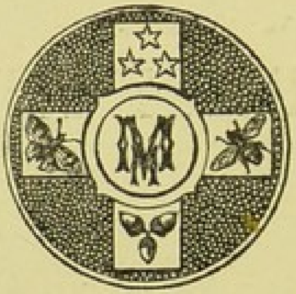
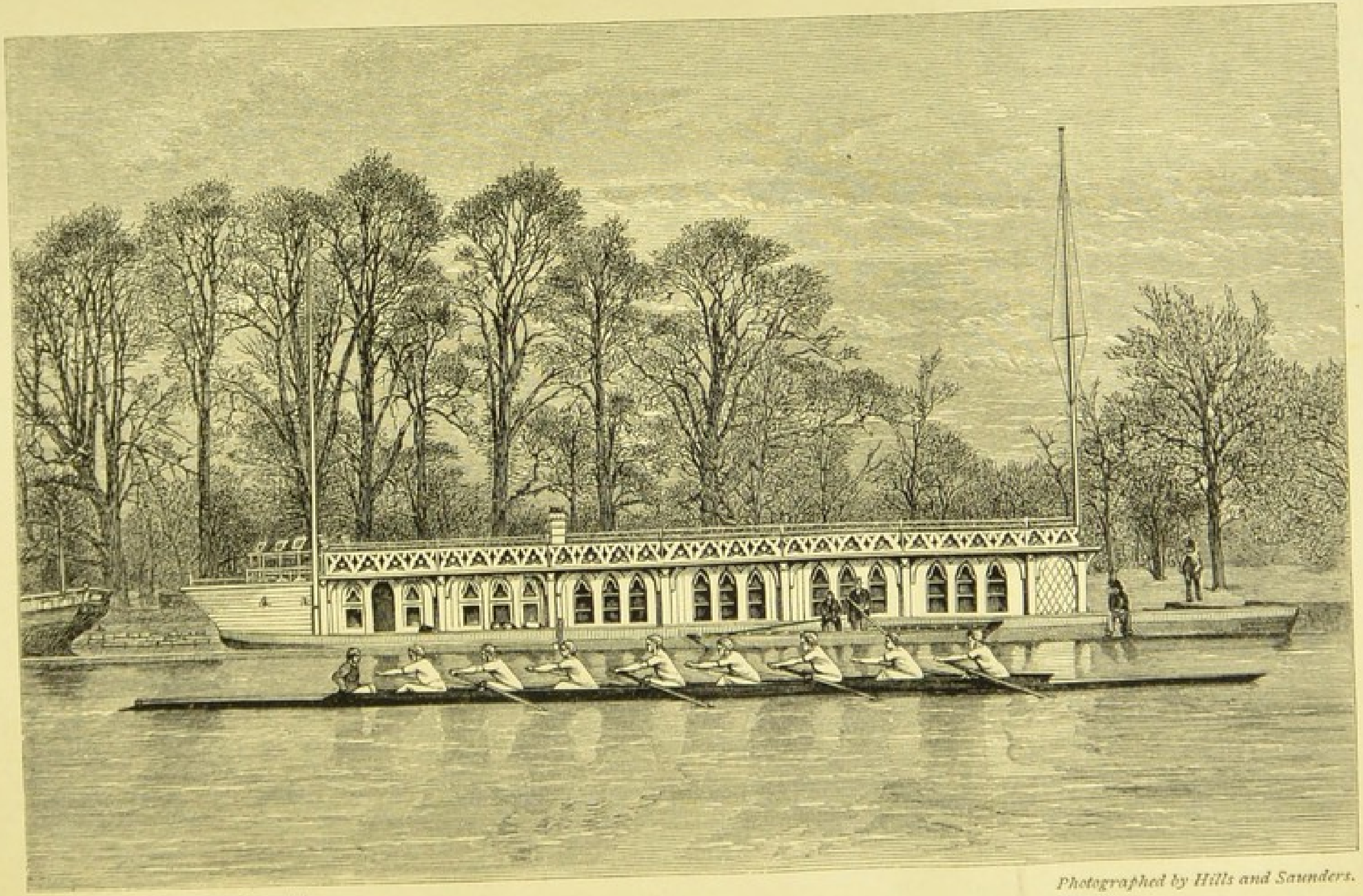
TRAINING.

MACLAREN.





Drawn on wood by A. Mac Donald. *Photographed by Hills and Saunders.*

THE UNIVERSITY EIGHT, OXFORD, 1866.

TRAINING,

IN

THEORY AND PRACTICE.

BY

ARCHIBALD MACLAREN.

London:

MACMILLAN AND CO.

1866.

OXFORD:

BY T. COMBE, M.A., E. PICKARD HALL, AND H. LATHAM, M.A.,

PRINTERS TO THE UNIVERSITY.

TRAINING,

IN THEORY AND PRACTICE.

In writing on the subject of Training, I propose to select one single exercise with which to connect my remarks, and to limit these in a great measure to the mode in which that exercise is practised at our Universities and Public Schools. I do so for two reasons: first, because it will enable me to keep together my observations upon each separate part of the subject, and secondly, because the principles of Training, as a system of bodily preparation for special exertion, are the same for all exercises, differing only in the mode of their application. Even this difference of application is virtually limited to the administration of but one of the agents of health—Exercise; and this chiefly because it is capable of being locally as well as generally applied all the other agents being addressed to the whole body, and with the view of promoting the strength of all the bodily powers.

For this purpose I select Rowing, as, in my opinion, the exercise most susceptible of being influenced by a judicious system of bodily preparation, being at once an art of considerable intricacy, demanding long and assiduous practice, and an exercise of considerable difficulty, involving the possession—although not in an equal degree—of both muscular and respiratory power, to promote which is the object of all training.

PART I.

Rowing is the chief of all our Recreative Exercises; no other can enter the lists against it; in fact it has collected and concentrated in itself all the attractions and all the emulative distinctions of all others: just as the boat-race admits of more amicable rivalry and friendly competition than all our other national pastimes put together. The *physique* of the men forming the crews, their enthusiasm, so generous and so contagious; the crowds of spectators who go to witness the races with enthusiasm no less strong and certainly no less demonstrative than that of the rowers; the flag distinctions, colours and costumes; the barges, music, and the beautiful river itself, all tend to give an *éclat*, an importance, to this exercise, unapproached by any other, and to give to it the first place in the front rank of Recreative Exercises.

The numbers who come down to the river-side to witness the sport in the summer evenings, testify to the extent to which the enjoyment is shared; and there is not a man on river-bank or barge whose eye does not kindle, nor a lady whose cheek does not mantle up, when the hoarse continuous roar comes on and on, and the crowd sways to and fro, and the boats rush by.

To the spectators it is all enjoyment, while seen and when remembered, without alloy, drawback, or danger. Is it less so to the actors in the scene? There are a hundred and fifty oars flashing through the water, worked by as many pairs of hands, aye, and by as many pairs of lungs too, and by as many throbbing hearts; and the excitement that stirs the crowd and sends the blood tingling to the finger-ends is shared by the rowers, as they sit straining at the oars. Is it all as well with the actors as with the spectators of the scene? Has the work no drawback or alloy for them?

Rowing-men have thoughtfully asked themselves the same question, and practically have answered it. They have seen the drawback, have in a great measure comprehended its nature; and without laying claim to special scientific knowledge on the subject, and guided mainly by the observation of results, they have organized a protective code of rules and regulations, in spirit well planned to meet the ends desired; and where failing, failing from the over-zeal which has carried certain details to extremes. This code is embodied in the word TRAINING.

To the question "What is Training, and what is it meant to do?" I would answer, "It is to put the body, with extreme and exceptional care, under the influence of all the agents which promote its health and strength, in order to enable it to meet extreme and exceptional demands upon its energies."

The ordinary agents of health are Exercise, Diet, Sleep, Air, Bathing, and Clothing. I put them here in the order of their importance, as I conceive, to rowing men. I propose to examine each of these agents somewhat in detail, and from two different points of view. First, as to the manner in which it is, or should be, administered under ordinary circumstances; and secondly, in what manner and to what extent this mode of administration is, or should be, altered for purposes of training, according to the preceding definition of the term.

First, then, what is Exercise? We have some notion of what Food is, and of the manner in which it nourishes and sustains the body; we see it, and taste it, and swallow it, and we feel even while doing so that it is essential to life and health and strength. We need no reminder of the necessity for Air, we experience this every moment of our lives, and our senses take note of its purity or impurity, delighting in the one and loathing the other; just as other senses delight in or reject articles of food: and, indeed, air is food in the highest sense of the word. Nightly we feel that Sleep is a necessity also to life and health; and if the precise nature of its action and influence are unknown, the results are so evident that its value is never questioned. The same may be said of Bathing, as a cleanser and bracer of the skin, stimulating it to functional vigour, and relieving it of a burden which we feel creates discomfort. And we all know how Clothing affects health by preventing the too rapid escape from the body, into the surrounding atmosphere, of the heat which it has generated; or by excluding from it external heat when in excess of its requirements. But what does Exercise do towards the life, health, and strength of the body? How do lifting and carrying, pushing and pulling, running and jumping, do us good? In fine, what is Exercise? what does it do? and how does it do it?

Exercise may be defined as *muscular move-*

ment[a]; indeed, every motion of the living organism is produced by muscular contraction. This property of contractility, with which muscular fibre is endowed, and which, so far as we know, is shared by no other constituent of the body, is to some extent described in the term, being the power of *contracting* or shortening the space between its two extremities[b].

The entire muscular system has been primarily divided into *voluntary* and *involuntary* muscles. The first, comprising all those which are subject to the will, form the bulk of the muscular system. They are mainly distributed over the framework of the bones, their office being to move the part or parts to which they are attached. The second comprise those over which the will has little or no control, but which are

[a] Muscle is *flesh*; or what in animals is called *meat*. It may seem unnecessary to state this, but it is with me a matter of daily occurrence to hear men talking of such and such an one, who "has not an ounce of flesh upon him—nothing but muscle;" or, "he must get rid of all his spare flesh;" or, "he must sweat down all his superfluous flesh;" "work off all his loose flesh," &c.

[b] See Appendix I.

stimulated to action by some other agency, each muscle or class of muscles having its proper stimulus; these are placed chiefly within the cavities of the body, and are employed in the vital processes of respiration, digestion, circulation, &c. It is with the voluntary muscles that we have now particularly to deal.

Exercise I have defined as muscular movement, but it must be movement of force sufficient to engage the energetic contraction of the muscles employed. Here we are touching upon the most important principle in the entire subject under consideration, namely, the destruction and renovation of the tissues of the body, which it is the object of Exercise to accomplish.

Our material frame is composed of innumerable atoms, and each separate and individual atom has its birth, life, and death, and then its removal from "the place of the living." Thus there is going on a continuous process of decay and death among the individual atoms which make up each tissue. Each atom preserves its vitality for a limited space only, is then separated from the tissue of which it has formed a part, and is resolved into its inorganic elements, to be in due course eliminated from the body by the organs of excretion. These processes are greatly influenced by the activity of the bodily functions. Every operation of the muscles or nerves involves the disintegration and death of a certain part of their substance. We cannot lift a finger, we cannot perform the slightest movement, without causing a change in certain of the atoms which compose the muscles executing the movement, in those of the nerves conveying the stimulus which directed them to contract, or in those composing the nerve centres in which the stimulus originates; and this change involves their decay and death.

The loss then of the body, and of each part of the body, being in relation to its activity, a second process is necessary to replace the loss, otherwise it would rapidly diminish in size and strength, and life itself would shortly cease. This reparative process is performed by the Nutritive System, the organs of which convert our food into blood

—liquid flesh (*chair coulante*) as it has been called—which in itself contains, and in its never-ending circulation bears to each tissue, the material for the replacement of all waste and for the building up of all additions. And as this material is borne along through channels permeating every part of the organism, each part, by a law incomprehensible but unerring, selects from it and appropriates that particular *pabulum* which is fit for its special use, and that only. At every point of the human body is this law in unceasing operation—activity, a loss of vital power, disintegration, decay, and removal; to be met by a replacement of substance, and a renewal of vital power. And as the disintegration of any part is hastened by its activity, so by an equally unerring law is the flow of blood, bearing the renewing material, increased in that part; and again by a law equally unerring and ever operative, the worn-out particles are cast into this current in its backward course, and conveyed to organs whose function it is to eliminate them from the body. And during the period of growth, and within certain limits, until the full attainable physical capacity of the individual has been reached, the new will ever exceed the old, so that a gradual increase in bulk and power will be obtained. And the strength of the body as a whole, and of each part of the body individually, is in relation to the frequency with which these atoms are changed; and the strength of the body as a whole, and of each part of the body individually, is thus ever in relation to its *newness*.

Exercise is then the chief agent in the destruction of the tissues, but it is also the chief agent in their renovation, inasmuch as it quickens the circulation of the blood from which the whole body derives its nourishment; the tide on which is brought up all fresh material, and on which is borne away all that is effete and useless; brought up and borne away most rapidly in those parts which are being most rapidly employed — where disintegration is most rapidly taking place.

I am here purposely narrowing my subject, and limiting my observations to the process of circulation only as it affects the nutrition of the muscles; but all the systems of the body, and every process connected with its growth and development, or influencing its health or strength, are also proportionately affected by the acceleration of the circulation of the blood by exercise.

But besides muscular movement, true exercise possesses another ingredient, which may be termed *resistance*. The voluntary muscles are made to do more than merely to move the parts to which they are attached. Man is placed on the earth to labour, to toil, to overcome and to remove material obstacles innumerable. Everything which floats upon the ocean or is built upon the land is the work of his hands —in simple fact, has been constructed by the contractions of his voluntary muscles; these muscles were made therefore not merely to enable him to *move*, but to do this and to carry his burden too. They were made in their action to encounter and overcome *resistance* in every movement; and being created for this, their health and strength will be developed and sustained in proportion to the fidelity with which this their design is remembered and observed. Exercise, which is voluntary labour, must resemble actual labour in all its physical essentials, if it be desired to obtain from it the physical advantages which actual labour bestows; without resistance there can be no full demand for muscular contraction, no full call therefore for material disintegration, no full requirement therefore for material renewal, involving proportionate increase of bulk and power; for, as we have seen, the strength of the body, and of each part of the body, is in relation to its youth or newness [c].

[c] In a long pedestrian tour, extending over nearly four months, in which the average per day on foot exceeded nine hours, and usually with a knapsack averaging twelve pounds, I found this law of development being in relation to employment strongly demonstrated; and I give the results here in preference to other instances which I could adduce, because they were the results of the mode of exercise most familiar to every one—walking. Thus the chest fell from 41 to $39\frac{1}{2}$ inches, the upper arm from $14\frac{1}{2}$ to $13\frac{3}{4}$ inches; the lower arm remaining unchanged at $12\frac{1}{2}$ inches: the lower limbs on the contrary were vastly increased, the calf of the leg passing from 16 to $17\frac{1}{4}$ inches, and the thigh from $23\frac{1}{2}$ to 25 inches.

These are the chief essentials of Exercise when viewed in connection with the voluntary muscles; but it is also an essential of true Exercise that the movements of these muscles shall be of speed or force sufficient to quicken the breathing; in other words, to increase the action of the *in*voluntary muscles engaged in the processes of respiration and circulation. During active exercise the act of breathing becomes greatly accelerated; each inspiration is larger in volume, and each follows each in quicker succession than when the body is inactive. This is a most important feature of exercise, for with every breath a load of the wasted material of the body is given up by the blood, in the form of carbonic acid, &c., and its place supplied by life-giving oxygen from the surrounding atmosphere. To make this all-important process plainer, let us glance at the mechanical action of breathing.

On the requirement for air, the "*besoin de respirer*," being experienced, the inspiratory muscles contract and lift the osseous framework of the chest, thus increasing its diameter from side to side and from back to front; while at the same time the large arched muscle (the diaphragm) forming the convex floor of the cavity also contracts, and in doing so its fibres are straightened, and its elevated surface is consequently depressed, increasing the diameter of the chest from above downwards. As this takes place the air rushes down the trachea, or windpipe, and passes at once into the lungs, which it fills out in every direction. But all muscular action is intermittent; the contractile effort accomplished, the reaction begins; the inspiratory muscles relax and a second set of muscles, the expiratory, antagonizing those which lifted the walls of the cavity, now contract, and the muscles of the abdomen, antagonizing the diaphragm, also contract, and the air is expelled by the aperture through which it entered[d]. This is, in outline, the process of ordinary effortless breathing; but in the forced respiration of energetic exercise, and especially of exercise calling into action the muscles of the upper limbs and

[d] See Appendix I.

the upper region of the trunk, many of the voluntary muscles may also be employed in the process of respiration.

I have stated that the involuntary muscles are prompted to action each by its proper stimulus; and the heart is stimulated by the presence and augmentation of blood within its cavities. Thus, the instant that any act of exercise, such as Rowing, begins, a considerable number of voluntary muscles are put into rapid employment; the contractile action of these muscles impels the blood in their veins onwards towards the heart, venous blood being greatly dependent on muscular action for its circulation; and the heart, stimulated by its presence, energetically contracts, ejecting its contents, and the blood is flushed along the pulmonary artery and distributed throughout its ramifications in the lungs. But the rowing is still going on, stroke following stroke; so wave on wave comes up from the heart, each driving before it its predecessor,—out of the lungs, along the pulmonary veins, back to the heart, where it is again rapidly admitted and as rapidly ejected[e]; for the heart is a double organ, performing the double office of propelling the blood through two distinct channels of circulation; through the one for its aëration in the lungs, through the other, when so aërated, for the nourishment of the whole body. Out of the heart then it is again ejected, out by the great trunk arteries, and along their innumerable branches, to complete the round of the systemic circulation. But neither heart nor lungs, nor vein nor artery, throughout the double circulation, is a *passive* agent in its progress; for though the heart is the great agent of propulsion, the whole circulatory channels possess a certain amount of contractile power, and are endowed with a degree of elasticity, and may in fact, in this respect, be regarded as hollow muscles actively engaged in regulating the moving current within them; and their health and strength, and functional ability, are promoted by the same agencies, as they are

[e] The quantity of blood ejected from the heart of a healthy adult of middle stature, at each propulsion, is estimated at about two ounces.

subject to the same laws as those which influence the condition of the rest of the body.

On these two powers, muscular and respiratory, depends the ability to perform all bodily exercise. The first involves the contractile force of the voluntary muscles employed; the second is more complicated, involving the contractile force of the heart, the condition of the lungs to perform their function, the size and shape of the chamber in which these organs are contained, and the contractile force of the respiratory muscles, voluntary and involuntary.

Such in brief is Exercise, such the ends which it accomplishes, and such the manner of their accomplishment; namely, the *destruction* of the tissues, the hastening of the decay and death of every part coming within its influence; but also the speedy removal of all waste, and the hastening forward of fresh material for its replacement; and in doing this it attains three distinct but co-relative results.

1. It increases the size and power of the voluntary muscles employed.

2. It increases the functional capacity of the involuntary muscles employed.

3. It promotes the health and strength of the whole body by increasing respiration and quickening the general circulation.

This being the nature and these the results of Exercise, in what manner is it administered to a man in training for a boat-race? What exercise does he take?

Imprimis, Rowing.

Let us now examine how the exercise of Rowing acts upon the body, by noting what parts are employed and the manner of their employment, and how far it promotes the acquisition of the two great requirements for all such efforts—muscular and respiratory power.

