking—effects which are not always recognised by the sufferers as due to tobacco—and in this connection spoke of headache, sleeplessness, mental depression, tremors, indigestion, anæmia, palpitation and giddiness, smoker's sore throat, winding up with dimness of vision due to the action of the drug on the optic nerve. He then went on to say :—

"Now, all these bad effects to which I have drawn your attention are much more easily produced by smoking in a close, confined room than in the open, outside air. Those who smoke know very well that they are extremely likely to suffer, even after moderate smoking, if that has been indulged in in a close room, along with a number of companions, who were also smoking. This is to be explained by the air in the room becoming saturated with tobacco smoke, so that the air breathed is not pure air, but air containing smoke from each of the smokers, who are subjected to the advantage or disadvantage, of inhaling the smoke emitted by all the smokers. Companionship in smoking within doors is, accordingly, anything but an unmixed advantage. It is a frequent cause of illness in moderate smokers, even when it occurs in a large and not otherwise overcrowded room."

For a more recent expression of similar views on the action of tobacco we may turn to a pamphlet issued during the war, "Is the Tobacco Habit Injurious?" by Professor Irving Fisher, of Yale; and to the tobacco section of the book, "How to Live," already referred to, of which he is one of the editors. Some of the following extracts are common to both. Thus to quote from Professor Fisher :—

"Professor Bruce Fink, of Miami University, who has studied the literature on tobacco, says: 'In running through a large amount of literature from various sources of special study, not a single article has been found written in the last twenty-five years that does not condemn tobacco to a greater or less degree.'"

Again :—

"Professor Pack, of the University of Utah, finds that tobacco-using athletes are decidedly inferior to abstainers. His conclusions are as follows :—

(1) Only half as many smokers as non-smokers are successful in the 'try-outs' for football squads.

(2) In the case of able-bodied men, smoking is associated with loss of lung capacity amounting to practically 10 per cent."

"Clark Griffiths, manager of the Washington Nationals, expressed himself thus: 'I am convinced that our failure to come up to expectations this season has been largely due to the fact that some of the players on whom I depended were cigarette fiends. There will be no more of it. Any player who insists on smoking cigarettes is through, so far as the Nationals are concerned, and that goes so long as I am manager of the team. No man in athletics for a living can use them.'"

"In a series of tests where ten men pitched a base ball ten times at a target, then rested half an hour and pitched other ten balls, if the interval was spent in merely resting, the second set of ten balls were thrown more accurately than the first; but if a cigar were smoked in that half hour, the second set were thrown less accurately than the first; and if two cigars were smoked, still less accurately. The results were substantially the same for smokers as for non-smokers (except that the second cigar had practically no effect on the smokers), and indicated a deterioration in the score of 20 per cent. due to smoking."

As to mental effects, Professor Pack quotes the following:—

"Bush, in a series of tests on each of fifteen men in several different psychic fields, found the following conditions among smoking students immediately after the period of smoking was completed—

(1) A 10½ per cent. decrease in mental efficiency.

(2) The greatest actual loss was in the field of imagery, 22 per cent.

(3) The three greatest losses were in the fields of imagery, perception, and association.

(4) The greatest loss in these experiments occurred with cigarettes."

From an industrial standpoint, Professor Fisher refers to several railway companies and large business concerns which discourage or forbid smoking among their employees, and among others

"Thomas Edison will not accept cigarette smokers in his factories." . . . "The Chicago Post Office employs no special delivery messengers who use tobacco in any form."

There seems to be no need for quotations from any more writers on the subject of tobacco. The writers selected have in common the recommendation that they seem to have been careful observers, desirous of ascertaining accurately the effects of tobacco on the powers of mind and body. They all arrive at the same conclusion, viz., that *tobacco lowers the maximum attainable standard of efficiency in both physical and mental*

forms of human activity. Further, it is noteworthy that so many of them consider that cigarette smoking is a specially harmful way of using tobacco.

These views, I understand, accord with those generally held by present-day trainers for athletics. Moreover, the views may be reasonably extended to apply equally to persons who wish to attain to the maximum of physical power and dexterity in any walk in life, and to brain workers who desire to preserve unblunted the acuteness of their mental vision.