Rowing as an art has made great advancement of late years; vast improvements have been made in the build of boats, the construction and disposition of propelling and steering gear, and also, and notably, in the mode of propulsion—in the "form," as it is technically called, of the stroke. In the first respect in reducing the weight and bulk of the boat[f], by making the material of which it is constructed as thin and light as possible, and in so fashioning it that the parts submerged shall encounter as little resistance from the water as possible, and the parts above water as little opposition from the air as possible[g]; in the second respect, by a scientific adjustment, on strict mechanical principles, of the shape and proportions of the oar, of its length within and without the rowlock; and of the fashion and disposition of the rowlock itself—the pivot of action of the propelling force: and last, but not least, by an alteration in the mode of executing the stroke; it having been found that a short quick stroke, by which the boat is kept at an almost uniform rate of speed throughout, is a vast saving of propelling power; the

[f] See Appendix A, B, and C.

[g] To such an extent has this been carried, that a sculling-boat now presents little more than a seat for the rower, and a point of attachment for the rowlock; indeed, it can scarcely be said to do even this, for if the rower be of larger proportions than a schoolboy, on each side he will overlap his boat. See Appendix B and C.

difference between this and the old stroke resembling that between an unbroken, even, level run, and a succession of leaps or bounds.

Now I regret to say that every one of these alterations, while it has undoubtedly advanced Rowing as an *art*, has detracted from it as an *exercise*. I shall endeavour to shew presently that everything which tends to make the muscular effort less, while making the respiratory effort greater, has this detracting effect; and the above-mentioned improvements in the art all have this effect in the most direct manner. Thus the weight to be propelled is reduced by the lightening of the boat, the water and atmospheric resistance is reduced by its improved shape and construction, the propelling power is augmented by the out-rigged rowlock; while the old-fashioned long swing of the back is discarded for the new high-pressure stroke, by which its duration is reduced, and by which the pressure on the organs of respiration and circulation is intensified in proportion to its increased rapidity. In fact a boat-race has now become a matter of wind rather than of muscle, and, as an old waterman at one of our races last year remarked in my hearing, "The crew that can bucket it the fastest will win the race, *if they don't bu'st.*"

But is not the exercise, the mere muscular exertion of the race, still very great? The exercise in rowing a College race (a short mile) is barely sufficient to keep a healthy man well; it is not sufficient to keep up the condition of a strong one[h]. This is shewn to me every year. The best men fall off when the racing, or the exclusive training exercise for the racing, begins; under it a powerful man dwindles; and this, not from "training down," as the phrase goes, for the reduction is not in weight only, but in girth and tension, and contractility of muscle, and in the stamina which gives endurance of fatigue. I know that this statement will startle some

[h] Not content, however, with my own observations of results on the men themselves, I have endeavoured to solve the question of the actual amount of force required for the propulsion of an eight-oar at racing speed, first, by theoretical calculation, and secondly, by practical test with the dynamometer. See Appendix E and F.

of my readers, but it is capable of proof, as I will endeavour to shew presently when I come to examine in detail the chief characteristics of this exercise, and the parts of the body which receive employment from it.

A little examination will prove, I think, what at first may not have been surmised, that the legs have the largest share of the work in Rowing. For while all other parts employed, back, loins, and arms, act somewhat in detail and in succession, the legs act continuously throughout the stroke, and the individual efforts of each, and the concentrated efforts of all the other parts of the body employed, are transmitted through them to the point of resistance, the stretcher. No doubt the seat presents a point of resistance during a portion of the effort, especially with men still learning to row, or when rowing within their powers; but the true application of the mechanical force employed in the propulsion of the boat is between the water-grip of the blade of the oar and the pressure of the foot against the stretcher on the floor of the boat. It will be found also that the stroke is nearly finished before the contractile efforts of the arms are in any degree engaged, namely, when the trunk reaches the vertical line, and they are called in to finish the stroke, and to turn and run out the oar on the forward reach of the body preparatory to another.

Rowing thus gives employment to a large portion of the back, more to the loins and hips, and most of all to the legs; but it gives little to the arms, and that chiefly to the fore-arm, and least of all to the chest. Moreover, as there is but *one* movement in Rowing, namely, the stroke, indefinitely repeated with the most rigid precision, and as it is in the rearward half of this movement only that any real muscular effort is made or resistance encountered, it follows that every muscle of the body not employed in this action is excluded from the exercise; moreover, also, every muscle included in it is employed but in one line of action, while it is qualified and designed to act in many, and will be developed and strengthened in proportion as these manifold modes of its use are observed; and moreover again, as, with few exceptions, all muscles have antagonistic muscles, designed to perform counter movements, it follows that as Rowing consists but of one motion, the antagonistic muscles of those employed in executing this motion must be virtually unemployed. Thus, as I have said, the legs have strong employment in rowing, but it is the *extensor* muscles alone which have actual employment: the *flexors* are comparatively idle; they perform no exercise, they gain no bulk, they obtain no increase in power. They are excluded from the work, they have no share in the reward.

Now it is the circumscribing of the line of muscular operation, the concentrating of the physical exertion into the narrowest channel, that has brought Rowing to its present point of artistic excellence,—which gives to the rower that statuesque appearance when resting on his oar, and that automatic precision of movement when in action, which constitute the very ideal of an oarsman, and of a crew.

The part of the body which receives the

smallest share of the exercise in rowing is the chest; it has little or no employment in the muscular effort required for the propulsion of the boat; and this is impressively evident in the results. Not only does it make no advance in development in this exercise, but, if it be exclusively practised, an absolutely depressing effect is experienced. No single result of recreative or systematized exercise may be more fully substantiated than this. Take any crew in the University, just as it stands, at any stage of its practice, and it is possible, in a given space of time, by varied systematized exercise, to increase the chest of every man by a given number of inches, with a proportionate development of power; let this cease, and exclusive rowing exercise be resumed, and the progressing development will also cease; nay, its muscles will lose their condition, and their power will decline, in obedience to the organic law that power is in relation to employment, for here they have virtually none. I could at this moment point to men who have had Rowing for exclusive exercise since they came to the University, men endowed with an organization capable of the finest development, whose chests have been almost stationary for years, the years during which they should have made the greatest advancement, who have now, in fact, the same developments in this region which they brought from school, lingering at 36 or 37 inches, when 40 or 41 were fairly within their reach.

And here I may state that this error of exclusive devotion to one exercise is not confined to Rowing, nor committed solely by rowing men; most men have a favourite exercise which they declare is "the finest in the world," and which they aver "exercises every muscle of the body." Now there is no single exercise invented or inventable by man, which gives employment to more than a part of the body, and to a very small part too, when closely examined; and none with which I am acquainted which gives anything approaching to uniform employment even to the parts employed. The error lies not in men having favourite exercises; every man ought to have his favourite exercise, in which he excels or in which he strives to excel, in which he takes pride and in which he finds pleasure, just as he may have his favourite author or his favourite subject of study; but not for exclusive reading, if he would have his *whole* mind cultivated or employed; and least of all should such exclusive devotion to one pursuit, mental or physical, be during the period of growth, when ultimate conformation of organ and capacity of function are mainly determined. The error lies in expecting from the exercise what it was never designed to give—what no single exercise can ever be made to give. The human frame is too complex, too powerful in its attainable strength, I had almost said too important, to be so treated. It was designed for greater things, and must have greater care and larger means expended on its culture, than to be turned aside with a single mode of employment. It was fashioned and designed for modes of action without limit, and it is so constituted that its own perfection of development and power will be attained only by a wide and varied range of occupation; so fashioned that its own state of health, and its own point of power, will stand in relation to the integrity with which these conditions are observed.

But we may be reminded that a race is not to be won by "brute strength;" and there is truth in the reminder. Skill, however, does not necessarily or even naturally accompany weakness, nor does awkwardness necessarily or naturally accompany strength; on the contrary, it will be found that strength is more frequently, more closely, and more suitably allied to skill than to awkwardness. The truth seems to be that strength can sometimes afford to dispense with skill, and can be all in all unto itself; and being seen thus disunited, the union is thought to be unsuitable and the divorce permanent; and as weakness passes not only unopposed, but even unobserved, when by itself, and is noticed only when allied to skill, it has become possible to regard them as natural companions. What is meant doubtless is, that strength alone is not sufficient, it must be strength united to skill—force allied to dexterity; and this is truth, and truth in its most desirable aspect;

for the race would soon lose all charm for either actor or spectator if it could be won by weaklings however dexterous, or by any amount of muscular power if inartistically applied.

It is with the second requirement of exercise, respiratory power, or wind, that we have now to deal; and first, let us hear what rowing-men themselves think of it.

"Men must run to be put into thoroughly good wind. No other motion removes the internal fat, the great enemy of good wind. There is no known exercise adequate to this result but this one."

Now the respiratory organs are almost the only parts of the body where fat is never deposited; on the lungs it is never found; and when found on the heart, except in meagre quantities along the interspaces of its fibres, and upon some blood vessels where it has important offices to fulfil, it is in actual disease, or in that "fatty degeneration" which not unfrequently occurs in many of the tissues at an advanced period of life; and that either of these is the normal condition of the youths of our public schools and colleges is surely difficult of belief. But fat is found on the viscera and organs of the lower cavity of all healthy men at this period of life; and at this time of great and often ill-regulated exertion, its protective[i] presence here is as valuable as it was on the surface of the body at an earlier stage of life, when the liability to injury was from falls and similar causes. The only way, as I conceive, in which its presence here could affect respiration unfavourably would be when accumulated in such quantity and bulk as to prevent the due depression of the diaphragm and contraction of the abdominal muscles, and that this is the general condition of rowing-men is, I think, a thing still more difficult of belief than the other.

But the theory of internal fat not only exists, but is believed in and acted on; and they find the proof of the correctness of the

[i] "Being thus deposited between and around different organs, it affords them support, facilitates motion, and protects them from the injurious effects of pressure."—*Quain's Elements of Anatomy.*

theory in the facts that by running men get thinner and lighter and the wind improves; while it is observed that they perspire copiously, and perspiration, say they, "is only fat in a state of melt." Truly, many a long-venerated theory has had less to support it than this. Nevertheless it is the text that has given origin to all the false doctrine preached on the subject of training for many a year.

In Rowing, as in some other exercises where the voluntary muscles of the trunk, and especially those of its upper region, are strongly exerted, the breath is "held" in the lungs during the muscular effort, in order to keep the chest distended and firm, or, as it is technically called, "fixed," that these muscles may have firm and unyielding points of attachment during their contractile efforts —fixed fulcra for their levers; and when this is prolonged or repeated over any considerable space of time, it becomes a highly disturbing influence to respiration; and doubly so if the exercise be one which greatly augments the respiratory requirement; for the act of fixing the chest is accomplished by retaining the chest at its point of expansion, when in the natural order of respiration it would be collapsing. And while in ordinary effortless breathing, or during exercise where the lower limbs are solely or chiefly employed, such as in walking or running, the inspiration and expiration follow each other in uninterrupted succession, each occupying about the same space of time as the other, and the two constituting the entire process; in Rowing, both these acts are hurried over during that time in which the muscles are relaxed, *i.e.* towards the close of the stroke, and on the rapid forward dart of the body preparatory to another; when the breath is again held and the chest fixed during the muscular effort.

Now in ordinary breathing the rate is, to a full-statured man, from sixteen to twenty inspirations per minute, while the racing pace is forty strokes per minute [k]; and we have seen that the breathing is regulated by the stroke, giving, therefore, the rate of

[k] In spirting it will rise as high as forty-three or forty-four strokes per minute.

respiration in rowing at forty inspirations per minute.

But we have also seen that although there is a breath to every stroke, still the double process of inspiration and expiration does not occupy the whole of even this brief space of time, being accomplished during the momentary muscular relaxation towards the end of the stroke, and the forward reach of the body preparatory to another. This greatly augments the rate at which this double process is performed. No need of internal fat to make a man gasp at such work as this!

The augmented processes of respiration and circulation during exercise are produced, as we have seen, by muscular agency. First by the constrictions of *voluntary* muscles on the veins, propelling their contents; and second, by *involuntary* muscles, when stimulated to greater activity by the blood thus propelled.

When a man is beginning his course of training, the involuntary muscles regulating respiration and circulation are suddenly called upon to do double their customary amount of work, and this too under disturbing influences of the most trying kind; they fail of course, and the failure is set down, not to want of functional power, but to obstruction from internal fat. When a voluntary muscle, or set of muscles, fail to perform some task we set them, we simply say they are not strong enough, meaning that their contractile force is not sufficient to overcome the resistance encountered; we do not attempt to account for such weakness by obstruction or hindrance from extraneous substances—by *external* fat, for instance,—though, doubtless, there are cases in which muscular action is impeded by such deposits. Still, even when we see this, we do not view it as the normal condition of *all* men, and set down *all* muscular weakness to its presence; nor do we then prescribe some single and special mode of exercise, some exercise which greatly affects the parts where fat is *not* and where it is never likely to be, and say that this exercise and this only will remove it. What we *do* do in such cases is to give employment to the weak part—employment in nature and degree suitable to its existing capacity, and of the greatest variety within the range of its action; gradually augmenting this employment in proportion to the augmentation of strength in the part consequent on the exercise, acting on the organic law that, *cæteris paribus*, the development will be in relation to activity, and strength in relation to development. And the law applies equally to voluntary and to involuntary muscles.

I must remark, however, that although both voluntary and involuntary muscles are trained to functional power on the same *principles*, that is by employment, it does not follow that they are trained by the same *modes* of employment; in fact training for strength and training for wind are different things, attainable by different means; and it is perfectly feasible to take (certain of) one of these systems of muscles, and train them comparatively to the exclusion of the muscles of the other system. Thus a man of good physical capacity may be trained so that the voluntary muscles of his arms and chest would be powerfully developed, with a contractile force proportionate to their size and induration; and yet his respiratory power shall be so disproportionate that he could not run a hundred yards at speed without gasping; and another, or the same individual, if possessing ordinary locomotive capacity, and fair development, may be trained to run ten times the distance without distress, but the voluntary muscles of whose arms and chest shall remain as they stood at the time that the training began. Indeed this principle solved to me a riddle which greatly puzzled the sporting world some time ago; I mean in the prize-fight between Heenan and King. The former it was found, I believe, preserved his mighty muscular power unimpaired, but, to use his own phrase, "he had scarcely begun the fight when he found his wind roaring." I have never heard the particulars of the mode of training which he had adopted, but I have no doubt it would be found to be such as to cultivate the voluntary muscles of the shoulders and arms, and probably also of the lower limbs, but not of the involuntary muscles engaged in respiration and circulation.

What then is the cause of respiratory difficulty, or "bad wind," the internal fat theory being discarded? What prevents a man who has not gone through a course of training, from breathing as freely in the race as a man who has?

Strictly speaking, the answers to these questions have already been given, and all these questions spring from, and all these answers point to, one circumstance in the organization of a living creature—its *mutability:* it is constantly changing; it is constantly capable of being altered; bit by bit, atom by atom, it is pulled down; bit by bit, atom by atom, it is built up again; and the new is fashioned by and is adapted for the circumstances under which it is built. So that, after a time, a new creature is produced, —new at all points, in organ and limb, but newest in the parts most directly under the influence of the circumstances under which the changes are wrought. Let us take for illustration the human hand. In men following widely different callings it can scarcely be recognised as the same organ; yet at one period of life it might have been more difficult still to perceive any difference; occupation has changed them, occupation has fashioned them, moulding the hand which followed it fittingly to its use. Look at the hand of a man whose occupation has been to wield the pen or pencil; it is slim and delicate as a woman's, the skin soft, the bones slender, the muscles small, and the joints round and mobile. Look next at his who follows some art or handicraft requiring strength combined with dexterity and precision of movement, and the hand, though still shapely, will be comparatively large and strong, the skin more opaque and darker coloured, the bones thicker, the muscles larger and firmer, and the joints still supple but strong. Look again at his whose sole occupation is manual labour, where force and tenacity of grip are the sole requirements, and again a greater change may be seen; the hand is larger still, nearly twice the size of the first, though from its bulk and breadth it scarcely seems so long; the skin is rough and horny, the bones are short and thick, the muscles, when contracted, angular and hard as the bones, and the joints furrowed up and rigid, and stiff and slow in action, but with a closing force like the opposing parts of metallic machinery. The time was when all three hands were the same; the time was when any of the three could have been made to take the condition and aspect of either of the other two. As clay in the hands of the potter have they been under the influence of *occupation.* It has moulded each, fashioned each; each fashioned and moulded at all points best fitted to its particular use.

Let us see how this law which regulates development affects the respiratory organs of the man who is just beginning to learn to Row; or of his who is so out of practice—so out of training, in fact,—that he cannot sustain for any space of time the necessary rapidity of respiration. Let us take the first case, as perhaps the most simple of illustration. Why cannot the beginner, as far as wind is concerned, seeing that in this respect at any rate there is nothing to be *learned*, keep pace with the man in training? Simply because his is not yet a rowing heart, nor are his rowing lungs, arteries, or veins. *His* heart and lungs and blood-vessels have been fashioned by other circumstances and other occupations, and fitted to perform their functions in another manner than that called for in rowing, as distinctly and as surely, and with results as inevitable, as those which fashioned the hands of the artist, craftsman, and labourer. In rowing, the heart has to contract, we will say, 110 times in a minute; *his* has been, by the circumstances which regulated its growth and determined its power, fashioned to contract only 75 times in a minute; and all nature's works are perfect, and accordantly adjusted each to each, and each to its place; and the blood-vessels of the lungs, and the veins and arteries throughout the body, have been at the same time endowed with elasticity and contractile power adjusted to the heart's capacity.

But just as occupation has made these organs what they are now, so will other occupations alter them; and the new occupations upon which the aquatic tyro is entering will re-fashion them to what these occupations require; *i. e.* the increased activity of the organ, caused by the exercise of Rowing or of cognate employments, will hasten the disintegration of its tissues and their reproduction, and these metamorphoses will be accomplished with rapidity and with completeness in proportion to the force of the fashioning influences; in other words, in proportion to the extent of the application to the exercise of Rowing, or of cognate employments. Actually and literally, a new heart and lungs, and a new system of circulatory tubes will be obtained suitable to the exercise of Rowing; just as distinctly, as actually, and as literally as if it were a new boating costume he had ordered from his tailor, which he has now to wear in lieu of the dress becoming his former occupation—of his cricketing suit, or his reading-gown and slippers.

But the difference—the mighty difference here—lies in the fact that the change of organ can only be made gradually, bit by bit, atom by atom; just as if, to extend the simile, the boating suit had been ordered to be supplied thread by thread of warp and woof, one at a time, and each for its place, and each to be introduced thread by thread, and one at a time, in lieu of threads extracted from woof and warp of the cricketing suit or of the reading-gown and slippers; and he will not feel at home on the water, nor be free from discomfort and distress till the old costume is removed, and the new is completed.

And this is the origin of our wise old proverbs that "Practice makes perfect," and "Use is second nature." We repeat the sayings without realizing the extent of the truths they express; we believe in their promise, but do not always comprehend the cause of their literal fulfilment. The results and evidence of the working of the law are seen before the nature of the law is understood, *that the functional ability of every organ is in relation to its activity.*

But here the question suggests itself, if this is an organic law, then is it applicable to all parts of the organism; if it applies to the heart and lungs, and circulatory channels, preparing them, changing them, fitting them for their augmented functions, how is it that the chest escapes its influence? The answer is, there is no exception to the action of this law, and the above instance confirms, not negatives, its universality. The chest escapes the altering influence of the exercise because it cannot be said to share in the employment; therefore it is uninfluenced—therefore it is unaltered: and the power of the vital organs which it contains is circumscribed by its capacity; their function is outlined by its circumference; and while it remains small, and tight, and stiff, the heart and lungs must press against its barrier-walls like caged birds against the iron walls of their prison; literally is this the case, and the imprint of the ribs has been marked on the lungs of a narrow-chested man.

To set a man with a flat, narrow, or otherwise defective chest to row in a racing-boat, is just as wise as to set a cripple to run or jump. This is the chief cause of the sickness, faintings, giddiness, and nausea experienced during and at the close of the race,—the chief cause of the greater evils that follow these, if their warning be persistently ignored[1].

Thus we have seen that muscular power plays quite a secondary part in Rowing; respiratory power makes the first claim, and makes it more exactingly than in any other mode of physical exertion in which men can be engaged; not only on account of the rapidity of the inspirations and expirations, and not only from the fact that these are *not* regulated by the natural action of the lungs themselves, but by the artificial movements of the exercise, but also from the interruptions caused by the

[1] It would perhaps be difficult to find a better specimen of a man possessing a naturally fine organization fully cultivated, than No. 7 of the Oxford University Crew of last year (1865), possessing both muscular and respiratory power in the highest degree. His measurements were, (age, 21,) height, 5 feet 9½ inches; weight, 11 stone 6 pounds; chest, 40 inches; fore-arm, 12 inches; upper-arm, 14 inches.

fixing of the chest, and forcibly holding in the lungs of the air inspired after, in the natural order of the function, it would have been expelled.

Everything therefore which can lessen effort in this direction—whether by enlargement of the cavity, which gives freedom of action to the organs within, by strengthening the muscles which lift its walls on each inspiration and depress it on each expiration, or by increasing the elasticity and mobility of its general structure—must be of direct and immense advantage.

The actual sensations felt after rowing will not guide men accurately in this respect; they feel fatigued, and conclude that it has been produced by the usual cause of fatigue—muscular exertion; whereas in this case it would chiefly arise from respiratory exertion; and that which is actually due to muscular exertion would be less from extent of effort than the result of want of relief and interchange of action with other muscles, from the *sameness* of the movements in the exercise; the same muscles making the same movements throughout, and making the last as they did the first.

What other exercise do rowing-men take while in training for boat-racing? What exercise in addition to their work at the oar?

Running or walking.

Running is a better auxiliary exercise for Rowing than walking, contributing more directly both to muscular and respiratory power.

What parts of the body receive exercise in running? First, the legs; and here the flexor muscles have their full share in the locomotive effort: this will be greatly to the advantage of the limb itself, irrespective of its rowing power, which will be also augmented by the equalization of the development of the antagonistic muscles, as in the boat it is the extensor muscles which are employed[m]. Secondly, the hips

[m] It will be understood that in speaking thus generally of the action of muscles, some modifications on certain points must be allowed; such as, for instance, the *rectus femoris*, which, while it extends the leg, at the same time flexes the thigh.

and loins are actively and energetically employed in running; in action and position all different from what they were at the oar. The lower limbs therefore, and the lower portion of the trunk, receive full employment in running, and as these are all chief agents in Rowing, this exercise is well chosen as an aid to the muscular power required. What else? Broadly speaking, nothing else; the arms are tucked in by the sides, elbows down, hands closed, head erect, and the upper portion of the trunk held steady, that the parts enumerated above as the active agents in locomotion may be as little as possible encumbered by the swaying or mal-adjustment of any portion of the burden. With respect to the other requirement of rowing-men, respiratory power, its influence is immediate and direct, for here we have the function of respiration performed in its natural manner, with no disturbing influence of fixation of the chest. The inspirations and expirations follow each other in regular succession; the process is accelerated only.

For Rowing, therefore, running is good, but like other good things, it must be used and not abused, or it may be converted into an evil. It must be rationally performed, especially in its initiatory practice, or it will fail in its expected results. Men seldom enter upon it with sufficient care, or pursue it with sufficient system. They run the first day as they run the last—all at once, and all at a burst; always the same distance, and all at the same pace; relinquishing the effort gasping, and lame from shin-ache. A trooper's horse is trained in better fashion than this[n]. Running, under such circumstances, had better be left alone; it but fatigues the limbs unprofitably, and as regards respiration aggravates the evil of the Rowing

[n] "In the training of horses the points always attended to are the very gradual increase of the exercise; gentle walking is persevered in for a long time, then gallops; then, as the horse gains wind and strength, quicker gallops; but the horse is never distressed; and a boy would be dismissed from a stable if it were known that the horse he was riding shewed by sighing or in any other way that the speed was too great for him."—*Practical Hygiene.* E. A. PARKES, M.D., F.R.S., &c.

which it was designed to alleviate by gradual preparation. Few things worth doing can be done suddenly; certainly no change in the human body can be so accomplished. All the changes wrought in that are gradual, accumulative and regular; and the agencies which produce the changes must also be gradually and regularly applied.

With a man unaccustomed to running, I would say, let him begin with a mile; setting himself to cover the distance in about eight or nine minutes, at the easiest pace and make-believe race he can run in. Let him break from his walk to the ground into this easy trot, and practise it until he find his wind decidedly improved, and the work, such as it is, pleasurable. He may then do one of two things — either increase the distance by another half-mile, to be run at the same pace, or hold to the first course and cover the distance in one or two minutes less. When the mile can be run in six minutes as easily as it was run in eight, let the tactics be changed; let him break the uniformity of the run, and cultivate variety of pace; let him begin the race, as at first, at an easy trot; keep at it for a quarter of the distance to allow the organs of respiration and circulation to take up gradually the accelerated action which is demanded of them as soon as the trotting begins, allowing also the muscles employed in locomotion to take up *their* accelerated action when the walking is relinquished; let the second quarter be in the same style but at a somewhat quickened pace, still keeping within the margin of easy performance; and let the third, if the preceding causes no distress, be quicker still, gradually culminating towards its close to an effort at the utmost strain of the powers; and last let it subside in the fourth quarter gradually into the first easy trot, ending in the effortless walk, to allow the throb of the heart and swell of the arteries and veins to subside and settle down, and the lungs to resume their peaceful tidal motion, and the air current in their cells its rythmical ebb and flow.

I do not give these as absolute, but as

approximate distances and rates of speed; they must be in all cases proportioned to the powers of the individual; but whatever may be his powers, let him begin within them, and augment the work very gradually, whether in velocity or distance; and this augmentation should always be regulated by the actual advancement made by the running powers, until at speed and without preliminary break or preparation the distance prescribed can be run. The distressing and often incapacitating pain of shin-ache is owing entirely to a disregard of this principle of gradual preparation. It is but the same kind of discomfort, arising from the same cause, which men out of practice feel in the arms on rowing suddenly at speed; *i.e.* unpreparedness in the parts to perform the work suddenly put upon them.

Of late years the customary morning run has been discontinued or has been commuted to a short walk, which to such men is in reality no exercise at all. And why has it been discontinued? Because "it takes it out of a man." This is an ordinary phrase springing from a very extraordinary idea. It is thought that men have a certain amount of strength within them, and therefore the more that is taken out of them, *i.e.* the more exertion they undergo in other exercises, the less there will be left for the evening rowing; and acting on this idea, and following it up, as we are all apt to do when very much in earnest, to extremes, they avoid all effort, all action, all exertion, throughout the day; keeping their store intact by moving about as "gingerly" as possible, until the occasion of its requirement. Now of all errors possible for men in search of muscular and respiratory power to commit, this is the greatest, the most directly opposed to the organic law ruling their acquisition.

In plain and simple truth the strength of a man, and his respiratory capacity also, will be in proportion to what he *does* take out of himself by exertion; literally and absolutely so, contradictory as it may seem, paradoxical as it may sound.

The more rapidly a man *does* wear down the tissues of his body by properly regulated exertion, the greater will be their strength and serviceability, the greater will be their bulk and consistency, the greater their functional capacity in every way in which function can be legitimately performed; because the action of the several systems of the body are so perfectly in accord, that the very process which causes the destruction also accomplishes the reproduction; and the organic law regulating power is, as we have seen, *that it shall be in relation to the youth or newness of the parts exercising the function.*

Of course it is understood that the exertion shall not exceed the powers of recruitment; and of course it is understood that the recruitment shall be facilitated by adequate diet and rest; of course also it is understood that men shall not take such exertion immediately preceding the rowing as to cause actual bodily fatigue; but I do say that, considering the very meagre amount of muscular exercise obtained from rowing once or twice over the course [o], and considering also the capacity for exertion which I know to be inherent in the men who row in these races, then I do say that an hour of active exercise before breakfast at walking and running, and at the least as much of an energetic

o The exercise in training practice on the Oxford system, allowing for the difference of some Colleges where a short run is preferred to the morning walk, amounts to this :—

WALKING—Say one mile, averaging four miles per hour	15 minutes.
ROWING—Say twice over the course and back ; part of the distance at racing pace, part at two-thirds speed, and part at half speed, averaging the whole distance, and allowing for backing and turning (five miles), at say nine minutes per mile .	45 minutes.
	60 minutes.

The training practice begins with the Term and lasts about three weeks, when racing commences. Once or twice during this time a crew will probably be taken to Nuneham (about seven miles), but they do not always row back on the same day, and during the time of the races rowing over the course a second time is exceptional, although often done. See Appendix O.

kind between it and the mid-day meal, would contribute vastly to their health and strength, and vastly to their physical resources in the evening race. This post-breakfast exercise should be the antithesis to that preceding it—exercise to the upper limbs, which, as we have seen, have little or no employment in Rowing or Running; exercise in which every voluntary muscle engaged in boat-propulsion will be systematically employed, so that no available particle of rowing-power may be lost, and in which every voluntary muscle *not* engaged in boat-propulsion will also be employed, so that the equilibrium of growth and development may be preserved—so that the *man*, in fact, as well as the *rower*, may be cultivated; and above all, exercise in which the fair and full development of the chest may be ensured, and every muscle, voluntary and involuntary, primary and auxiliary, engaged in respiration may be strengthened to its fullest capacity.

Let no man be afraid to exert himself lest "it take it out of him." There is nothing in him that will not be replaced with interest by the very process of extraction.

But while urging upon men the adoption of this more energetic discipline, I would warn those unaccustomed to exercise before breakfast that they cannot begin it with too much care, or proceed with too much caution; the shortest walk or run at the slowest pace will be sufficient for introduction, to be gradually quickened and extended as bodily power is increased.

I have been speaking of Running when practised as an auxiliary exercise to increase the rowing power; using one exercise to help another, on the principle of the advantage of variety of employment, as already explained. When, however, running is practised for itself, when the training is for the running, and the exercise is to prepare the body for the performance of some difficult pedestrian feat, then it should be begun and conducted with still greater method and care; and all its separate features should be studied, and every other exercise enlisted in its service which can be brought to bear upon the parts of the body employed, either as aids to local muscular power, by developing the voluntary muscles directly engaged in locomotion, or to respiratory power by strengthening the involuntary muscles and all parts of the frame engaged in respiration.

In fine, it is essential to excellence in any special exercise, assiduously to practise the exercise itself; and this emphatically applies to exercises where precision or dexterity of movement is required. But where muscular force to any considerable extent is also required, then is *variety* of exercise necessary, because the voluntary muscles are constituted not for one but for many modes of employment, and not for one but for many grades of effort; and the greater the variety in these respects the greater will be the material development, the higher the degree of mechanical force, obtained. Sameness in exercise will give precision and dexterity, but variety is essential to vigour and power.

And as respiratory power is dependent

not alone on the condition of the organs which (strictly) perform the function, but also on the condition and capacity of the chamber in which they are contained, therefore is it of primary importance to develop the chest to its fullest capacity for the practice of all exercises in which great respiratory effort is involved.

PART II.

Next in importance to exercise is diet, or as it is variously called, regimen, or system of food.

Unlike exercise, which has never received attention commensurate with its importance, diet has long been receiving even more than its due share, and instead of being viewed as regards its actual nutritive function—as following exercise so as to supply the want by it created—it has been advanced to the first place, and invested with attributes altogether imaginary; and "things good for training" and "things bad for training," and "things good for wind" and "things bad for wind," are questioned and combated and debated until the actual place of diet, as an agent in promoting bodily health and strength, is apt to be forgotten.

I propose here to glance briefly at the subject of dietetics; first examining diet with reference to the requirements of the human body under ordinary circumstances, and then inquiring what changes should be made in it, to meet the exceptional habits and wants of training.

It has been already stated that the blood is the bearer to the tissues of the body of that nutriment, which is to replace the waste arising from the disintegration constantly taking place in them,—yielding up, as it is carried through the circulatory system, constituents of its substance to supply the place of those particles, which have become waste and eliminated from the body in various ways. This nutriment is furnished by food, which by the various processes of digestion and assimilation, &c., is gradually converted into blood, from which, as we have seen, each tissue has the power of extracting its own proper pabulum.

But food has another office to fulfil. It is necessary to health, nay to life itself, that the temperature of the body shall be maintained at a given point, that point being with but trifling variations the same by day and by night, when active or when at rest, at all seasons of the year and in whatever climate life may be passed [a]. This heat is generated in the body itself, the materials for its maintenance being found in the blood, partly from the combination of the oxygen inspired by the lungs with certain elements of disintegration, but chiefly, in such a climate as ours, by its combination with certain elements of our food; and as we shall presently see, every substance which we employ as food is subservient to one or other of these processes—the formation of tissue, or the production of heat.

Food has thus a double office to fulfil, each one of vital importance; namely, to furnish the blood with the materials for repairing the waste of the tissues, and its fluid secretions, and with the materials for carrying on this internal combustion, the fuel for this ever-burning fire. Each of

[a] The standard heat of the human body is placed at 98 degrees.

these two processes is as important to life and health as the other; and food is taken, consciously or unconsciously, as much for the one purpose as the other; for just as the vital functions cannot be performed, and life itself cannot be preserved, when the nutritive supply falls for any length of time beneath the demand occasioned by the waste, so would these functions fail, and life itself cease, if the heat of the body were allowed to fall for any length of time below the normal standard.

The organic[b] compounds of food have been divided into three principal groups, *albuminous*, *saccharine*, and *oleaginous*. The first of these groups includes all the constituents of food which are closely allied to albumen. This is a substance resembling in chemical composition the animal tissues themselves, and is found in an almost pure form in the white of egg or the lean of meat. It is present in vegetable as well as in animal substances, and bears a different

[b] I do not in this place notice the inorganic compounds of food, although essential to health, as these are contained, in suitable proportions, in the organic.

name according to the source from which it is derived. But though varying in certain particulars it is still in effect the same, and its essential importance as a constituent of food arises from the fact that it is from albumen that the tissues of the body chiefly derive their nourishment. It is also capable of serving, when required, for the production of heat.

The second of these groups, the saccharine, includes all substances which resemble sugar in their composition, or are capable of being converted into sugar during the process of digestion. They are derived solely from the vegetable kingdom, and are found in large proportions in all farinaceous and vegetable articles of diet. They resemble none of the animal tissues in chemical composition, and are almost entirely employed in the maintenance of the heat of the body by the combustive process above described. They are however capable of being converted in the body itself into the compounds of the oleaginous group, and as such may be used in the nutrition of the nervous and fat tissues.

The third group, the oleaginous, comprises all substances of an oily or fatty nature, whether derived from the animal or vegetable world; these are believed to afford nourishment to the nervous tissues and to the adipose or fat tissues; but their great value lies in their calorifying or heat-producing power, which appears to be greater than that of any other substance.

To these is sometimes added a fourth group, the gelatinous, comprising all articles of the jelly kind. It has been supposed that constituents of this group aid in the nutrition of the gelatinous tissues of the body, but it is now considered more probable that they are chiefly, if not entirely, subservient to the production of heat.

There are, besides, several substances employed as aliments which do not strictly belong to either of these groups; these for the most part contribute little to the nourishment of the tissues, and are chiefly employed in calorification.

Thus it will be seen of these groups of alimentary substances, that one is principally applied to the formation of tissue and the others to the production of heat; but it must be remembered that almost every article, whether animal or vegetable, used as food, contains substances belonging to two or more of the groups in varying proportions; nor could life be supported on any one alone. All experiments on this subject have proved that an animal fed exclusively on substances belonging to but one, dies of starvation.

Every rational scheme of diet must be based upon a knowledge of these principles; for it will be in proportion to the discretion with which the various substances comprised in these groups are mingled and employed, that food will be efficient or otherwise in maintaining the body in health and strength.

The lower animals are for the most part either carnivorous or herbivorous; in their natural state we rarely find them uniting these two forms of diet, and we find the construction of their digestive apparatus suited to their appetite. Thus with the carnivora, whose nourishment is in a very concentrated form, the stomach is small and the intestines short, while in the herbivora, whose food contains little nourishment in large bulk, the stomach is very large and the intestines very long.

The digestive apparatus of man, in accordance with this rule, is much larger than that of the carnivora and much smaller than that of the herbivora, thus indicating that his food is a combination of that of these two classes of animals; and we accordingly find that that diet which is formed by a judicious union of these two descriptions of food, is the one of all others calculated to produce and maintain a healthy state of body; for these combine in the most suitable degree those constituents which nourish the tissues, and those which produce animal heat.

It is by this power of adapting his food to the circumstances in which he is placed, and his knowledge of the laws which should regulate this adaptation, that man is enabled to live and preserve health in climates of every variation between the poles. He finds that in those countries where, from lowness of temperature, it is necessary to resort to artificial means in order to maintain the standard heat of the body, the most desirable kinds of food are those comprised in the oleaginous group—fats of all kinds; for here alone is found the required proportion of heat-making elements. Again, in countries where the heat exceeds that required for the health and comfort of the body, a diet in which the farinaceous and leguminous character predominates is found to be preferable; because this class of aliment contains smaller measure of combustive material in larger bulk than the oleaginous; and the mode of life in such countries being a much less active one, the waste of tissue also is comparatively small, and calls for a smaller supply of the purely tissue-forming.

It is not, however, altogether a matter of indifference whether the tissue-forming constituents of food be obtained from the animal or vegetable world: by the exclusive use of either, a considerable influence is exercised on the condition of the blood itself; on the one hand by raising, and on the other by diminishing, the proportions of one of its most important constituents. Nor is it altogether immaterial whether the heat-producing compounds of food be drawn from the oleaginous or saccharine groups: besides its calorifying power, a certain amount of oleaginous matter, eaten as such, appears to be essential to the perfect conversion of food into blood.

It would be unnecessary here to enter upon any analysis of the numerous and widely varied substances which are rendered subservient to our use as food[c]; but experience confirms the hypothesis afforded by structure and natural appetite, that in moderate climates like our own, a considerable proportion of animal food, with a due admixture of farinaceous and vegetable food, is the most perfect combination of the albuminous, oleaginous, and saccharine groups attainable. The precise effect of fresh vegetables in nutrition is by no means clearly understood, but experience has proved that their employment as an article of diet is absolutely essential to health.