We have not, however, quite finished with the part which alcohol and tobacco may play in relation to training when we have pointed out the evil results of their naroctic action. It is claimed that this very narcotic action may be of service under special circumstances, and this claim must be considered. The circumstances referred to are when persons under training are over-fatigued by physical exercise, or are mentally upset by worry or anxiety directly or indirectly attributable to their mode of life and objects in view. To begin with fatigue, neither alcohol nor tobacco can dissipate it as oxygen does by neutralising the poisons which cause it, but both can soothe the disagreeable sensations which accompany it. For this reason either drug can give comfort at the end of an unusually severe day's work. Such an effect is no doubt encouraging, but what about the effect of the narcotic on the work of the day after? This is where the difficulty comes in. These drugs have certain disadvantagous actions of their own which they add to those of fatigue, so that if the training is still in progress, the comfort obtained by their use is a questionable benefit.

The other possible advantage of alcohol or tobacco lies in their power to soothe the mind. During training there are anxieties as to results and sources of petty annoyance in daily life which sometimes come to be seriously disturbing. A great deal depends on the coach and on the personal character of the component individuals when a team is working together. Mental anxiety and moods of jealousy or ill temper are fertile sources of waste of nerve energy. These disturbing factors should certainly be avoided, and one way of diminishing them at least is to make use of the narcotic action of alcohol and tobacco. By their sedative influence the edge of nervous irritability can be blunted, petty annoyances

soothed, and fretting cares for the time being forgotten. This seems to promise well so long as the sedative effect predominates over the effect of reaction, and some find it so. Others, however, do not succeed so well. At the best, however, remedies such as these require to be employed with caution. Indeed, it is open to question if results at least equally good and without risk of drawback cannot be obtained by carefully cultivating the art of self-control for the mind, no less than for the body. More will be said about this subject in connection with "Economy of Nerve Power."

Books of Refrence.

"Is the Tobacco Habit Injurious?" By Professor Irving Fisher.

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CHAPTER VI.

ECONOMY OF NERVE POWER.

At the outset let us admit that no one knows what nerve power really is, any more than he knows what electricity, gravitation, or any other of the powers of Nature really are. All that we can say is that they are all forms of energy, that is, are various powers capable of doing work of different kinds. The spheres of action of nerve power are the bodies of living animals, and on the work done by it depend the life and health of every individual. We can go no further than this towards understanding the nature of nerve power, but we can learn by observation and experiment some of the laws by which it is governed. Obedience to these laws will guide us to the use of nerve power to the best advantage, so far as that is within our own control. My own knowledge of the subject is small, and the most I can do is to try to point out briefly some of the more obvious practical deductions which may be drawn from present knowledge on this important subject.

All manifestations of nerve energy are associated with action of the nerve cells of the brain. Consequently, on the healthy condition of these nerve cells depends the due manifestation of all forms of bodily and mental activity. Although many of the systems and organs of the body are indispensable for the life of the individual, yet because the brain is the seat of control and of the co-ordination of the other organs one with another, it may be considered as the organ of supreme importance. This position as the chief of the vital organs of the body is more easily understood when we consider what happens when any of the higher animals is starved to death.

Professor Mosso describes what happens very clearly, as follows :—

"When the body is receiving no nutriment the less important are sacrificed to the more important tissues in the combustion which must finally destroy life. To the very last moment, as long as there is any possibility of life being saved, all the organs give of their substance save the heart and the brain; and even when the heart has been reduced by hunger to desperate straits, and the temperature of the blood has fallen to 30°, the cardiac contraction, having become both weaker and less frequent, even then this organ which was the first to give any sign of life, will continue faithful to its duty till the end, and will collect the last remains of energy from the wasted organs to transmit them to the brain. And the final transference, the final cession of living material from the body to the brain, will be made with the final systole of the heart."

If this striking illustration helps us to realise more clearly the importance of this mysterious nerve power which is centred in the brain, we can the better appreciate the need for economising it.