Having seen the principles upon which our food should be selected, we will therefore

[c] See Appendix M.

next enquire what quantity is necessary for the carrying on in proper manner this double office of the formation of tissue and the production of heat. This must in a healthy individual be determined by the appetite; not the appetite excited by the taste of varied and stimulating food, but the natural demand of the system for fresh nutriment.

It must always be remembered that our bodies are nourished not by what we *eat* but by what we *digest*. And further, that the digestive powers are limited, and can only operate fully and without injury to themselves upon a given quantity; for during health these powers will ever be in relation to the wants of the body, as evidenced by appetite.

In another aspect quantity must be considered, an aspect in which it becomes inseparably connected with *quality*. As I have remarked above, a certain *bulk* is necessary to the proper digestion and assimilation of food. Nature has decreed that our nutriment should be, as it were, diluted by being contained in a proportion of innutritive matter; and except in peculiar conditions of body, or states of existence, such for instance as entail severe muscular exertion, where the waste of the tissues is extremely great; or where the exercise entails great respiratory effort, (when distension of the alimentary organs would prove at once a hindrance and a source of danger,) food in which a large quantity of nourishment is concentrated into a comparatively small bulk is injurious. Under ordinary circumstances, therefore, animal food requires the addition of some less stimulating aliment to supply the bulk, and hence one great advantage of farinaceous and leguminous aliments.

The proper *times* of eating appear to have been better understood than the other principles of dietetics. Experiments all prove that from three to four hours is the time required to digest an ordinary meal[d], selected on the foregoing principles; and it is important that the stomach should have had time not only to dispose of one meal, but to have, as it were, a time to rest, before its energies are

[d] See Appendix K.

claimed for the digestion of another; and accordingly we find that from four to five hours is the usual interval between meals. The precise hours of the day are of no actual importance to a healthy individual, because the human body has such a marvellous power of adaptability that its demands, indicated by appetite, will soon return at the time when they are accustomed to be satisfied.

It is generally well known that exercise, mental or physical, should be avoided immediately after eating, because a large supply of blood and nervous energy is required by the stomach in carrying on its functions; and hence arises that incapacity for exertion experienced after an abundant meal. Respiration too is circumscribed to ordinary breathing when the stomach is full; the depression of the diaphragm being checked on inspiration and the contractions of the muscles of the abdomen being hindered on expiration, when the alimentary canal is distended. Neither should a meal immediately follow violent exertion, for the blood will be then greatly distributed among the parts of the body which have been actively engaged in the exercise; and here again nature is our unerring guide, for at such times there is no real desire for food experienced.

Besides quantity, quality, and the proper times of taking food, there are yet a few points worthy of observation in connection with its condition and preparation. Among the chief of these is cooking. The effect which this produces on the viand is of several kinds; one, and not the least important, being its modifying influence upon the taste and smell—a modification which does not always receive due attention in dietetics; also, by lessening the cohesion of the particles and by separating the fibres, the meat is rendered more easily masticated, and consequently more fully subject to the action of the gastric juice in the stomach; and, lastly, it undergoes certain chemical changes during its subjection to heat in the process of cooking.

Another point of the highest importance in all alimentary substances is that they should be perfectly *fresh;* and here again nature is our guide, causing us to turn with disgust from all stale or decomposing substances [e].

As hunger is the warning voice of nature telling us that our bodies are in need of a fresh supply of nutriment, so is thirst the same voice warning us that a fresh supply of liquid is needed to replace that which has been separated from the body, in the form of exhalations from the lungs, perspiration, and other secretions. Though the sensation of thirst appears to be confined to the mouth and throat, the demand for fluid is in reality experienced by the entire system, and the immediate relief afforded by drinking is owing to the rapid absorption of fluid from the stomach and its speedy introduction into the general circulation.

Thirst, like hunger, being a natural demand, may safely be gratified, but, like hunger also, it is liable, if unduly indulged or stimulated, to become a habit, beyond or apart from actual requirement; and its

[e] Animal food should never be allowed to pass that first stage of decomposition which, by lessening cohesion in the fibres, causes it to be tender.

gratification is then injurious (as regards quantity), because liquids taken in larger quantity than is required by the system, are not at once absorbed, but remain in the stomach—distending it, relaxing it, and interfering with the production of gastric juice. The increased thirst experienced during and after strong muscular exercise is owing in a great measure to the diminution of the fluids of the body by perspiration and respiration.

The best general drink for a healthy person is undoubtedly water; its action is so valuable and so important as to be virtually indispensable to the healthy condition of every tissue, and the performance of every function. It constitutes the basis of all the beverages we take from day to day, and, without so intending it, it is almost exclusively for the water they contain that they are taken. Not only can no article of food be dissolved or converted into blood without it, but it combines freely with the tissues also and appears to form a necessary part of their structure; and the muscles eagerly absorb and retain it after exercise. Indeed, water constitutes more than two-thirds of the entire weight and bulk of the body; thus a man weighing 12 stone will have more than 8 stone of water, or, as has been ascertained by experiment, "A human body weighing 154 pounds, or 11 stone, contains 111 pounds of water[f]."

Besides the water which the body receives in a liquid form, either as water or in other drinks, much of what we call solid food has a large proportion of water; in the potato, for instance, 74 out of every 100 parts are water[g]. Nor is this confined to vegetables; bread and meat contain considerable quantities of water, all to assist in keeping at its standard amount this great reservoir in the living organism, subject as it is to loss by numerous causes. Under ordinary circumstances more than a pint will be daily exhaled by the lungs alone in respiration, and from two to three pints will be secreted by the kidneys; and the skin, without special exercise, and merely by what is called insensible perspiration, from

[f] *Lectures on Food.* E. LANKESTER, M.D. F.R.S.

[g] See Appendix M.

two to three pints more, making in all a loss of from five to six pints of fluid excreted from the body daily under the ordinary conditions of life [h].

Tea, coffee, chocolate, &c. have often been considered as improper aliments, but this appears to be the case only when they are taken too strong, too hot, or in too great quantity; taken thus they are undoubtedly injurious from their effects on the nervous system and on the stomach; but when taken with due regard to avoid these extremes they are refreshing and beneficial.

[h] In early life, when working in the Gymnasia and Fencing Schools in Paris, I noted the amount of liquid which I found necessary to comfort and health and to physical power, to replace loss from perspiration, chiefly caused by heat and the great muscular exertion which I was undergoing. This ranged between six and eight pints per diem, consisting chiefly of wine and water; in other form, from 120 to 160 ounces of liquid, independent of what was contained in the so-called solids, a considerable portion of which were bread and ripe fruits. The haymaker's confession with reference to his weak beer, that "he began the day's work with a gallon, and wetted it every hour with a pint," would not probably greatly exceed the want caused by the elimination of moisture from his body in a day's mowing in the open fields, under a July sun.

The injury to the stomach from their being too hot is perhaps a greater evil than that to the nerves from being too strong; the effect of hot liquids on the linings of the stomach appears to be analogous to that which they produce on the skin, namely, by over-stimulating, to relax and weaken[i].

Beer, in moderation, is unquestionably a wholesome beverage, and in certain conditions of body may be taken with the greatest advantage. It is found to lessen to some considerable extent the elimination of fat from the body; hence one of the causes why persons who drink much beer are liable to become fat. When taken merely for the purpose of quenching thirst it should be weak, for in this state it does not contain more than half-an-ounce of alcohol to the pint.

Wine in this country can scarcely come under the head of aliments, and when drunk habitually it almost ceases also to be a stimulant. Let no man, young or old,

[i] The highest temperature at which food, either solid or fluid, should be taken, has been stated at 100 degrees.

habitually drink wine; he never knows its value who does so; for its chief value and greatest virtue, that of a stimulant, is lost by the circumstance of its having become an article of daily consumption. I speak of port and sherry, and not of the uninebriating continental wines.

Distilled spirits of course find no place on a young man's table. He knows that to youthful blood and to youthful brains they are pernicious—destructive as vitriol to steel.

From the foregoing remarks it will be seen that, for men in the position of life for whom I am more particularly writing, there is at his ordinary table abundance to meet all the wants of the body, under every condition of physical exertion; and that therefore, what is called for by the exceptional requirements of training, is to make a judicious selection, embracing such as afford the required constituents of food in suitable proportion[j], and excluding those

[j] Indeed it would appear that so long as these essential constituents are obtained, and the food prove suitable to the digestive organs, and agreeable to the palate, it matters but little in what form, as organic substances, they are

which, though harmless, or even useful at other times, might now prove prejudicial.

This principle was perceived at the outset by rowing-men, and their code of laws on dietetics consists almost entirely of restrictions; but again, like one or two other things which I have already noticed, the idea has been too eagerly embraced, causing the excluded articles to be regarded with an amount of aversion, altogether disproportionate to their real alimentary unfitness; and also causing the accepted articles to be regarded with an excluding favour, altogether disproportionate to their actual merits; indeed, to be invested with properties not possessed by any alimentary substance whatever, and to be regarded as accomplishing results in which food, so far as our information extends, could play no part.

The effect of this too rigid system has been to produce a *sameness* in diet, which has a depressing effect upon the nutritive organs, and upon the natural appetite,

taken:—whether in the bread and bacon and cheese of the field-labourer, or the fish and fowl and game of the man in higher position of life. See Appendix N.

which is the expression of the body's wants; for however nutritive in itself food may be, when eaten with distaste it will not be digested so freely or so fully as if it had been eaten with relish and pleasure.

To see that this is the case, we need only observe the physical difficulty we experience in swallowing what we dislike, or the proverbial facility with which we swallow what we *do* like; nay, even before we can bring it to the lips, do not the glands of the mouth and throat pour forth their secretions anticipatory of the first process of digestion—mastication and deglutition? Something also in this, as in other matters, should be yielded to "use and wont." To change a man's habits suddenly, even if the change be for the better, is not always judicious, and not infrequently fails in its object, on account mainly of the unpreparedness of the body for the change; and men accustomed to variety will injuriously, instead of beneficially, be affected by even necessary restrictions, if too suddenly begun.

The true and substantial nourishment of the body requires variety, and the healthy condition of the stomach itself requires variety, care being taken that it is variety in succession of meals and not of dishes at the same meal[k]. Seeing that the due and complete conversion of the food into blood is the desideratum, everything that will complicate or hinder the operation should be avoided; and where many substances of different degrees of digestibility, some requiring two, some three, and some four hours[l] subjection to the gastric juice, are all put into the stomach at one time, it follows as a matter of course that, even if the process of digestion could be as completely and as regularly carried on, as when the meal consists of one principal substance,

[k] One authority, perceiving the necessity for this principle in diet, prescribes that the same dishes shall appear on the table no two days running, but this is surely carrying the principle to the opposite extreme, and supporting, although in a contrary direction to that complained of (sameness), exaggerated notions of the importance of diet. There is nothing in rational training to require a rule like this. See Appendix O.

[l] See Appendix K.

yet the alternations of rest and employment, which we have seen are necessary to its health, are interrupted.

The alimentary virtues of beef and mutton are undoubtedly great,—greater, perhaps, than of any other two articles which could be named as the staple of diet, under such circumstances, for healthy young men; these very virtues are however held in check by the wearisome monotony of their use and mode of presentation, and also, and let me mention the two extremes in sequence, by the amount consumed—I can scarcely say *eaten*. I have known many men, and still know some, who believed and believe that the whole art and secret of training is, to use their own phrase, "to stuff as much beef and mutton into them as ever they can, and then go on the water to work it into them[m]:" a double error, intensified by its inversion, and directly opposed to the physiological law, which regulates the demand by the loss, which enacts that the

[m] Following Captain Barclay, perhaps, who expressly advises exercise after eating.

supply shall be in *answer* to the demand, as the demand will be in answer to the waste consequent on the exertion. Therefore the exercise must regulate the diet; for could a man consume the contents of a whole market-place, his stomach would but digest what was sufficient for the requirements of the body at the time of its consumption; or, even if a larger quantity could be digested, assimilated, and converted into blood, not one drop of it, or one globule of one of its drops, could by any process be incorporated into the body until a proportionate demand had been created by the waste of tissue. To eat, therefore, beyond the requirement of the natural appetite, is a gross error, for every particle of food so eaten becomes an encumbrance, a hindrance, and a loss. Strictly speaking, the digestive organs will not convert more food into blood than is needed to supply the actual wants of the body, and if they can be excited to do so, every drop so produced is a superfluity for which there is no immediate use. There are several ways by which such superabundance of nutriment may be disposed of. First, it, or a portion of it, may be converted into blood; but the next meal will be reduced in quantity, for want of natural appetite, by the amount of the superfluity of the preceding one, and the composition of the blood itself will be injuriously affected. Secondly, it may be converted into fat, which, wherever it may be deposited *as a superfluity* will be an encumbrance, impeding to the extent of the deposit the free action of the parts where it is placed. Thirdly, it may be passed through the stomach and intestines in a partly digested state, but to their certain discomfort, and probable disarrangement, and with no possible advantage to the system. And fourthly, the superfluity may be disposed of by two or more of these processes, entailing the evils consequent on each in proportion to the departure from natural function. When therefore we hear of men eating enormous meals, and then going out "to work it into them," they are reversing the order in which the natural requirements of the body for food are supplied, and they are trying to perform the conjuror's trick of putting a quart of wine into a pint bottle, without having taken the conjuror's precaution of providing a secret receptacle for the superfluity.

How then are we to ascertain the proper quantity of food required—that which is sufficient and no more — sufficient for each separate individual, sufficient for each special occasion, varying, as does the requirement, with habits and condition of life and occupation and age and temperament and climate and season and time? How are we to know the proper quantity of food required, when subject to so many and often conflicting influences? The answer is distinct, prompt, and unerring, because Nature herself has given it, —given it before the word *training* ever met our ear, or its meaning was communicated to our minds; and she has been repeating it to us daily ever since our first unconscious meal.

When the natural appetite has been satisfied with suitable food, we have had sufficient; we have had all that can be made useful in augmenting or in sustaining the strength, or in promoting the growth and development of the body. Hence even a better reason for the exclusion of all spices and pickles from the table of a man in training, than that they are in themselves indigestible or otherwise injurious,—they are stimulants to eating beyond the true appetite, which is the expression of the true requirements of the body; hence also a better reason for the limitation of the meal to one or two dishes, than that these are suitable and all others are unsuitable for the diet of a man in training,—variety of viands possessing variety of flavour stimulates to eating beyond the natural appetite. The law of restriction in this respect is therefore very wholesome, the danger of superfluity being infinitely greater than that of insufficiency.

I would advise every man while in training, at dinner and throughout the day, to drink nothing but water; confining himself to a moderate quantity of beer with the evening semi-meal. The present practice of drinking beer, sometimes new and sometimes stale, is, I consider, most injurious;

and in conjunction with one or two other habits which I conceive to be errors, and to which I will presently allude, is one of the causes of that painful affliction of rowing-men, Boils.

Indeed, in training on any rational system, to drink, of any other fluid than water, the quantity required to replace the amount of moisture given off by the body, is almost impossible without injury to the digestive organs, disarrangement of the process of nutrition, and the general lessening of the powers of the body.

And here I come to what appears to me to be the fundamental error of training dietetics, namely, the restrictions put upon the amount of fluid which a man has to take, in order to satisfy the demands of the body. We have already seen that in ordinary life there is excreted from the body daily, as it has been computed, from five to six pints of fluid, but this can bear little proportion to the loss sustained during the exciting and stimulating circumstances, under which a man lives while training,— so much time spent in the open air and sunlight, the great stimulants to the skin and other organs which secrete moisture from the blood ;—the greatly accelerated respiration, causing greatly increased exhalations from the lungs in the form of vapour, and from the whole of the body's surface in the form of perspiration [n].

But why should there be any restrictive laws on this subject at all? Why may not a man restore to his body the water which has just been extracted from it—water which is necessary to its comfort, health, and efficiency? It is the most natural of all natural demands, the most simple of all requirements, the most salutary and safe to gratify. We never think it necessary when hungry to refrain from eating, when tired to refrain from resting, when cold to refrain from warming, or when hot from cooling ourselves; then why refuse to drink when

[n] In one hour's energetic Fencing, I found the loss by perspiration and respiration, taking the average of six consecutive days, to be about three pounds, or accurately, forty ounces, with a varying range of eight ounces. Of this about thirty-six ounces remained in the clothing, the remainder having probably been lost in respiration, transpiration from the face and hands, or evaporation from the clothing.

thirsty, a requirement so natural and springing from causes so apparent [o]?

I am speaking, of course, of that general thirst which is the result of the diminution of the fluids of the body, and which is the

[o] In cases of extreme thirst the best plan is first to cleanse the mouth and throat, either by rinsing it with a mouthful of water as a gargle, or by chewing a morsel of bread or biscuit and spitting it out when lubricated, and then to swallow slowly a few mouthfuls of the liquid ; again to repeat the rinsing and the chewing, for the mouth and throat having been the place where the thirst was most severely felt, the salivary excretions at this time are unfit to be conveyed into the stomach ; again to repeat the mouthful-by-mouthful mode of swallowing until thirst has become a little allayed. By this means the water will be conveyed into the blood almost instantly, leaving no quantity to remain in the stomach ; after a little space the luxury of a hearty *drink* may be freely taken. I have myself followed this rule under the fullest extremes of heat and thirst, meeting the simple demand for the fluid (by the sensation of thirst) by quenching it at the first opportunity, adopting only the *natural* precaution of restoring it gradually, approximating the restoration somewhat to the manner of extraction, and always with increased comfort, health, and bodily power;—not only during special exercises which I was laboriously practising, but when traversing on foot, in mid-summer, some of the hottest parts of Europe, when, as the natives complimentarily have it, "everything was asleep or in the shade but dogs and Englishmen."

exponent of its demand for their replacement; for although the sensation of thirst is always the same, and has its seat in the same locality, viz. the mouth and throat, yet there seem to be in reality three distinct kinds of thirst, springing from different causes, indicating different conditions of body, and susceptible of being assuaged by different modes of relief. In considering the subject of thirst, and the best manner of its alleviation, it is important to distinguish between these three kinds, because the overlooking of such distinction has been, I think, the cause of much of the disagreement of opinion on this important subject, by men whose opinions and statements are in every way worthy of the most serious consideration.

First, there is what may be termed *general* thirst, which is the expression of the demand for liquid experienced by the whole system, to supply the place of liquid with which it has parted, consequent usually upon bodily exertion or extreme external heat. For this form of thirst there is but one real means of cure, viz. the replacement of the fluid which has been extracted,—drink, in the simplest form obtainable.

Secondly, there is what may be termed *local* thirst, the requirement being in a great measure limited to the mucous linings of the mouth, throat, and air passages. This thirst arises from no loss of fluid experienced by the system, but from local dryness and irritability, occasioned by their frequent contact with dry or heated air, dust, or other irritating influence. It may therefore be cured by any means calculated to allay local irritation, and to stimulate to action the glands of the parts affected; such as rinsing the mouth, chewing orange or lemon-peel, sucking a pebble, or swallowing butter. Drinking in this case can obviously afford little or no real relief, and is to be avoided, as filling the stomach with liquid for which there is no demand experienced by the system[p].

[p] The thirst experienced by men immediately after the race is a combination of both general and local thirst; for during the greatly quickened respiration the air expired does not contain the usual amount of watery vapour; and the dry air inspired and expired with such extreme rapidity will cause local thirst of the most intense descrip-

There is also a third kind of thirst, arising from no loss, local or general, which the body has sustained, but caused by the presence in the stomach of some irritating article of food, requiring fluid for its dilution. This is the thirst experienced after eating salted or spiced food, or drinking exciting drinks. It can be alleviated by drinking, but will only be cured when the offending substance has been dissolved or removed from the seat of irritation.