When we speak of economy of money we mean care and forethought in the spending of it. A thrifty man does not part with his money unless for objects which he really requires, and for these objects he gives no more than the amount just necessary. He will, no doubt, try to lay by a reserve fund (his capital) against any sudden emergency, and will avoid, if possible, any drain on it which might leave him bankrupt.

All this is true in principle of nerve power, and in following out the analogy we may consider the physical condition of the brain as an index of the nerve power available, the best (most economical) ways of using nerve power, and the evils associated with undue depletion of reserve material. This will give us three heads under which to glance at this very wide subject: (1) maintenance of the physical health of the nerve centres; (2) avoidance of fatigue; and (3) prevention of exhaustion.

1. *Physical Health.*—It is, perhaps, needless to say that every measure adopted to maintain the general health of the body has a beneficial effect on the central nervous system so tersely expressed in "*mens sana in corpore sano.*" The converse is also true that all the poisons introduced into the blood from faults in diet, accumulated there from imperfect excretion of normally formed waste products, or those introduced directly from without, such as alcohol and tobacco, will lower the output of nerve

energy, physical and mental, and predispose to fatigue. There is no need to say more on this head.

2. *The Avoidance of Fatigue.*—This brings us into such a large range of subjects that only a few can be brought under notice, and that briefly.

(*a*) In daily life, no less than in physical exercise, it is quite common to see unnecessary fatigue produced by *waste of physical power*, and hence of nerve energy. This may result either from making more movements than are required for the end in view, or from neglecting to release muscles from contraction after they cease to be required.

The first form of wastage is referred to in "Applied Psychology," when ways of avoiding such waste are indicated :—

"Sometimes the changes made are not in the path of movement itself, but rather in the arrangement of the worker's body, his materials, tools, or equipment. Thus in Gilbreth's classical study of bricklaying operations, the changes made were mainly in the disposition of the materials and in the routing of the work, but these changes brought up the average number of bricks laid per hour, from the traditional standard of 120 to 350 per man, and reduced the number of movements involved in laying a brick from 18 to 4. In almost any workshop, factory, office, or home, simple changes in the height of chairs or benches, the elevation of tables and desks, the position of stools, filing cabinets, drain boards, sinks, etc., show that this type of human study behaviour and the conditions of its effectiveness is both interesting and valuable."

This principle, so far as simplicity of movement is concerned, has no doubt been adopted in coaching for rowing, hurdle running, and other forms of athletic exercise, but it is not carried out as fully as it might be, and, so far as simplicity of arrangements in daily life is concerned, we have still much to learn.

The second source of wasted energy is illustrated by people who stand when they might quite as well sit, and who sit bolt upright in a chair when they might rest against the back. This needless exertion may not seem much, but when it happens in various forms many times a day and for long periods, it causes an expenditure of nerve energy which might have been reserved for better uses. An American writer, Miss A. Call, discusses fully this subject as well as others of a similar kind. Athletes who are also students will do well to watch for applications of

this principle, for they have a twofold demand on their nerve power, and need it all.

(*b*) Fatigue of body and mind, although a natural result of exertion, may be brought on unnecessarily by failure to appreciate the *value of due intervals of rest.* For instance, in physical work, in a trench-digging contest between two companies,

" the officer of one company allowed his men to work uninterruptedly until their condition demanded a rest. The officer of the rival company divided his men into three sections, of which each section successively worked their utmost for five minutes and rested for ten minutes. This systematic arrangement resulted in an easy win for his company " (Meyers).

The same principle as to the need for due intervals of rest applies to the use of nerve energy for intellectual exertion. Thus Mosso says :—

" There exists only one kind of fatigue, namely, nervous fatigue. This is the preponderating phenomenon, and muscular fatigue also is at bottom an exhaustion of the nervous system."

The problems, however, in this department are more delicate and complicated than those concerned with muscular action. I shall not attempt to handle them, but am glad to be able to refer those interested to " The Students' Guide," to " Applied Psychology," or to " Mind and Work," where this and other kindred subjects are fully discussed.

So far as fatigue of muscle is concerned, this is now recognised to be due to several causes, some associated with the contracting muscle and some with the brain. Several of these causes cannot be properly understood without a technical study of physiology, which is foreign to our present purpose, but we may refer to one of them which can be understood more easily. This is the accumulation of waste products in the muscle as the result of its activity. These waste products act as narcotic poisons on the muscle in action, and, having passed also into the blood, act similarly on the other muscles of the body and on the brain. At first these poisons do not seem to alter the structure of the cells they depress, but in time they may do so. Hence fatigue in milder degrees is a temporary phenomenon only, and in this restraining action it may be considered as a warning mechanism which defends the body against undue wear and tear. The name " defensive mechanisms " is accordingly given to this and various other bodily changes by which fatigue is induced.

That the powers of the body are not exhausted when a feeling of fatigue indicates rest is well known. Great excitement will call out even violent action from a tired body, and keen interest will summon renewed activity from an inattentive because fatigued mind, but these demands had better not be made too often lest the bill that has afterwards to be paid become too great for solvency.

(*c*) *Nerve Exhaustion.*—On the other hand, nerve exhaustion—sometimes also called "neurasthenia" or "shell shock"—is a more serious condition depending on certain obscure changes in the delicate structure of the nerve cells. Anything which lowers the general health will predispose to it, and it is understood to be due to many other causes besides fatigue from bodily or mental exercise when carried to excess. Thus severe bodily injury or great mental shock will produce it at once, while the same kinds of cause in a milder form, as for instance pain or anxiety and worry, will gradually bring it on if repeated often enough.

It seems advisable to mention these various causes of nerve exhaustion, so that should early symptoms of its onset gradually appear, their true nature may be more readily perceived. Treatment can then be instituted by removal of the cause before much harm is done—"a stitch in time saves nine." Recovery from nerve exhaustion is painfully slow.

Of the various causes indicated, only two groups need be referred to here, *i.e.*, those caused by undue fatigue, and those due to repeated mental disturbance or "worry."

In athletic circles a common manifestation of a somewhat obscure condition is familiar to trainers under the name of "staleness." It often happens that a man in training after making a good beginning gradually ceases to improve, and soon even loses ground without any apparent reason. His muscles do not seem to be at fault, but they refuse to respond to his efforts as they did at first, and he feels tired and slack. If he should train harder in consequence, as he feels tempted to do, his condition becomes worse. Sometimes this "staleness" may be due to some temporary digestive disturbance which throws waste products into the circulation, sometimes it may be due to insufficient time having been given to

the nervous and other bodily mechanisms to adapt themselves to the increased demand upon them. Mostly, however, I think it is due to commencing exhaustion and deterioration of the nervous system—neurasthenia. In its earlier stages this trouble is associated with a call for more sleep. If this warning be unheeded the symptom will pass into one of imperfect, unrestful sleep, and later on into insomnia. Whatever be the cause, and especially if nervous exhaustion be threatened, the only treatment is *rest*. The man in training must either knock off entirely for a time or " ca' canny." His policy must be to lie low, follow the rules of health, and give Nature a chance to build up the nerve reserve again. Perhaps the following account of an enforced rest before a match may illustrate this point. A young Rugby football player was picked for a big match just a week before it was to be played. He had been in training before, but intended to train harder in the interval still left. However, early in the week, in forcing the pace round Salisbury Crags, he blistered his foot, and had to rest on the sofa for the next few days. This seemed at first hard lines, but his medical attendant was confident that he would be all right, and he was. When the match day came the blister was healed, he was in every way fitter than he had ever expected to be, and his active play justified the selection committee in choosing him the following year. The blister had been a blessing in disguise by saving him from becoming stale. Let students reading for an examination apply the moral of this incident to their own case, for the mind can become " stale " just as much as the body. The stores of strength and the stores of knowledge require to be built up slowly in the period of training. When the day of trial comes these stores will be of little use unless the power house, with a plentiful supply of fuel and smooth-running machinery, is ready to bring them into action.