Nor is it necessary to adopt greater precautions in satisfying thirst than other bodily wants. It is important not to drink too fast or in too great quantity in times of extreme thirst[q]; just as it is important not to eat too

tion. Care should therefore be taken to alleviate this sensation by any of such means as I have mentioned above, before proceeding to satisfy also the general demand for fluid.

[q] The same influential authority who has foreseen the necessity of variety of food, permits a man *at the end of the day* to "drink as much cold water as he has a mind to." Now I submit that this is not what is wanted. Men are not at such times either to eat or drink of anything "as much as they have a mind to," but carefully and heedfully to mete out the supply to the actual requirement. Moreover this wholesale gratification of a protracted desire must be indefensible. A little and often is

fast or in too great quantity in times of extreme hunger. It is advisable when thirst is extreme to refrain from drinking suddenly or in large quantity, not because the stomach is heated by exercise—for the heat of the stomach and of all the internal organs in health is always about the same—but because at such times liquid should not be taken into the stomach faster than its absorbent vessels can take it up and convey it to the blood. And it is desirable equally to avoid the accumulation of water in the stomach, or its too sudden and copious introduction into the circulatory channels. For this reason any property in the liquid imbibed which proves an inducement to drink slowly, and at the same time stimulates the glands of the mouth and throat, where the *sensation* of thirst, when it has been acutely felt, often lingers long after the actual wants of the body have been supplied, is a great advantage[s].

I had never been able to comprehend how

the true principle. The *demand* for drink should never be allowed, so to speak, to accumulate. See Appendix O.

[r] For this purpose there is nothing better than lemonade.

the idea of restricting this natural demand of the body for fluid arose, or, having arisen, how it could be perpetuated and carried on from year to year; or what benefit a man was supposed to derive from it, and from all the misery and discomfort he thereby suffered, until I came upon the "internal fat" theory, and then there was no mystery about the matter; for even when this "great enemy of rowing-men" had been expelled, as evidenced by the reduced weight, yet somehow if the man was allowed to quench naturally his natural thirst, by the simplest of all means, by a draught of pure water, the lost weight was all restored, the "enemy" had returned in full force, and it had all to be done over again. Therefore it has been decreed that—no matter what the circumstances may be under which the thirst is caused—hot weather or cold, much exercise or little; no matter whether the man's stature be large or small, or whether he perspire freely or slowly; whether it be at the beginning of the training, when the work is new and severe, or later, when he has become familiar with it and it is easy;—

at the beginning of the training, when all the efforts and exposure tell tenfold as strongly, in this respect, upon the frame unused to them, as they do towards the close, when the law of adaptability is beginning to mitigate the misery of the deprivation[s]; under any circumstance or condition of body, his drink shall be one, or at most two, cups of tea at breakfast, one pint of beer at dinner, and one at supper. There is no point in training upon which a man stands so firmly as this[t].

After seeing the part which water plays in the animal economy; after seeing the amount which the human body daily loses,

[s] Some men suffer from thirst to the last.

[t] One authority simply declares that drink should be avoided altogether! and that "the man who can be satisfied with rinsing the mouth and gargling the throat with water, will train better than he who drinks any kind of fluid, even in limited quantities." There is a notion, too, that "*solids only* conduce to strength, and tend to supply the waste which takes place in the system,"—a notion so stated by a writer on the subject,—and that therefore all moisture or moist food is injurious or in some sense objectionable. For this reason even stale bread is by many men rejected, and crust or dry toast substituted. See Appendix O.

and must lose, if it is to remain in health, even in ordinary and unexposed life, it follows as a matter of course that a man at the end of a day of training practice, with a very restricted allowance of liquid, will be considerably reduced in weight; but it is the reduction, not of a burden which he had to carry, but of *himself*,—of himself most emphatically, because his muscular and nervous energies are all reduced by it, as evidenced by the irritability of a man suffering from thirst, his restlessness, sleeplessness, his dry and feverish skin [x], his parched mouth and cracking lips; and all because the moisture extracted from his body has not been restored, for it was essential to comfort and to health, to the tone of his nerves and to the contractile power of his muscles. These have been as fairly deprived of a portion of their mechanical force—as palpably, as if certain of their fibres had been extracted from

[x] An M.D. writing on the subject says: "Excessive thirst (in training) is a sign of feverishness, and should not be encouraged in much drinking." The advice may perhaps be questioned, but accepting it as sound, what in this case caused the feverishness?

their sheaths. No man, that is, no healthy young man of the class of whom I am speaking, would permanently lose weight by exercise, if these dietetic restrictions were not in force. He would *gain* weight and not lose it, and gain it too in proportion to the amount of exercise taken and the energy with which it was pursued, for this is the organic law regulating growth and development, as already described. So well is this understood in the army that if a recruit loses weight by exercise, it is considered a subject fit for medical enquiry.

The theory however is, that the weight lost is fat—internal fat; the man is "training down," or "training fine," and therefore this reduction of his weight is a subject of rejoicing and congratulation. Give him five minutes at the first pump and he will soon train up again. I have walked down the river side, night after night, and seen every rowing-man in the twenty racing-eights sitting at his oar. I have gone from barge to barge and seen every rowing-man get into and get out of his boat, and in a season's crews I have not seen one man whose weight I could reduce by exercise, but the reverse. These are not the men, and this is not the age, at which it is *possible*, with adequate diet and adequate rest, to reduce the bulk or weight of the body by exercise. One method alone remains capable of doing this: extract from the body a quantity of its fluid, which, as we have seen, is part of itself, enact that this fluid shall not be restored, and you have the man reduced by the amount of the extraction.

I have spoken thus strongly of the error of an inadequate supply of fluid in training, but, in my opinion, under the present laws of training, the reduction of weight is also due to inadequate muscular exertion. The partial employment which Rowing gives, the sameness of the employment, the disproportion which *resistance* bears to *movement*, the nominal weight of the boat, the less than nominal opposition which the boat encounters from the water, with the exaggerated respiratory action, all tend to this end, and all contribute to produce what I observe to be the inevitable and invariable results of training tactics—loss of bulk, loss of weight, loss of power. And the question here presents itself—and does so in a manner to admit only, as it seems to me, of an affirmative answer,—"have not these dietetic restrictions re-acted injuriously upon the administration of the other agents of health—on exercise, for instance, by making the thirst already induced literally insupportable, if aggravated by bodily exertion?" For no man already parched with thirst would voluntarily take exercise to increase that thirst, and if induced to do so from conscientious adherence to training rules, his strength would be impaired, not increased, by such exercise; and the notion would be started, or, if already existing in his mind, confirmed, "that exercise took it out of him."

But I believe that, although the internal fat theory has been the means of perpetuating this restriction with regard to liquid, yet that the law of restriction had a legitimate origin in the customs of the times when it was probably first instituted. I think it might perhaps be traced to the times when boating was in a measure limited to watermen, and boat-racing consisted of their periodic trials of skill in their craft; and with such men at that time, probably, restriction on their ordinary habits of imbibition of liquids was the most salutary rule that could be framed and enforced; because the habits of inactivity and self-indulgence consequent upon frequent or prolonged drinking, would be the reverse of what was required for that bodily condition favourable to success in boat-racing; for muscular power played no secondary part in those days of heavy and bulky boats, encountering great aqueous and atmospheric resistance, and with all their propelling gear and fitments of a comparatively unskilful kind.

When Rowing passed from the stage of being merely "patronized" by "gentleman amateurs" to being adopted by them as a recreative exercise for themselves; when they came to the water to learn of the waterman the waterman's work, doubtless they would learn, and doubtless also they would adopt, the waterman's ways, of preparing for it; and perhaps at that time it was the wisest course they could adopt, and perhaps also at that time the difference in habits of intemperance, if any, might rather be in favour of the professional rower.

Everyone who can look back for even a quarter of a century, will admit the immense improvement that has been effected in this direction. The change I believe to pervade, in a greater or less degree, all classes of men; but in that of which I am now specially speaking, and speaking on the strength of careful observation—of men who pass through public school and University life, the improvement is so great that little is left to be desired.

Now it is my firm belief, a belief also founded, I may say, on the strength of careful and extensive observation, that these restrictive training laws and regulations, carried although they may have been to injurious extremes, have been most influential agents in the working out of this reform; agents to which all the corrective and preventive measures of local authorities, of proctor and police-power united, have been as nought; for the crowning value of this reform is that it has come from within, from the men themselves. There has been no prohibitive *Thou shalt not* in this case; the regulations and the laws all were and are voluntary, handed over and handed down from man to man, from school to school, from college to college, and University to University; aye, and beyond the University too, inculcating the idea and habituating men to its influence, that intemperance and self-indulgence are incompatible with health, strength, or activity; that energetic and regular habits, implying early hours of rest, early hours of rising, hard beds and spare bed-clothes, and frequent and abundant use of cold water, are all agents in promoting physical power, all means of obtaining physical distinction. "The glory of a young man is his strength." Amen. Among mundane things he will never find a better.

But the severity of legislation and the stringency of laws may surely be relaxed, when the evils which they were designed to prevent or punish are virtually abandoned, and culprits err only in their eagerness for well-doing. Granting the soundness of the advice, given by an authority, as to the desirability of reducing the fat of the body, when it has so accumulated "that the shoulders are clogged and loaded," and the "belly" is so "bulky" as to prevent a man from "reaching over his toes;" yet if no such accumulative encumbrances exist among rowing-men of the present day, the value of the advice is lessened. Sound, again, may be the advice as to the mode of training for "a gentleman's son," who on coming to the University takes to hard drinking, and other amiable practices, and is threatened with an attack of *delirium tremens;* but as no such gentlemen's sons now-a-days happily *do* come to the University, or if they come, happily or unhappily, are not likely to pull an oar in a College Eight, or be admitted into the society of those who do, the usefulness of the advice is lessened, and its necessity, like the time and the occasion for its enunciation, has passed away.

Nevertheless, the obsolete advice is kept up, and taken up, and acted on, and applied to those whose ways of life, and whose bodily constitutions, and all their material and immaterial surroundings, are essentially different. It is like applying a prescription prepared for a *bonâ fide* patient to a man sound in wind and limb; and just as the prescription aimed at making a sound and healthy man of the patient, so will it when thus misapplied make a patient of the man now healthy and sound.

To speak distinctively of the separate meals. The staple article of the first meal, about eight o'clock, is either beef or mutton, and, as we have seen, the selection is a wise one. The everlasting beef-steak of former years has now a divided sway with the mutton-chop, and in some colleges it is more varied still. This is a great advantage, and the range may very safely be made wider yet. Eggs, unless poached, are still excluded, (why?) and even when eaten the white is rejected. A man in training, with his dread of fat, would be shocked to find that in eating the yolk he has swallowed what is little more than a ball of oil, and in rejecting the white he has rejected an article of almost pure albumen, the special pabulum of the muscular tissues. Undoubtedly stale bread is better than new, but not from the fanciful virtue of being "better for wind." It is better than new, because during mastication it can be better broken up, and the saliva can more freely penetrate it, and so more readily and rapidly prepare it for the next stage of digestion. New bread is liable to be worked up during mastication into a tough doughy ball, merely externally lubricated. Butter in itself is most wholesome, and furnishes an excellent aliment of the oleaginous class, the presence of some article of which we have seen to be essential to the perfect conversion of food into blood; but men who find it difficult of digestion should avoid it. Tea is preferred to coffee, and, in my opinion, on very insufficient grounds; for the allegation that the latter is heating is far from being substantiated, and hardly agrees with its universal use throughout the East and on the Continent. Choice in this respect may safely be left to the individual, for although the active principle of the two beverages is so nearly alike as almost to be identical, yet their effect differs with different constitutions. The chief thing to be guarded against—and this applies to all drinkers of tea and coffee, as well as to men in training—is not to drink them too hot. There is nothing more injurious to the stomach than hot drinks of any kind, and could drinkers of them only perceive the delicacy of the membrane which lines the throat and stomach, no enforcement of this advice would be required. Indeed, from a knowledge of the injurious effects of drinking warm liquids, as also from a knowledge of the tonic and invigorating properties of the excellent French wines now largely and cheaply imported into this country, I am of opinion that their adoption in Continental fashion, *i. e.* largely diluted with cold fresh water, would be a far better morning beverage, for men undergoing special physical exertion, than either coffee or tea.

The hour of dining is well selected, leaving five clear hours between the principal meals, and about the same space of time between the last and the rowing. The same principles which guided in the selection of the first meal, should guide also in the second, *i.e.* plain and substantial solids with simple and unexciting fluid. The importance of an abundant supply of vegetables is often lost sight of. The mere drinking of water or other liquid will not entirely supply the want in the blood for moisture, at times when it is often and largely eliminated from it; it is desirable that a certain amount of fluid, proportionate to the amount and nature of the solids, should be slowly extracted in the ordinary process of digestion from the solids themselves, and of this vegetables contain a large proportion; moreover the inorganic substances which they contain, and which we know to be essential to the health of the body, are not attainable in the same form from any other source. A fair proportion of vegetables is therefore absolutely necessary to the healthy condition of the body: not rice and sago, but actual roots and leaves and green seed-pods; of these let men freely partake, avoiding all fanciful selection [y].

There can be little doubt that all pastry and made dishes should be excluded from the table of a man in training, from the simple reason that all compositions of fatty matters and flour are difficult of digestion, and contain little that is nutritive when digested. *Le jeu ne vaut pas la chandelle.* The energies of the digestive organs are taxed severely by a substance which gives no adequate return for the labour. Therefore the rule of avoiding all kinds of pastry and made dishes is a necessary one; although it certainly borders on that step said to be next to the sublime, to see the look of horror and consternation

[y] What has been said of the restrictive laws against water may be said with equal truth about those against vegetables. The same authority who cuts off all liquids, limits the supply of vegetables to a "good potato now and then, for a change! This is the only vegetable a trainer should use."

with which men, whose stomachs could digest cast steel, eye a square inch of raspberry-tart.

There are also a number of proscribed articles usually classed under the head of *condiments,* such as pickles, spices, seasonings, and sauces; all these are best avoided. They are not only stimulants to eating beyond the natural appetite, by varying the flavour of the viand with which they are taken, but many of them are insoluble without much water, and thus produce a second cause of thirst beyond the want of liquid in the system.

It is not however from fear of the consequences to their digestion but to their "wind" which makes men avoid forbidden aliments, acting on the idea that respiratory power is obtainable from special articles of diet. The respiratory power, or wind, can doubtless be unfavourably affected by the presence in the alimentary canal of any substance which actually taxes digestion. So also bulky food which distends any part of the digestive apparatus affects wind for the time being, because it prevents the due depression of the diaphragm and contraction of the abdominal muscles. But beyond this it is difficult to understand how any special article of diet can improve respiratory power. This is more than a negative evil, for it leads men to neglect the one means which can give it—exercise adequate to develope to their full capacity the parts of the body which perform that function.

The slight supper about six or seven hours after dinner is unobjectionable, and the bread and cold meat of which it is usually composed may be legitimately accompanied by a moderate allowance of beer. For at this time, the entire body is not only less elastic, less springy, and less sustained, but reduced in weight, in girth, and in height[z]. The action of the organs of respiration is less energetic and regular, and the organs of digestion have probably also to a considerable extent lost their power, and may therefore be advantageously stimulated by such a draught, or by a glass or two of

[z] After a day of active exercise a man of middle stature will probably be half an inch shorter than he was in the morning.

wine, according to the habits or inclinations of the man; an advantage not equally felt if these liquids have been taken at the preceding meal, when no requirement for a stimulant could be experienced[a].

All use of tobacco is forbidden to men in training; and I would quite agree with the restriction if it were forbidden in non-training times also; but I hold it to be from the purpose of training, suddenly or greatly to change a man's habits in anything, and especially in such as notably affect the nervous system: and I know that many a man would far more willingly go without his dinner than his pipe, until the periodic craving had been overcome, and the jarring nerves had learned to be composed without the aid of the accustomed sedative. Let it not be from this supposed that I advocate the use of tobacco. I would only advocate the

[a] A glass or two of good wine will often be of the greatest value as a restorative from depression and a promoter of sound and refreshing sleep. Let however no fanciful regulations influence choice, like those in vogue with some professional trainers, who allow to pedestrians two glasses of wine per diem and to boxers the same quantity, but to the former sherry and to the latter port!

rational system of not suddenly breaking in upon a man's fixed habits, at the time you are asking for the effective display of his greatest bodily energies. There is no subject so open to controversy as the practice of smoking, and none which enlists opposing champions more able, earnest, and enthusiastic; and yet when the arguments and positions are dispassionately examined, it is discovered that, as sometimes happens in more important contests, and with more exalted combatants, they are in reality nearly agreed, and that a little yielding of each extreme would reconcile them. Thus it is admitted by the intelligent opponent of smoking that, in middle life, and at the close of an anxious, harassing, and fatiguing day, the gentle sedative of a cigar or pipe may be a safe and valuable agent in soothing over-excited brain and over-irritated nerves; it is equally freely admitted by adult champions on the other side that, during juvenescence, before the real battle of life has begun, when there is nothing more serious to harass and fatigue body or mind than the preparation of studies and the pursuit of amusements, there does legitimately exist no such requirement. And everyone whose opinion on the subject is worth having, is agreed in this, that the narcotic which may be harmless to the mature frame of manhood, may be injurious in the highest degree to the immature frame of youth. I have never seen the young man who did not smoke, whom I thought could be benefited by doing so; while I could count by hundreds those whom I have known to be injured by the indulgence. But when the habit has been acquired, and confirmed by use, the eve of the races, or the short period of preparation for them, is not the time to break it off, and least of all should it be done suddenly.

In the Appendix I have given an abridgement of several training systems, which will shew the variety of opinion which exists on the subject of diet. It has been remarked that this variety is an advantage, because "as no one system will exactly fit every man, it must be made a little elastic, or something must give way somewhere." But it must be remembered that this variety of opinion is not held with this view; the variety is the variety of disagreement, not of toleration; each authority holds to his own as the one true faith. Each advances something new, each condemns something old, until there is nothing new to advance and nothing old to condemn. For example, one advises to sup on half-a-pint of weak gruel, with a few raisins and currants, and a glass of port wine in it; a second, on the gruel with the raisins and currants, but without the wine; a third, on the gruel, but without either raisins or currants or the wine; and a fourth on nothing at all! Again, men take their stand on their beef and mutton—there they feel secure. Mutton or beef, roast or broiled, with a sprinkling of salt for seasoning, by these they hold amid the shifting quicksands of training dietetics. But no; beef, their last refuge, their sheet anchor, is slipping. It has been discovered "that mutton is better than beef for wind, and roast better than broiled." *Nil desperandum!* Let a man hold on to the mutton, roast: aye, but if he does he must eat it without salt, for salt it has also been discovered "is bad for training."

But the good sense of a practical man cannot be quite at fault, even when groping about bewildered among dietetic crotchets. "The north-countrymen," says H. Salter, "are not often so particular as those on the London river, as they frequently have fruit, rice-puddings, &c., but after all, as in this instance, where the bent is so decided, the great thing in training is to find out as soon as possible what mode of living the subject has been accustomed to, and as it must to a great extent be the most suitable to his peculiar case, to adopt it without hesitation."