And now we come to the last topic remaining for consideration—that of mental anxiety or worry in its bearing on nerve exhaustion. It can be better understood when we fully realise the marvellous power which the mind has over the body. That it has such a power has been familiar to mankind from time immemorial. It is seen in the rapid changes in colour of the face in such emotions as anger and fear, in the flow of saliva at the sight, or even thought of savoury food, and in the drying up of

the supply under great anxiety; in the rapid beating of the heart and increased respiration in anger, and so on.

In recent years, however, the knowledge of the degree to which such changes extend, and the means by which they are brought about, has been much widened as the result of physiological research. Professor Cannon has shown that strong emotions of anger and fear immediately call forth an impulse from the brain, which, passing along certain nerves excites one of the internal glands to discharge its secretion (adrenalin) into the blood. At once this fluid, although in an incredibly small, amount, changes the whole activities of the body. He likens the change to that of a country roused from a state of peace to that of war. *All digestive processes in progress at the time are stopped,* and the blood with which the digestive organs were supplied is diverted to the muscles for fighting or flight; to the heart for pumping that blood where it is needed; and to the brain, which is the General Headquarters, for devising exciting, and controlling all offensive and defensive measures. At the same time the liver is summoned to discharge into the blood its reserve stores of muscle fuel (glycogen, a form of sugar), while the lungs, in conjunction with the heart, have to act more rapidly and fully. If the emotion which raised the war cry is followed by action, the body is ready for it. If nothing happens, all these activities die down, and the organs are tuned once more to a state of peace.

But just as it is an expensive business to mobilise an army,[1] so is it with the body. All the changes in bodily activity now known to be called out by emotion, and probably other changes not as yet discovered, involve an expenditure of nerve energy which must be considered as wasted if there has been a false alarm.

In short, as Professor Cannon tells us :—

"The functions which in quiet times establish and support the bodily reserves are, in times of stress, instantly checked or completely stopped, and

[1] While this sentence has been passing through the Press, the Chancellor of the Exchequer has announced in Parliament what it costs the tax-payer to make ready to meet the threat of starvation held up to the nation by the Triple Alliance in connection with the coal strike. For mobilising the Naval and Military Reserves, the Defence Army, and the fleets of vehicles required in the event of stoppage of the railway traffic, the expense is estimated at little less than £1,000,000 a week, and this is apart from the diversion of the men from productive industries.

these reserves lavishly drawn upon to increase power in attack and in the defence or flight."

In order to demonstrate clearly some of the manifestations of the bodily changes induced by emotion, Professor Cannon records the following most instructive observations bearing on the excitement of the football field :—

"C. H. Fiske and I examined the urine of twenty-five members of the Harvard University football squad immediately after the final and most exciting contest of the season of 1913, and found sugar in twelve cases. Five of these positive cases were among substitutes not called upon to enter the game. The only excited spectator of the Harvard victory whose urine was examined also had a marked glycosuria, which on the following day had disappeared."

But to show that excitement due to mental strain and effort may produce a similar result, he brings forward other observations :—

"One of my former students, W. G. Smillie, found that four of nine medical students, all normally without sugar in their urine, had glycosuria after a hard examination, and only one of the nine had glycosuria after an easier examination."

There can be no doubt that Professor Cannon's admirable explanation of the effects which strong emotions and excitement have on bodily functions bear directly on the subject of anxiety, which is mostly fear, and on worry, which is often both fear and anger combined. This certainly is his own view, expressed in a footnote as follows :—

"One who permits fears, worries, and anxieties to disturb the digestive processes when there is nothing to be done, is evidently allowing the body to go on to what we may regard as a war footing when there is no war to be waged, no fighting or struggle to be engaged in."

There can be no question from all that has been said of the immense importance of avoiding worry and anxiety if a man in training is to make the most of his nerve power. But that is not all. There seems to be an equal importance of developing a positive influence leading to good results as of avoiding a negative influence leading to bad results. Cheerfulness and confidence, or at least a healthy equanimity, are of great importance, and are generally recognised to be so in training circles. So much so, indeed, that confidence is apt sometimes to run into boasting

in professional boxing circles at least, although we need not follow it there.