It has been already remarked that the alimentary properties of food, and its digestibility, are much influenced by *cooking;* and on this point also men would seem to have wandered from the right path by their extreme desire to avoid the wrong. Having learned that over-cooking hardened the fibre of meat and lessened its nutritive value, they have gone to the opposite extreme and eat it nearly raw; ("underdone" is the term applied, but it is not only often "blood-raw" in the interior, but, as I have often seen, simply as free from influence of fire-heat as it was when it hung in the butcher's shop.) The steak or chop to be merely "warmed through" is held to be quite sufficiently cooked for men in training[b], but it does not often get even this amount of cooking, as taste and smell can testify; and colour too, for the dark dull leaden hue of raw flesh is there still. I have seen men swallow such food with as much repugnance as if they were taking physic, never "sticking their teeth into it" at all, but "bolting it" in pieces, with the aid of the niggardly apportioned tea, or equally niggardly allotted beer. Yet men wonder that on such diet as this they are assailed by diarrhœa or constipation, that boils rise in groups, that blisters canker into sores, and that wounds do not heal!

There is a favourite mixture which must not be overlooked, viz. egg in sherry.

[b] It will be seen in the Appendix that on this point also authorities disagree.

Medical men prescribe it to patients, as containing at once a stimulant and nourishment, when a stimulant is required, and nourishment cannot be taken in other form; but surely crews of racing-boats need not aliments in such form. Moreover, it has been recommended to be administered to men "just as they are stepping into the boat." Now how will this mixture, so administered, act upon the man who has swallowed it? The wine will act upon his nervous system immediately, whether beneficially or not is another question; the egg will remain in his stomach *as egg* until long after the race is over, and will aid him no more than if it had been put into his pocket.

There is no danger whatever in going into a rational system of training, but there may be considerable danger in going out of it, if not done gradually; if the dietetic restrictions be relinquished too soon, and the physical exertion too suddenly abandoned. Indeed the custom still in vogue with many, of instantly, the very night of the last race, flinging off all restraint, is suicidal,—and the ill effects are laid upon the Rowing. The very fact that the exercise has ceased, requires increased watchfulness for a space over the appetite. The same law which should regulate all changes—gradual advance and gradual retreat, is here not only desirable but necessary, and that in proportion to the extent and duration of the departure from the ordinary habits of the individual. I am the more earnest in calling attention to this point, because training, when conducted on rational principles, is the most important means of ensuring the safety and in promoting the efficiency of the rower; and from the alacrity with which men enter upon its duties, encountering with the utmost good-humour all its *petites misères*, and resisting, with the most exemplary self-denial, all temptation to break through its irksome but self-imposed restrictions, I feel sure they have but to be convinced of the importance of the recommendation to adopt it.

PART III.

Exercise to create the demand; Food to yield the supply;—what is needed to complete the process of renovation?

Sleep;—during which the incorporation into the living organism, and the endowment with vitality of all new additions, take place.

The amount of *time* required for this purpose varies not only with individuals, but with the same individual at different periods of his life, and is influenced by various causes, and by the action of the other agents of health, and specially by Exercise. The growing and immature frame evidently requires a much longer time for recruitment than is found necessary at a later period of life, when growth and development are completed; as might be expected from the facts that in the latter there is but the day's waste to restore, the day's "wear and tear" to replace; whereas in the other, there is the permanent and continuous demand for the body's enlargement and consolidation. Thus the requirement is greatest in infancy, when growth is most rapid; gradually lessening through childhood and youth, on to adult life; remaining at its minimum over able and active manhood, and again increasing in old age.

It is customary to name eight hours as the standard amount of sleep, required under ordinary circumstances by an adult in fair health; but I am inclined to think that in the greater number of instances this considerably exceeds actual requirement, and that habit, in this, as in many other things, has contributed to establish a fictitious want. Six or seven hours will, in my opinion, be found adequate, after a month or two of systematic and gradual abridgement, to yield all that mind or body can need. Certain it is that with care, sleep can be, if the phrase might be used, *condensed;* we might get in a shorter space what we require, without lessening its value.

There is a belief that sleep to be perfect must be begun before midnight, and the saying is as well credited as it is familiar, that one hour's sleep before midnight is worth two after it. The theory upon which this idea is founded, or rather the theory which endeavours to account for this idea, having accepted it as fact, is perhaps too fanciful to be convincing, although it embraces some facts which do not otherwise seem explicable[a].

[a] The outline of this theory may be thus sketched from *Hufeland's Art of Prolonging Life;* translated by Erasmus Wilson, M.D.

Everyone who has had the painful duty of sitting by the bedside of a sick friend must have remarked the increased nervous excitement manifested at the advent of evening, and culminating to a crisis towards midnight. This excitement is not confined to patients, but is shared by everyone whether sick or in sound health, but it is most *noticeable* in feverish patients, because in them it is intensified in proportion to the activity of the fever from which they are suffering. This feverish state of nervous excitability is not unknown to medical men, and by them familiarly called *Evening Fever;* for during it not only is the nervous system, including the cerebral organs, in unnatural activity, but the pulse also is quickened and

I think the real origin of the idea may be traced to this: that early retiring to rest, so as to secure the commencement of sleep before midnight, ensures that the body shall not be overtaxed by excitement or dissipations in addition to the day's toil; and that it being observed that when this was done, so as to enable this necessary agent of health and strength to come into operation before midnight, recruitment was more complete, it was believed, or it was thought a desirable precept to advance, that there was a special virtue in the pre-midnight sleep.

progressively culminating to the midnight crisis. The cause of this periodic fever is surmised to originate in 'the absence of the sun, and that revolution of the atmosphere which is connected with it;' as it begins with the time of his disappearance, and its crisis is observed to coincide with the period when he is in the Nadir, or midnight; and secondly, it is surmised that it is during this crisis that the renewal of all waste of the body experienced during the past day, the act of incorporation of all new material in the living organism, is effected; and that when this crisis is permitted to pass before sleep, such incorporation must be untimeously, and therefore imperfectly performed, and the renewal of tissue from previous waste imperfectly accomplished.

It must, I think, be viewed as one of the errors of training tactics that men are encouraged to take too much sleep; at any rate to spend too much time in bed. What requirement can young men, undergoing such bodily exertion as present training practice involves, have for ten or eleven hours' sleep[b]? What need to spend nearly half their time in bed? In this, as in most things, some men will require more than others, but speaking generally, seven hours will be found abundant at this time of life. To sustain the body in full vigour, if a man goes to bed at eleven o'clock he ought to be out of it by six.

The importance of fresh air is, upon the whole, well understood, and upon the whole, fully appreciated and acted on; but something still may be said regarding the more efficient ventilation of bedrooms. (Speaking in general terms, and bearing in mind the accommodation in this respect yielded by hotels and lodging-houses, college rooms are not unfavourably constructed to admit sufficient air and light for the

[b] See Appendix O.

single occupant. When a deficiency is experienced it is in "old buildings," "garrets," and "back rooms.") Whatever may be the cubical capacity of a man's bedroom, or its facilities for changing its atmospheric contents, he holds in his own hands, in a great measure, full power for the unlimited extension of its facilities in both these respects. Let every man whose throat and lungs are sound leave his window slightly open; the smallest space will do—a few inches in summer, and in winter half an inch or less, the thickness of the blade of a knife at top and bottom, or at top only; for the difference of temperature between the internal and external air is so much greater in winter than in summer, that it will enter freely at the single aperture without special outlet.

Our organs of external sense are not behind the other organs of the body in their power of adapting themselves to the circumstances in which they are placed, and unless care be taken this adaptability will be too often to our disadvantage. Thus let a man sleep in a small close room, and although in the morning he will awake flushed and hot, he will detect nothing disagreeable in the atmosphere; but let him go into the external air for a few minutes, and then return,—it is insupportable. Has he been breathing this throughout the night? Not altogether, not so bad as this throughout the night; it has been getting worse every minute since he first retired to rest and it is now at its worst; for every breath he breathed lessened its purity. Let him the next night leave his window open, as recommended, and in the morning he will waken without head-ache or heat, and the flush, if flush there be, on his cheek, will be the effect and the sign of renewed vigour from sound and refreshing sleep. Let him go into the external air, as before, and then, as before, return to his bedroom;—can half an inch of ventilation by a single window do so much?

I would urgently recommend the man in training to rise early. To him who would build up his body in health and strength, this will be the corner-stone of the edifice.

There is in the morning air an invigorating freshness which is sought in vain at any other period of the day. There is an absolute sensational pleasure in the act of inhalation of the external air in the early morning, quite special and peculiar. And let him not only rise early, but do this and rise the very first instant he awakes. The fact of his being awake shews that the full recruitment of his frame has been accomplished; that bed can do no more for him, and that after this, every hour passed in the air of the sleeping-room is a serious loss, for in one hour every drop of blood in his body will have many times passed through his lungs, and have been subjected to the air inspired, be it pure or impure. Let him never forget this.

But air is not only valuable as regards *quality*, but as regards *quantity* also, the quantity actually inhaled; and although during sleep the breathing can neither be quickened nor augmented, in amount on the inspirations, beyond the actual tidal capacity of the lungs, as it can be while awake by exercise; yet it is susceptible of the reverse process—of being unduly diminished, to the reduction of the oxygen inspired and consequent accumulation of carbonic acid in the system ; and by no cause more readily than by too many bed-clothes. A great deal of oppression may be endured from this cause unconsciously, yet not less injuriously than from improper clothing by day. There is a pernicious habit common to bed-makers of pulling the bed-clothes a yard too high, and then folding the over-length back again; thus placing just double the weight of blankets and sheets over the chest, the part of the body which requires it least (for if cold be felt it will not be here, but in the extremities)—the part of the body which is least able to bear extra weight; for from its necessity to rise and expand upon every breath of air inhaled, all accumulation of bulk or weight over it is injurious.

The instant that a man is awake, let him get out of bed ; and the instant that he is out of bed, and his ablutions performed, let him open his windows to their fullest extent ; thus giving to his apartments and their furnishings what he gives to his body by the agency of water; for these two agents of health should ever go hand-in-hand, fresh Air and fresh Water.

Bathing must be viewed as an agent of health in two distinct aspects: first, in its capacity as a cleanser of the skin, and secondly, as an agent of considerable tonic power. In its first aspect it addresses the skin as the organ of transpiration only; in the second, as the organ of common sensation, possessed of great nervous sensibility and influence. In the first, it addresses the skin with the view of removing from it all impediments to functional ability, and arousing it to greater activity; in the second, it acts directly through the skin upon the nervous and circulatory systems.

In viewing the bath in its first aspect, as a cleanser of the skin, we must remember that the entire surface of the body is continually pouring forth streams of fluid exudations, separated from the blood by the glandular roots of the perspiratory and oil tubes with which it is closely studded. It is through the skin that the medium temperature of the body is mainly preserved, and the perspiratory ducts form the main channel through which this important operation is performed; for moisture being a powerful conductor of heat, perspiration eliminates the heat from the body when produced in excess of its wants, as in exercise. Some idea of the extent and importance of this excretory process may be formed, since it is computed that the number of these ducts and tubes, over the whole extent of the body, average no less than 2,800 to the square inch of skin. A second process, of a somewhat cognate nature, equally important to life and health, and equally marvellous in extent, is that of the oil ducts and glands. These, with the exceptions of the palms of the hands and soles of the feet, pervade the entire surface of the body, though less regularly than the perspiratory ducts; for in some places they are few in number, slightly spirated and of small diameter, while in others they are thickly crowded, wide and straight, with large convoluted roots. These glands secrete an oily fluid, which is exuded through the ducts and poured over the surface of the skin, for the purpose of lubricating and softening it, and thus keeping it pliable through all atmospheric changes, and every degree of heat and cold.

It is through the perspiratory ducts that what is called "insensible" perspiration (*i.e.* that which is vaporized and carried off as fast as it is secreted) is constantly poured forth, and it is through these ducts that moisture, not necessarily in excess or superabundant, is in a great measure drawn from the blood in forced perspiration, for the equalization of the body's temperature during muscular exertion or exposure to great external heat[c].

It is evident that the rational clothing of the body must, in a measure, be regulated by a knowledge of this function of the skin which covers the body's surface and which regulates its temperature; and

[c] When the perspiration is the result of great external heat, it cannot properly be said to be secreted by the skin, being in a great measure simply passed through it by the process called transudation.

clothing will be comfortable or otherwise, sanitary or otherwise, as it is fashioned to admit of the escape of the vaporized moisture constantly rising from the skin,—sufficiently loose, and open, and porous, to permit the heated air around the body's surface to escape. Otherwise oppressive heat would rapidly be accumulated and held around the body, and extreme exudations of fluid extracted from the blood would in consequence equally rapidly take place.

We shall see, when we come to speak of clothing more in detail, how far this principle is observed during the exercise of Rowing, but I mention it here to shew how a knowledge of it has put into a man's hands a means, by which he can rapidly lessen the weight of his body; he has but to accumulate covering upon covering, so that they will not allow the heat generated by exercise to escape from the surface of his body, to cause the copious extraction of the body's fluids; and the body is just as capable of material reduction by such means as if, in Abyssinian fashion of obtaining a beef-steak (where the skin is lifted and the steak is cut from the living animal), a given bulk of flesh were cut from his trunk or limbs.

The great cause of error in these forced perspirations lies in the idea, that perspiration is in whole, or in part, *fat*—that it is actually the accumulation of fat in or on the body which is thus visibly and tangibly melted away. Hence the belief that fat can be reduced by the presence of external heat. Now perspiration and the reduction of fat, although they may be brought about by the same means, have in reality nothing to do with each other. Perspiration contains fat only in an infinitesimal quantity, and this is drawn directly from the blood. The amount of fat deposited in the body can only be lessened by either of two means. First, by exercise; for by muscular exertion circulation is quickened, and respiration is increased, by which a greater quantity of oxygen is inhaled; and whenever this is the case a proportionate amount of carbon is demanded to combine with it for combustive purposes;

and the carbon is found most readily in the fat and analogous substances already deposited in the body—or supplied in food. This already points to the second means of reduction of fat, namely, to withhold it and other heat-producing substances from the food,—thereby causing the absorption of that already within the body,—either by omitting from diet those aliments which contain them in the greatest abundance, or by a general reduction of the amount of food of every kind consumed. For although certain articles contain calorifying substances in much greater degree than others, yet all or nearly all articles of ordinary consumption contain them to some extent, or may be made subservient to that purpose. And thus to take active and energetic exercise, which involves increased consumption of heat-producing substances, and at the same time to withhold or greatly limit the supply of these in food, must directly, under ordinary conditions of bodily health, reduce the fatty deposits.

External heat, therefore, unless accompanied by exercise, active or passive (as the shampooing of the Turkish bath), would rather seem to have the tendency to sustain undiminished the fat already accumulated in the body, because, in proportion to the caloric supplied from without, is the demand for its supply from within diminished; in proportion as heat is supplied by external agencies is the necessity for its production by internal ones lessened —is the store of internal fuel husbanded.

But, it will be answered, the heat produced by heaped-up clothing on the body, during exercise, is not supplied from without, but from within, and that too by the ordinary process of combustion within the organism; its escape into the surrounding air is merely prevented, by the entanglement of the numerous body-coverings. And this answer, so far as it goes, is right; but it does not take in the whole question. The heat, once eliminated from the body, and thus detained around it, in no way differs, as far as its effect upon the body is concerned, from external heat produced by any other means. Let us put the question somewhat differently. Which would be the most effective, to run two miles in flannel encumbrances, in the manner prescribed, or to run a greater distance without them, the sole object being the reduction of the *fat* of the body.

In both these cases the reduction of fat would be commensurate with the amount of heat actually produced within the body, because it is to assist in this process that it would be absorbed;—commensurate therefore with muscular action, which quickened circulation, and increased the expenditure of nervous influence; and commensurate with respiration, regulating the inhalation of oxygen, with which the elements of fat combine. Now which of these two processes—which of these two modes of taking exercise—would make the greatest demands upon the upstored fuel of the body;—the first, which holds the heat around the body, to be absorbed and eliminated, and re-absorbed indefinitely throughout the exercise; or the second, in which it is set free, and carried off by the atmosphere as fast as generated?

If, however, the sweating exercise were taken for the reduction of *weight* only, and this irrespective of reduction of substance, whether solids or fluids, or whether acting favourably or unfavourably upon health and strength, then the former would be unquestionably the better method; for by this means the extraction of the fluids of the body can be accomplished as directly as by the insertion, if the comparison may be used, of a tap or syphon into a barrel; for the perspiratory ducts dip at once into the current of the blood, and their office is to draw from it moisture, and pour it out over the skin, and to this office they are excited and in this office they are sustained by heat, whether internal or external; and therefore the retention by the clothing of the heat generated by the exercise is a most powerful means to this end.

But it is believed that not only can the fat of the body be reduced by forced sweatings, but that the fat on any particular part of the body, or on any limb, can be reduced, specially and separately, and independent of the remainder, by the simple process of encasing it in extra clothing at the time that the exercise is taken; in simple fact, that its fat can be melted down by the heat induced by the exercise, and held with extra security around the particular part by the extra wrappings; just as the fat could be melted from a joint of meat in an oven. And detailed directions as to the number and nature of these garments to be worn for each and every part, to accomplish these local metamorphoses, are given in books accepted as authorities on the subject.

In the first place, admitting for argument, that fat can be reduced on any particular part of the body by elevation of its temperature, yet the temperature of any particular part of the body cannot be raised during exercise beyond the general temperature, merely because it is enveloped in a greater number of wrappings. The wrappings do not make the heat, they only catch and retain what comes out of the body. The heat induced may at such places be more completely prevented from escaping, and there the surface of the body may be warmer, seeing that the atmosphere is prevented from receiving its heat; but as the heat is the product of combustion within the whole organism, regulated by circulation and sustained by the exercise, it will be distributed uniformly, or nearly so, throughout the body; the exceptions being, when it does occur, *not* the parts bearing the extra coverings, but those most immediately engaged in performing the exercise; because there muscular movement is most rapid and energetic, and there destruction of tissue and expenditure of nervous influence are most continuous, and there circulation is most fully augmented and sustained.

And granting further, that greater heat could be created and sustained at the particular part desired, by means of local coverings, and that this heat thus retained could reduce the fat there deposited, by sweating, still it would not follow that the sweating would be greatest in these parts. The sweating would be then, as it always is and ever must be, greatest at those parts of the body's surface where the perspiratory ducts are the most powerful and numerous, be the part clothed or naked, covered with one garment or many.

I am aware that these practices are sparingly used by rowing-men, and are chiefly used in training tactics for other exercises; still they are used occasionally, and the distinction is not always drawn between them and the exercise for which they have been employed,—in fact Rowing gets the blame of the evil, when evil follows.

Men must judge of the necessity for extreme perspirations, each in his own individual case, and to what extent they should be carried. But of one thing they must be sure, that they are handling a most powerful agent for good or evil, and in the reckless and indiscriminate way in which it is now used, I fear the evil immeasurably predominates over the good. And what is the consequence?—Unless the man has a constitution which one could scarcely expect to find in a draught-horse, there is a miserable break-down, and he is said to have "trained off." There is a better phrase for it now becoming current among young men, which is not that a man has trained off, but that "he has fallen to pieces."