These last considerations bring us to this point, that the training or discipline of the body must be accompanied by a training or discipline of the mind if the best results are to be obtained. As soon, however, as this statement is made, the question arises, How is it to be done? In the course of training, causes of irritation and disappointment arise, jealousy shows its ugly head, and anxiety as to the result is apt to appear in proportion to the eagerness to win in a competition. This is no less true in daily life. Undoubtedly control over the emotions is difficult, but "where there is a will there is a way," and I take it that the way is not so hard to find as is the resolution and power to follow it.

Probably philosophers will think me all wrong, but the following is how it seems to me that the question can be answered practically. Let us suppose an autocratic ruler, with power to select and appoint as Prime Minister anyone from among his subjects that he chooses. Various candidates will probably press forward into notice, but he selects whom he wills. The person chosen takes office and follows out his own line of policy as the Chief Minister of State. Perhaps he begins well, and then drifts off into paths which lead the State into danger. He may become a militant, and threaten to embroil the State in war; perhaps he favours luxury, and squanders the finances in useless self-indulgence for the people. In either case the ruler can see, if he chooses, that there are rocks ahead, and that a change of policy is required. He does not argue with the person at fault, nor does he attempt directly to turn him out. All that he needs do is to summon to his presence a new Minister of a different stamp, and he, whether brilliant or commonplace, in virtue of the summons will displace the offender. Even then the dismissed one may press forward again, but a resolute ruler will refuse to reinstate him.

It would be impossible to enumerate the endless ways in which the principle underlying this analogy can be carried out, but two illustrations may be offered as examples. Thus we sometimes make mistakes, perhaps from haste or want of foresight, and we are depressed or annoyed at ourselves in consequence. We find it difficult to avoid "crying over

spilt milk," although we cannot mend matters perhaps at all. However, if we turn our attention to realising why and how the mistake came to be made, and to devising precautions against its repetition, we will cease to worry, and, without waste of nerve energy, will bring out something useful from the experience.

> When remedies are passed, the griefs are ended
> By seeing the worst, which late on hopes depended.
> To mourn a mischief which is past and gone
> Is the next way to draw new mischief on.
> What cannot be preserved when Fortune takes,
> Patience her injury a mockery makes.
> The robb'd that smiles, takes something from the thief;
> He robs himself that spends a bootless grief.—*Othello.*

Or again, we may feel fretted and annoyed at being kept waiting unexpectedly. If, instead of letting this grievance run its course, we apply the scout's motto, and "do something else," however trivial, the delay will soon be forgotten.

If the principle be grasped, that control over the field of mental activity is possible for us so long as the necessary line of action is understood, the battle, well begun, is half ended.

And now, having tried to point to ways of maintaining efficiency of body and to some extent of mind, let me drop a word of caution. It does not seem possible to reach the highest standard in physical and in mental attainment at the same time. Only a certain amount of nerve energy in all is available, and while health demands a definite amount of exercise in both spheres of activity, the preponderance of exertion in either must depend on the individual and on his requirements at any definite time. In particular, let no one think he can rest a tired brain by spurring on a tired body.

In closing these papers, let me say that it has been a great pleasure to go over old ground in the light of new ideas, and I shall be glad if I have been able to collect from books, and hand on from experience, anything that will be useful to the present generation of students.

While the war, and all that it has meant in noble lives laid down, still haunts our memories, may we not each accept for ourselves the call

which Sir Henry Newbolt addressed to his old school in these stirring lines :—

VITAÏ LAMPADA.

There's a breathless hush in the close to-night—
  Ten to make and the match to win—
A bumping pitch and a blinding light,
  An hour to play, and the last man in.
And it's not for the sake of a ribboned coat,
  Or the selfish hope of a season's fame;
But his captain's hand on his shoulder smote—
  "Play up! play up! and play the game!"

The sand of the desert is sodden red—
  Red with the wreck of a square that broke;—
The Gatling's jammed and the colonel dead,
  And the regiment blind with dust and smoke.
The river of death has brimmed his banks
  And England's far, and honour a name,
But the voice of a schoolboy rallies the ranks:
  "Play up! play up! and play the game!"