I began this treatise by asking the question "What is training?"—for unless we know what we want we are not likely to know it when we get it, or when we miss it;—and the answer appeared to be, "That training means to put the body with extreme and exceptional care under the influence of all the agents which promote its health and strength, in order to enable it to meet extreme and exceptional demands upon its energies." Then what does this "training off" or "falling to pieces" mean, when men are only preparing for the contest and struggle, by putting the body *with extreme care* under the agents which promote its health and strength?

Comment on this point is unnecessary. The agents are misapplied, the extreme care becomes a reckless effort at material reduction, through the extraction of the fluids of the body which are essential to its well-being, and instead of being prepared and strengthened for the effort, it is subjected to an ordeal infinitely more trying than the purpose for which the training has been undertaken.

I do not from this condemn sweating;

on the contrary, when produced by natural means it is the visible sign that the great agent of training, Exercise, is accomplishing its work, and it is the great means of preserving the healthy condition of the skin—a matter of such great importance to health and comfort—and of performing many other important offices. But sweating produced otherwise than by actual muscular exertion should be conducted with extreme care, when the object is the health and strength of the body, and an equivalent for all fluid so extracted should be carefully and liberally returned in its purest and least exciting form.

Nor do I of course say that there are not conditions of body when this change of a portion of its fluids may not be beneficial to the blood, to the tissues, and to the skin itself; and I do not say that there are not some kinds of competitive exercise in which a reduction of the weight of the body, as the burden to be borne, would not be an advantage; but it must be clearly recognised that, under ordinary conditions of health, the price to be paid for a forced reduction of weight by forced transpiration, implies and involves a reduction of mechanical force also, proportionate to the fluid extracted. Reduction of weight by exercise under such circumstances will be scarcely possible; for the perspiration induced, not by heat artificially collected and held about the body's surface, but by the natural process of secretion, consequent on accelerated circulation and rapid muscular action, will be daily restored by the regular processes of nutrition.

It seemed necessary to make this departure from the observation of the agent immediately under consideration (Bathing), because, while the skin is the active medium through which these excretions take place, the bath, especially in its first aspect, assumes a more than ordinary importance in training. It is necessary to health under all conditions of life, but especially so under these circumstances, that the skin should at frequent intervals be cleansed from all transpiratory exudations and from extraneous matters which gather upon its surface, as well as from the wasted particles of its own substance which are regularly accumulating there; for the cuticle or outer skin is composed of layers of cells, filled with fluid from the cutis or inner skin, upon which they are originally formed. Life and death are constantly going on here as in every other part of the body; gradually the inner layers of cells come to the surface, their place being occupied by others constantly being formed, and on reaching the surface the most prominent of them become despoiled of their moisture from evaporation, collapse, flatten, and become disparted from their fellows in the form of dry scales; adhering, unless the skin be regularly cleansed, to its surface by the glandular exudations, to the enfeeblement of the secreting glands (the regular function of which is thus impeded) and the consequent impairing of the healthy condition and purity of the blood itself.

Now simple water has the power of dissolving the saline matter exuded by the perspiratory ducts, but not the oily matter exuded by the oil ducts; for this latter purpose soap is necessary, because certain ingredients in its manufacture have the property of dissolving oily substances. The temperature of the water also greatly affects its cleansing power, for cold water being of a temperature much lower than that of the surface of the body, its contact with it causes the skin and subjacent tissues to shrink, by which the pores or mouths of the ducts are closed, and the lines and declivities in which lie the greater part of its excretions are contracted. A higher temperature has a contrary effect; the skin expands under its influence, allowing the deepest cutaneous deposits to be reached and removed.

In the second aspect of the bath, that of a tonic, its properties are in an inverse ratio to its cleansing power. Here the point desired is what is sought to be avoided in the former aspect, namely, the sudden contraction and shrinking of the skin and subjacent blood-vessels, by which the blood circulating in them is driven inwards upon the internal organs. This is the *rompre pour mieux sauter*, the recoil for an energetic return. The tissues through which the blood is driven are greatly stimulated by this sudden aflux; the action of the heart and lungs becomes more vigorous, back rushes the blood, faster and more forcibly than before, as manifested by the ruddy glow which comes over the body after its sudden immersion. Thus the concussion and reacting effect are not confined to that part of the nervous and circulatory systems which forms the sensory layers of the skin and the fibrous bed upon which it is extended, but are shared directly by the entire body. For the cutis or true skin, of which the cuticle is but the protective covering, is an organ of marvellous delicacy of construction, consisting of a network of nerves and blood-vessels so minutely interwoven, that the point of the finest needle cannot penetrate its meshes without wounding a nerve or severing a minute artery or vein.

In training, these two distinct objects of the bath must be steadily kept in view, and the tonic or the cleansing bath taken as required. It is not unusual to hear men say that they prefer cold water to warm, or *vice versa.* They forget that they are for different purposes; as well may they say they prefer stockings to boots, or coats to waistcoats. They serve different purposes, although both are necessary to the well-being and comfort of the body.

In addition to the daily morning plunge, I would recommend a tepid bath of about 80 degrees, with free use of soap, to extend over a few minutes only, once in every four or six days, according to the amount of exertion which the frame may be undergoing at the time; and, under ordinary circumstances, I would recommend the dry rub or tepid sponging after exercise, during the day or in the evening. All *dabbling* in cold water after strong or protracted exercise, when the energies of the body are reduced and the temperature of its surface cooling down, should be avoided.

The best time for the cold bath is undoubtedly immediately after getting out of bed, when the whole surface of the body is glowing from its warm coverings; if taken later, or during the day, it should be as soon after the exercise as possible, while the blood is rapidly circulating near the surface of the body and therefore the re-actionary capacity is at its greatest. It is a mistake to think that the body should be allowed to "cool down" before the bath, this would be to court a chill. It is less dangerous, but equally fallacious, to think it necessary to dry the body first, to "close the pores" as has been recommended. Nothing can close the pores but one thing, *the shrinking of the skin,* and to do this before the cold bath is to defeat the purpose for which the bath is taken: to do it before the warm or tepid bath, supposing it could be accomplished by the means recommended, which it could not be by any possibility, would serve no purpose good or bad.

In training the best time for the warm bath is either some little time before dinner, or before supper, a preference being given to the latter when choice is allowed. Under no circumstances should the bath, warm or cold, be taken until some hours after a meal, for reasons similar to those given for the same observance with respect to exercise, *i.e.* from its effect upon respiration and circulation, acting on digestion.

The evaporation of heat and moisture from the body's surface is impeded, not only by the number of garments worn, but by their shape and size, and the closeness of their texture, and the nature of the material of which they are made. Thus linen is more obstructive to the evaporation of moisture than cotton, and cotton more so than flannel, silk holding an intermediate place between linen and cotton.

Now all these points have been well observed by rowing-men in their racing costumes. Two light loose garments, constituting a single covering to the body, are all that is worn. A jersey of spun cotton, a few ounces in weight, and as open as network, leaving the neck and arms bare, with loose white flannel trousers; these with a light, low-crowned, narrow-brimmed straw hat for head-gear. Nothing could possibly be better contrived than the dress of the rower.

There yet remains one point which must not be passed over without notice. It is customary for men to physic themselves, the whole boat's crew all round, before "going into training." On what rational plan is this done? All medicines, it must be understood, are virtually poisons, *i.e.* calculated to produce a given change in the normal action of some function or functions of the individual; it is the quantity taken and its fitness, which gives them the properties and the name of medicine. On what plea then of fitness or of requirement do all the crew take the same quantity of the same drugs? and what are the advantages which they suppose will accrue from this wholesale purging? The usual answer to this question is that it is "to remove the crudities of the stomach and bowels and have a clear point to start from." What the obnoxious crudities may be, and how they come to get lodged in every stomach from bow to stroke, and how it is necessary to disturb the action of the nutritive organs, when their action is sound and good, by medicines whose virtue lies in producing this abnormal result, or what the "clear point" may be, if not an empty stomach, and scoured intestines, I have never yet been able to make out.

For Rowing, the medicine usually consists of a simple purgative, but for feats of pedestrianism, stronger measures and medicines are applied; "salts and senna in the morning and antibilious pills at night, to clear the stomach and bowels and tissues of all extraneous matter." But even this is mild to what is thought necessary for Boxing. And although training for that accomplishment does not properly come within the intentional scope of these pages, and although the practices to which I shall allude are already greatly modified, still it may be useful to see what has been thought necessary to the acquisition of bodily power in an exercise, where such power was so emphatically required.

"If the person trained, after the second week exhibits signs of irritability, he must be bled and purged well and take a dose of powerful cathartic. Vomiting may be used when the stomach is foul, to get rid of the crudities not cleared by the purging. This radical cleansing is absolutely indispensable to bring the organs of digestion to a healthy state of action." Surely this will allay the irritability of the British boxer, and surely his crudities will all be removed by this "radical cleansing." But no. In addition to this he is to swallow "one grain of tartar emetic with twenty grains of ipecacuanha, worked off with camomile tea." And if this be insufficient he is to have, as a simple opening medicine, "blue pill worked off with senna tea." How any human body could stand this purging, vomiting, and bleeding, with pills antibilious and blue, with salts, senna, and camomile, with forced sweatings and restricted liquid and semi-raw flesh, stale bread and few vegetables, is to me incomprehensible; no wonder surely that such prescriptions should be followed by directions as to the manner of keeping up the spirits of the *patient*, and how to manage him if he "trains off" or "falls to pieces."

And yet I shall be met with the remark—and legitimately so, because it is marvellous—"See what things men so trained have accomplished!" The truth is, that men who *were* able to stand this were able to stand anything; moreover it is mild, I believe, to what the "old system" of training entailed, and yet "see what things men so trained accomplished." In modern tactics it was principally at the beginning of the training campaign that this "treatment" was applied, whereas in the old system it was prolonged less or more unto the end—surely without metaphor, "unto the bitter end."

I would advise men, in training or out of training, to leave all drugs alone; if unwell, let them go to the doctor in whom they have faith, and take what he recommends, and take nothing which he does not. There is no "crudity" either in bowel or brain so dangerous as this notion of amateur physicking.

In the foregoing pages, when speaking distinctly of Rowing, I have been expressing my opinion, as to the best mode of adopting the use of the ordinary agents of health, with reference to training for the College Eight-oar Races in the summer weather, but I would modify some of my recommendations when the training is for the winter races. The requirements of the body in summer and winter are not identical. In winter, diet should be more generous, with a larger share of the third group of aliments, for the heat-producing articles are more in request, and the metamorphoses taking place in the tissues are favoured by a full supply of such food. A smaller share of vegetables will be required, and a smaller amount of liquid, for a much smaller amount of moisture will be eliminated from the body, and much less thirst probably experienced, During the day, and after exercise, all bathing should be relinquished, and the dry rub take its place. There is nothing so injurious, during so much respiratory effort as rowing entails, as a *chill*, and nothing so likely to give it as partial bathing and protracted washing while the body is cooling down after exercise. The thin open jersey, so suitable to the summer, should now give place to the loose flannel shirt, not only for comfort, but when viewed as an aid to efficiency, present and prospective. Cold acts with a numbing and deadening effect, not only on the nerves of sensation but on those of motion also; under its influence muscular contraction is less rapid, the mobility of the joints less free, and the skin is less elastic. Therefore, however much men may despise comfort and look only at efficiency, let them not retain in the middle of winter the costume selected for its fitness for the middle of summer[e].

But I think, and many will agree with me, that the time is coming when all winter racing will be viewed as a mistake, without any advantage to the rowers which could not be otherwise obtained, without interest or pleasure to the spectators (if any), often interrupted, and sometimes prematurely ended by floods and the severity of the weather. To strip in a frosty wind, or storm of rain or hail, is to diminish by much the aptitude of the body for this special mode of exertion, by reducing its elasticity and suppleness.

It is, I am aware, difficult to say when these races ought to take place—the time when this militia to the regular army of oarsmen is to be drilled and taught its duty;

[e] I cannot do better than give the reply of Capt. Burton, at home preparing for an exploration into Central Africa, when I asked him what *training* he adopted to prepare his body for the hardships he was about to undergo. His answer was significant: "The best training for work in Africa is, I find, to take the best care of myself that I can while at home."

but doubtless they who manage all aquatic matters with so much judgment could grapple with this also. I only give my opinion as to its effects upon the crews, for to the above objections I attribute many a break-down which I have seen in men of late years. It is forgotten too that these men who are thus exposed are, as a rule, the youngest on the river[f], the least qualified to stand the exposure. They are too inexperienced, too impressionable, to be the *enfants perdus* of the aquatic strife.

To these observations I would add that too much care cannot be taken in selecting men for the work, and in "coaching" them when selected. Rowing at speed with young hands should be long delayed and very gradually approached. I am not speaking of the advantages of such measures to them as oarsmen, although these will undoubtedly be great, but as to the effect which such gradual initiation into

[f] This will, I am aware, scarcely apply to this year's races, in which many senior men rowed ; one boat, it was said, numbering five Bachelors. But surely this is from the purpose of these races, which were instituted for the rearing of oarsmen for the College Eights.

an art, which makes such great demands upon the energies of the most susceptible organs of the body, will have upon present and future health and strength.

The training practice should also be made to extend over a longer period than at present,—three weeks of preparation for a series of races extending over half that period; indeed the nature of this preparation and its duration so closely resemble the actual racing which it precedes, that I have found some difficulty in separating them when wishing to speak of them distinctively.

Men should not be selected by skill alone, nor from willingness alone, for the spirit of a man to enter upon such efforts is often in an inverse ratio to his power to pursue them; but also by their general bodily power and state of development[g].

[g] I missed a man from the Gymnasium a term or two ago, whose exercise I had thought it necessary to regulate with unusual care. On enquiry into the cause of his absence I found him rowing in his College Eight! A man of his measurements was just as fit to walk a thousand miles in a thousand hours as to row a course of College races. His measurements were—(Age 19) height 5ft. 9ins.; weight 9st. 3lbs.; chest 32ins.; arm $9\frac{1}{4}$ ins. and $9\frac{3}{4}$ ins.

No man of ordinary stature and fair growth should be allowed to put hand upon an oar in a racing boat until his chest has the minimum girth of 36 inches ; less will not give him space adequate to the full and fair action of the vital organs within, in the work upon which he would engage; less, no man of ordinary stature and fair growth need pass his eighteenth year without possessing[h].

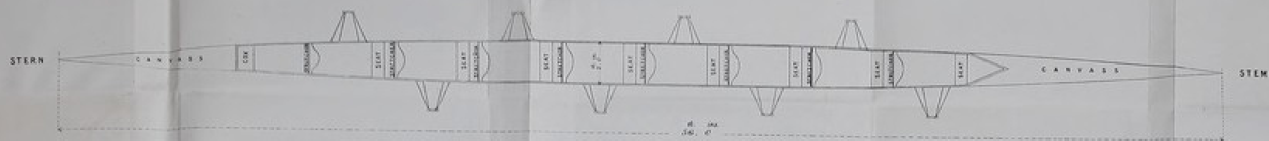
There are other points which must be left to the candour and good sense of men themselves; such as never to row while suffering from severe cold or any inflammatory affection of the chest or throat, and instantly to withdraw from the crew on the slightest indication of any irregularity in the heart's action. It is every man's duty to be candid on these points, not only for his own sake but for the interests of Rowing.

[h] See Appendix H.

APPENDIX.

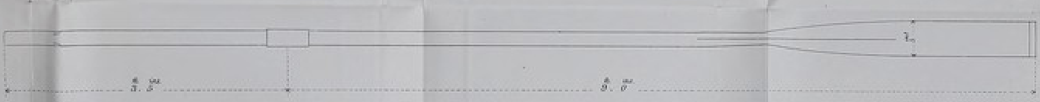
A.

EIGHT-OARED OXFORD RACING BOAT.

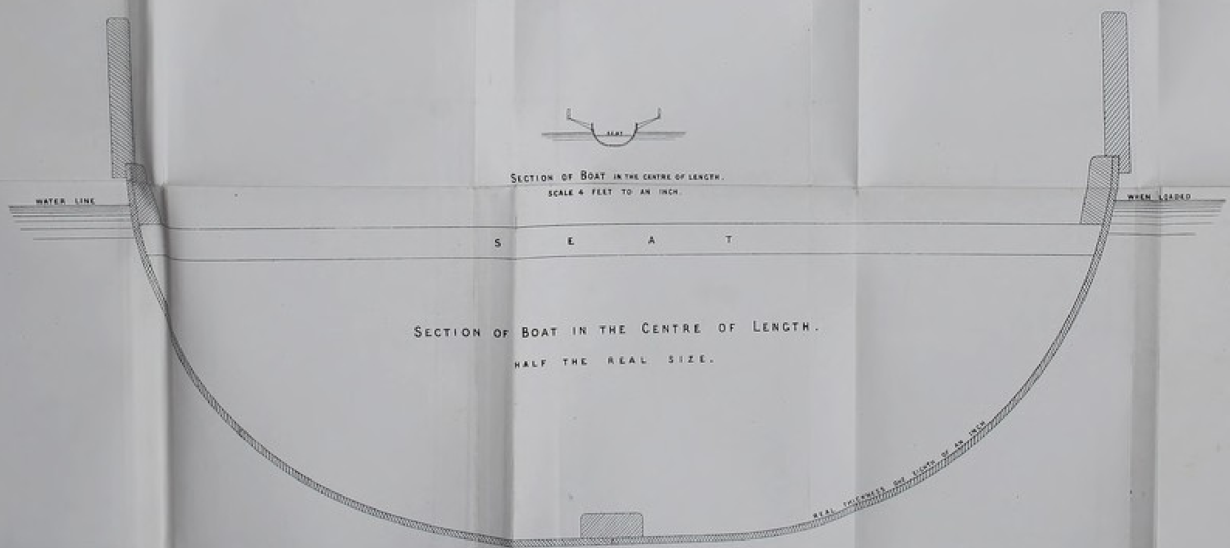


PLAN OF BOAT LOOKING DOWN — SCALE 4 FEET TO AN INCH.

SIDE ELEVATION OF BOAT — SCALE 4 FEET TO AN INCH.



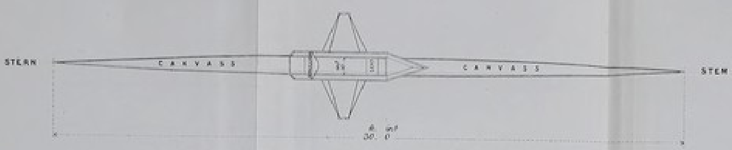
OAR — SCALE 1" FOOT TO AN INCH.



SECTION OF BOAT IN THE CENTRE OF LENGTH.
HALF THE REAL SIZE.

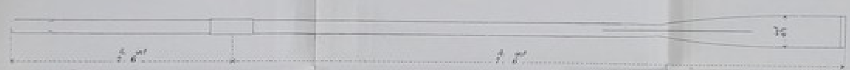
B.

OXFORD SCULLING BOAT.