This is the word that year by year,
  While in her place the school is set,
Every one of her sons must hear,
  And none that hears it dare forget.
This they all with a joyful mind
  Bear through life like a torch in flame,
And falling fling to the host behind—
  "Play up! play up! and play the game!"

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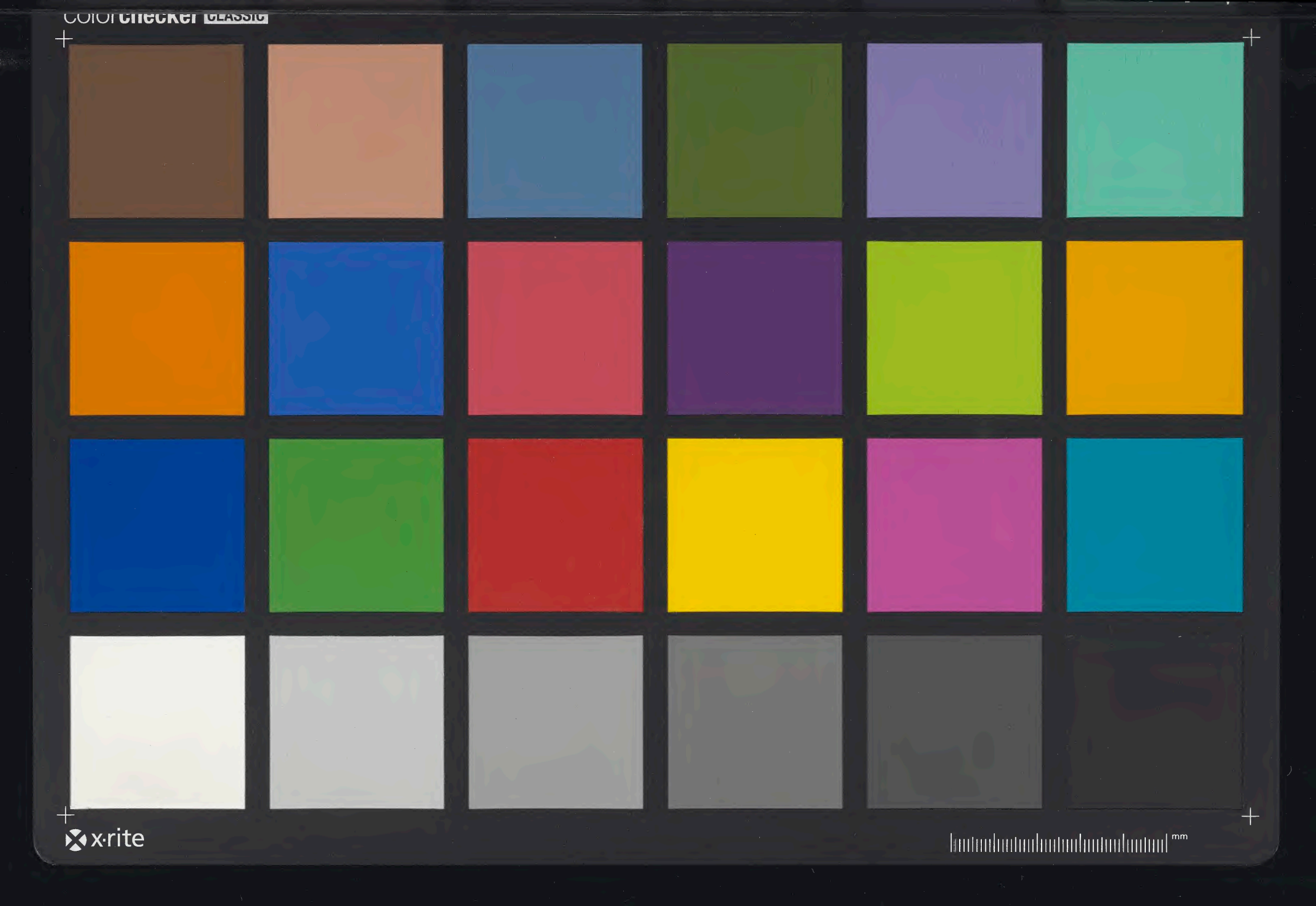
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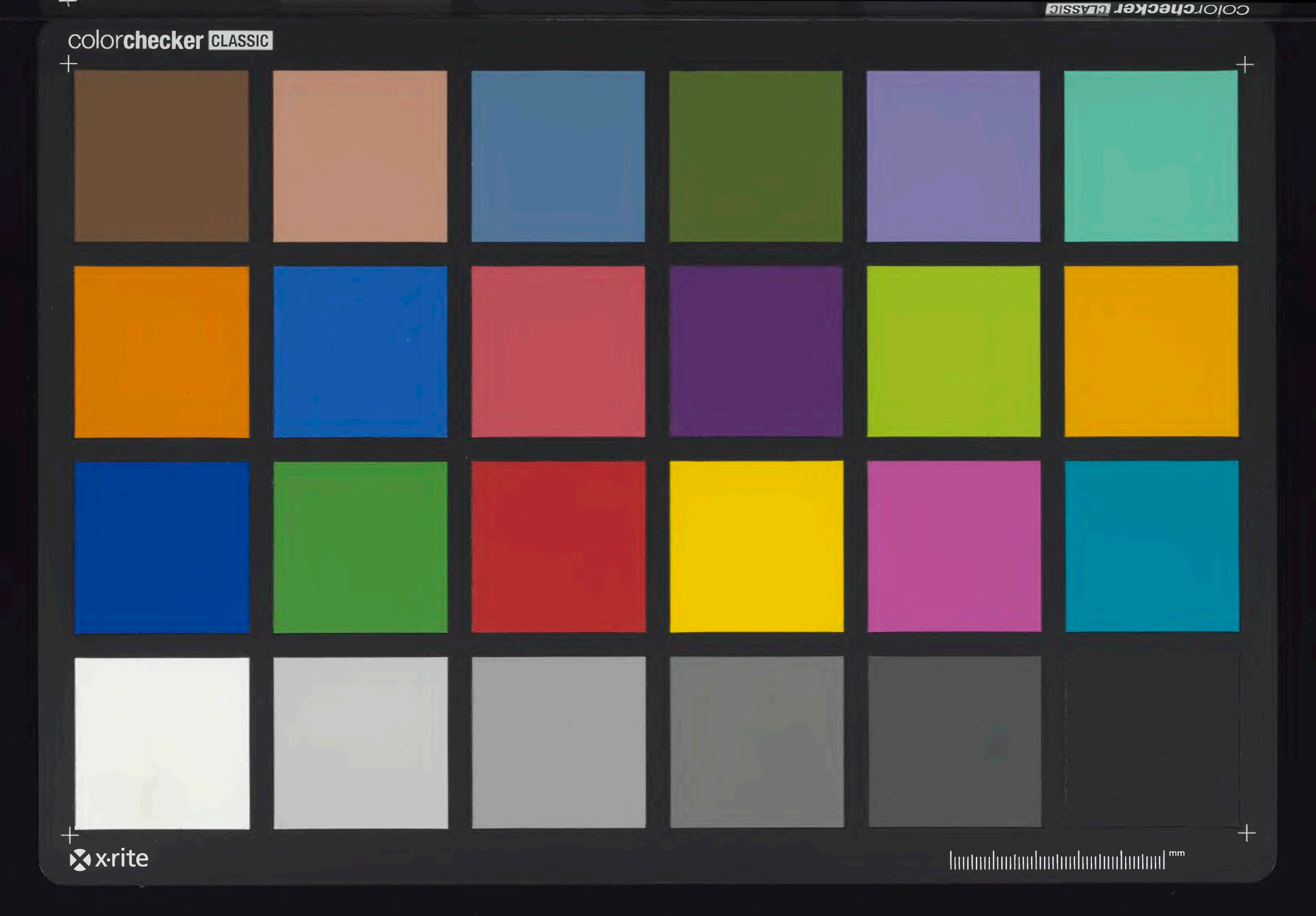
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