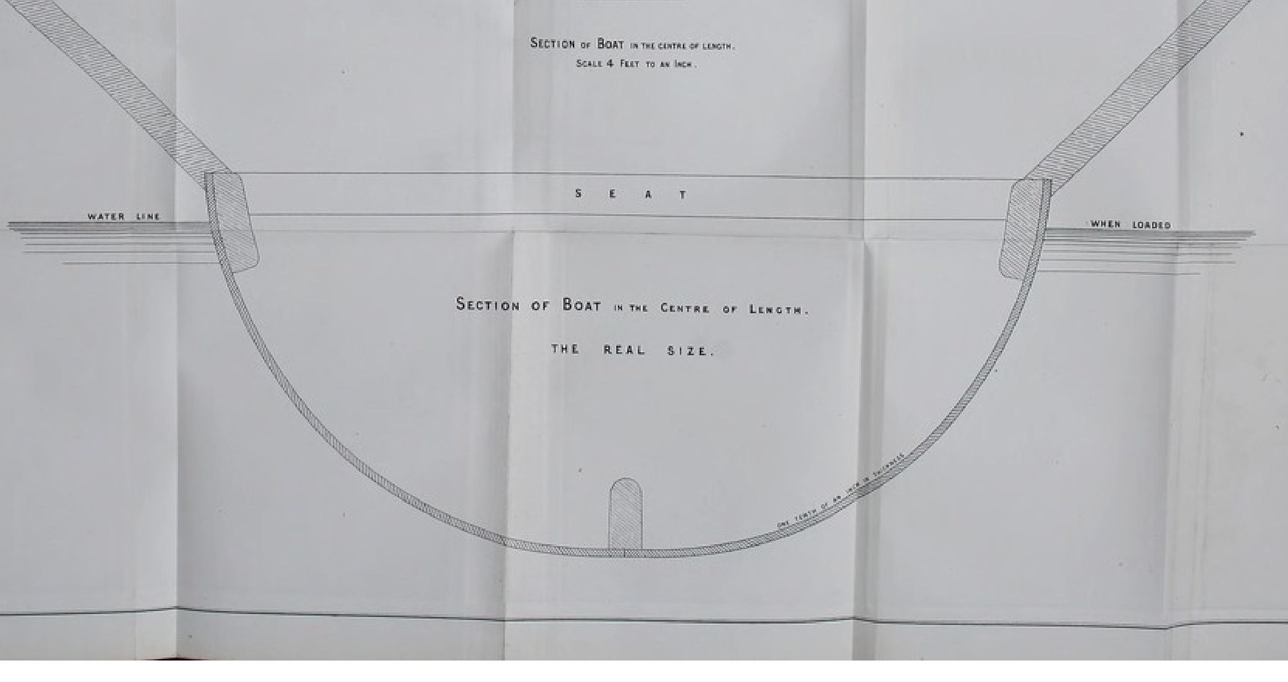
PLAN OF BOAT LOOKING DOWN __ SCALE 4 FEET TO AN INCH.

SIDE ELEVATION OF BOAT __ SCALE 4 FEET TO AN INCH.



SCULL __ SCALE 1 FOOT TO AN INCH.

SECTION OF BOAT IN THE CENTRE OF LENGTH.
SCALE 4 FEET TO AN INCH.



SECTION OF BOAT IN THE CENTRE OF LENGTH.

THE REAL SIZE.

APPENDIX C.

TABLE shewing the Breadth, Length, Weight, &c., of Racing-boats.

Description of Boat.	Breadth, extreme at top of gunwale. In Inches.	Length, not including Rudder. In Feet.	Weight, &c.
Eight-oared Racing-Cutter, outrigged, covered in fore and aft with canvas, built of cedar.	24 to 26	56	To carry an 11 st. 4 lbs. crew complete, with rudder, cushions, &c., 283 lbs. Oars additional 68 ,,
Eight-oared Gig, outrigged, built in streaks.	26 to 28 [a]	56	(Not known.)
Four-oared Racing-Boat (light), outrigged, cedar-built, canvassed.	20 to 20½ (st. lbs. 10 7 crew | st. lbs. 11 4 crew)	42	Boat and Fittings, 165½ lbs. Oars, 34 ,,
Two-oared Racing-Boat (light), outrigged, cedar-built, canvassed.	16 to 18	34	Boat and Fittings, 75 lbs. Oars, 17 ,,
Sculling Racing-Boat [b] (light), cedar-built, canvassed.	10 to 13	30 to 31	Boat and Fittings, from 35 to 40 lbs. Sculls about 12 ,,
Pair-oared Gig, outrigged, built in streaks.	28	26	(Not known.)
Pair-oared Gig, inrigged, built in streaks.	40	20 to 22	Boat (oak) 223 lbs. Oars, 17 ,,
Whiff [c], built in streaks.	25	20	Boat (deal) 85 ,, Sculls, 12 ,,
Punt, medium size.	38	22	Boat (oak and deal) when new probably about 350 lbs.
Punt, racing merely.	18	25	(Not known.)

[a] Regulation minimum of width for Torpid Races.

[b] The dimensions of the boat used by the winner of the Diamond Sculls (1866) and of the Wingfield Sculls (1866) are as follows:—

Extreme length ..	33 feet.	Weight, including Sculls, &c...	36 lbs.
Extreme width ..	10½ ins.	Thickness of plank	⅛ in.

[c] Intermediate between the old Wh]erry, or Funny, and Sk[iff;—hence its name.

Remarks on preceding Table.

The boats weighed were fair specimens of the class; none of them quite new. A boat, though always taken out of the water and housed after use, will nevertheless, after a little time, gain appreciably in weight. A 35 lb. sculling-boat would probably gain something like 3 or 4 lbs. after about a month's use.

Sculling-boats have been built rather lighter than the weight here given, but have not proved stiff enough to allow of a long steady stroke. They jump instead of progressing continuously. The same remark applies to the other racing-boats; want of stiffness causes a boat to lose its form, and is far more detrimental to speed than a moderate increase of weight would be.

The weight (exclusive of his own) which each man has to carry (including a coxswain in the eight, four, and pair oar gig—say 112 lbs.) will be approximately as follows :—

Racing Eight..	58 lbs.	per man.
Racing Four	78 „	„
Racing Pair	46 „	„
Sculling-boat ..	46 to 48 „	„
Pair-oared Gig	176 „	„

T. H. T. H.

APPENDIX D.

TABLE SHEWING RATES OF SPEED OF RACING-BOATS.

[a] Average best speeds over the Henley course taken on the times of the years 1853, 1854, 1859, 1860, 1862, 1864, 1865 (these being the only years in which the times of *all* the boats required have been recorded), are as follows :—

	min. sec.		min. sec.
Eight-oar	7 50½	about 1 mile in	5 50
Four-oar	8 47½	" 1 mile in	6 30
Pair-oar	9 45	" 1 mile in	7 10
Sculling-boat	10 11½	" 1 mile in	7 25

Average best speeds over the same course, calculated on *all* the years, when the times have been recorded, between 1851 and 1865, are as follows :—

	min. sec.	average of
Eight-oar	7 47¾	11 years.
Four-oar	8 33	11 "
Pair-oar	9 42	8 "
Sculling-boat	10 3½	10 "

The difference, it will be seen, is in favour of speed; the fast years of 1863 and 1865 being brought in, and the slow year of 1860 being more diluted.

[a] The fastest time of each description of boat in each year is the basis of the calculation.

The highest recorded speeds ever attained over the same course, are :—

Boat.	Club or Crew.	Average Weight of Crew exclusive of Coxswain.	Year.	Time.	Remarks.
Eight-oar	Kingston .	st. lbs. 11 $5\frac{3}{4}$	1865	min. sec. 7 21	Beat the London Crew after a very fine race.
Four-oar	3rd Trinity, Cambridge	11 $12\frac{1}{2}$	1865	8 8	Beat London by three-quarters of a length. Both crews "fearfully distressed."–*Bell's Life.*
Pair-oar	Warre and Arkell .	11 13	1859	9 0	The steering in this race was magnificent.
Sculling	Michell . .	—	1865	9 5	Beat Lawes and Woodgate.

The Henley course is 1 mile 2 furlongs 20 poles long, and is the fairest course for comparisons of speed ; there being but little stream, and the races being rowed always *up* stream. It is moreover the only course in which first-class racing-boats of all kinds have been contending for any number of years, on the same day, and consequently generally under the same conditions.

The speed on the Putney course is, of course, greatly influenced by the state of the tide. If University crews, picked and trained with the same care as for the Putney race, had appeared oftener at Henley, it may be fairly assumed that the average speed of Eights would have been higher. The highest speed (till last year) was attained by University *College* Boat in 1863, viz. 7 minutes 24 seconds.

T. H. T. H.

APPENDIX E.

CALCULATIONS TO DEMONSTRATE THE FORCE EMPLOYED IN THE PROPULSION OF AN EIGHT-OAR BOAT IN RACING TRIM AND AT RACING SPEED.

[I am indebted to the Reverend Professor Haughton of the University of Dublin, well known for his valuable works on muscular action, for the following important calculation.]

Investigation of the Work done by the Crew of an Eight-oar, at the rate of one knot in seven minutes [a].

The resistance offered by the water to the motion of the boat is divisible into the following parts, due respectively to—

1. The distortion of the particles of water.
2. The introduction of currents.
3. The production of waves.
4. The production of frictional eddies.

In the case under consideration, the first three causes of resistance may be neglected, in consequence of the "fair" form of the boat and of the limited speed at which she is driven; and the whole resistance may be regarded as due to the production of frictional eddies.

[a] Length of boat, 56 ft.
Greatest width, 2 ft.
Greatest depth, 12½ ins.
Weight, including oars and other gear, 350 lbs.
Thickness of plank, $\frac{1}{8}$ in.
Length of course, 1 mile.
Mile to be rowed in 7 minutes.
Extreme distance which oar traverses, 8 ft.
Oar in the boat, 3 ft. 5 ins.
,, out of the boat, 9 ft.
Average weight of crew, 11 st. 4 lbs.
Weight of coxswain, 8 st.

In discussing the amount of resistance due to this cause, I shall adopt the principles laid down by Professor Rankine in his Treatise on Ship-building (fol. Mackenzie, London, 1866), pages 78 *et seq.*, from which it appears that,

$$\text{The eddy resistance} = fw\,\frac{c^2}{2g}\,\sqrt{q^3}\,ds\,;\ (1).$$

where ds denotes the element of the boat's skin;

- q, the ratio which the velocity of gliding of the water over that portion bears to the speed of the boat;
- c, the speed of the boat;
- g, gravity;
- w, the specific gravity of the water, or weight of one cube foot;
- f, the co-efficient of friction ($= 0{\cdot}0036$).

In this equation $\sqrt{q^3}\,ds$ is the *augmented surface* of the boat's skin, and is supposed to sum up together the skin resistance, and that due to the excess of water in front, and to the deficiency of water behind.

From the value of the co-efficient of friction employed (which is deduced from Professor Weisbach's experiments on the flow of water in iron pipes), it follows from the preceding equation that *at ten knots, the eddy resistance is one pound avoirdupois per square foot of augmented surface; and varies for other speeds as the square of the speed.*

The whole difficulty of the calculation of the eddy resistance turns upon the calculation of the *augmented surface,* which is effected by Professor Rankine on the assumption (conformable to repeated experiments) that the augmented surface, and its resistance, is the same as that of a trochoidal ribbon, whose length is the length of the boat on the plane of floatation, whose breadth is the *mean immersed girth* of the boat, and whose co-efficient of augmented surface is

$$1+4 \sin^3 w+\sin^4 w,$$

where w is the angle of greatest obliquity to the horizon formed by a tangent to the trochoid.

Applying the foregoing principles to the sections of the Oxford Eight-oar when loaded with its crew, I have found the following results :—

1. Length of the plane of floatation = 52 ft.
2. Girth of central immersed section = 31 ft. 5 ins.
   Mean immersed girth = 21 ins. = 1·75 ft.
3. Sine of obliquity . . . . . . = $\frac{1}{4}$ „

Hence the co-efficient of augmentation is

$$1+4\left(\tfrac{1}{4}\right)^2+\left(\tfrac{1}{4}\right)^4=1{\cdot}254,$$

and the augmented surface

$$=52\times 1{\cdot}75\times 1{\cdot}254=114{\cdot}11 \text{ sq. feet.}$$

The speed of the boat is assumed to be one *knot* in seven minutes, or $\frac{60}{7}$ knots per hour; hence by the rule already laid down, the resistance per square foot of augmented surface is

$$\left(\frac{60}{7}\right)^2\times\frac{1}{100}=\frac{36}{49} \text{ lb. av.,}$$

and finally the total resistance is

$$114{\cdot}11\times\frac{36}{49}=83{\cdot}84 \text{ lbs.}$$

Exactly speaking, this result should be 81·36 lbs., as the eddy resistance taken above as 1 lb. is really only $\frac{625}{644}$ lb.

This calculation, reduced from the speed of one *knot*

(2000 yards) in seven minutes, to the racing speed of one *mile* (1760 yards) in seven minutes, gives

$$81{\cdot}36 \times \left(\frac{1760}{2000}\right)^2 = 63{\cdot}00.^{b}$$

This resistance is overcome through the space of one mile (5280 ft.) in seven minutes; and therefore
The total work done

$$= \frac{63{\cdot}00 \times 5280}{2240} = 148{\cdot}50 \text{ tons lifted a foot.}$$

The work done per man is 18·56 foot-tons in seven minutes, and 2·65 foot-tons each minute.

Professor Haughton also gives the following rule (which is exact):—

"The work done per minute by a boat's crew varies as the *cube* of the velocity. Thus a double speed requires an *eightfold* work per minute."

The rule is thus proved:—

The work done varies as resistance, multiplied by space described.

Resistance varies as square of velocity.

Space described (in a given time) varies as velocity.

Therefore

Work done (in given time) varies as *cube* of velocity.

It may be useful to some readers to explain what is meant in Professor Haughton's calculation, by so many "tons lifted a foot" (called foot-tons). This is the usual method adopted in this country for estimating the amount, and comparing the various forms, of labour. The process

[b] The practical experiment by dynamometer, calculated up to this speed, gives 63·00 lbs. also. See Appendix F.

is shewn clearly by Dr. Parkes in the work already alluded to (*Practical Hygiene*), by the case of a workman in a Copper-rolling Mill, who was said occasionally to raise a weight weighing 90 lbs. to a height of 18 inches, 12,000 times a-day; that is $90 \times 12{,}000 = 1{,}080{,}000$ lbs. $= 482$ tons lifted 18 inches $= 723$ tons lifted only 1 foot[c].

The work done per man in rowing one mile at racing speed is, by the foregoing investigation ..	18·56 foot-tons.
The work done by one of the crew weighing 158 lbs. (11 st. 4 lbs.) in racing costume, walking one mile, would be	18·62 „ „[d]

Now it is stated by Dr. Parkes (page 331) "that looking at all these results (of the various calculations given of work done in different modes of labour), we may perhaps say, as an approximative, that every healthy man ought, if possible, to take a daily amount of exercise, in some way which shall not be less than 150 tons lifted a foot, equivalent to a walk of about nine miles."

[c] It will be seen that the work actually done would be the same whether the weight be lifted in pounds or in hundredweights, or, if it were possible, all at once.

[d] The formula for calculating this is—

$$\frac{(W + W') \times D}{20 \times 2240};$$

where W is the weight of the person; W′, the weight carried; D, the distance walked; 20, the co-efficient of traction; and 2240, the number of pounds in a ton. The result is the number of tons raised one foot. From *Practical Hygiene.*

APPENDIX F.

PRACTICAL TEST TO ASCERTAIN THE ACTUAL FORCE EMPLOYED IN THE PROPULSION OF AN EIGHT-OAR BOAT IN RACING TRIM AND AT RACING SPEED.

[I am indebted to the Rev. T. H. T. Hopkins, M.A., Magdalen College, Oxford, for the following results of an experiment made by him with the dynamometer. These results, it will be observed, correspond exactly with those arrived at in the preceding investigation made by Professor Haughton.]

An Eight-oared Racing-boat, weighted with sand-bags to represent an 11 st. 4 lbs. crew (the weight for which she was built), and steered by an 8 st. coxswain, was towed over part of the Oxford course, where the water is straight, broad, and deep. The Four-oared Boat by which she was towed was itself towed by men on the bank, and kept in a straight course by a coxswain. The Eight-oar was kept as nearly as possible in a line with the Four-oar by the coxswain placed on board for that purpose.

The tow-line from the Four to the Eight-oar was fastened to the bow-oar's thwart in the Eight exactly in a line with the keel, and the strain measured by a dynamometer (a Salter's spring-balance), interposed between the end of the tow-line and the Four-oar.

The distance traversed was ..	560 yards.
Time occupied	6 min. 20 sec.
Average strain on dynamometer	7 lbs.

There was a light side-wind, but not enough to ruffle the water, or seriously interfere with the experiment.

The strain was measured when the keels of the two boats were as nearly as possible in the same straight line.

The course was against the stream, which is very slight.

The facts are, I think, reliable for the speed at which the experiment was made.

The rate at which the boat travelled would be according to the above data, one mile in 19 min. 20 sec. We may call this three miles per hour.

If a constant force of 7 lbs. propels a boat at the rate of three miles per hour, what force would be required to propel it over the same course at the rate of nine miles per hour, which is about the pace of a good Eight over this course?

If we assume the formula "that resistance (or, in other words, the force required) varies as the square of the velocity," then it will follow that a force of 63 lbs. is required to propel a boat at the rate of nine miles per hour (about one mile in seven minutes).

This formula, however, though true within limits, is probably only approximately so at high speeds. Whether the difference between three and nine miles per hour would seriously interfere with it, it is impossible to say without actual experiment.

It must be remembered also that the whole of the force measured in the above experiment was available force; whereas, even in theoretically perfect rowing, there is only one moment, viz. when the oar is at right angles to the keel of the boat, that the force expended by the rower is all used in directly propelling the boat. Neither the beginning nor end of the stroke produce anything like the same effect, though they equally tax the strength of the rower.

If then we really wish to know the force exerted by the rower, we must ascertain how much force is unavoidably wasted in other directions, besides the actual direction required; how much is wasted in friction of oar in row-lock, &c.; how much in lifting his body from the inclined to the perpendicular position, &c.; and all this supposes the rower, boat, &c., to be theoretically perfect. If, however, we consider that no boat ever is so; that coxswains will deviate from the right course, more or less; that boats will roll from time to time; that bodies will catch the wind; that corners have to be turned and waves rowed through,—we shall have to add a very large per-centage to the force required as theoretically estimated.

T. H. T. H.

APPENDIX G.

A SYSTEM OF MEASUREMENTS TO DETERMINE THE RATE OF GROWTH AND DEVELOPMENT.

Height (*without boots*). The position of *Attention.* The heels together, the knees braced back, the chin raised, the head held steady, the shoulders square to the front; the heels, hips, shoulders, and head touching the pillar of the standard. The height to the eighth of an inch to be reckoned.

N.B. This measurement, when repeated, should always be taken at the same time of the day, and after the same amount of bodily exertion.

Weight (*in working costume,* i.e. *in light shoes, flannel trowsers, flannel shirt or jersey*). The weight to a quarter of a pound to be reckoned.

N.B. This measurement, like the preceding, when repeated, should always be taken at the same time of day, and with reference to any circumstance which would affect its accuracy.

Chest (*over the jersey or naked breast—skin measurement*). The position of *Attention*, but with the arms horizontally extended, the palms of the hands held upwards and open, the fingers straight. The tape should be passed around the chest in the line of the nipple, and the girth to the quarter of an inch to be reckoned.

N.B. Care must be taken that the chest is not inflated beyond its due expansion during ordinary breathing. Where a single measurement is taken the above line is the best as gauging approximately at once the muscular and respiratory capacity; but when the latter quality is of primary importance (as in rowing), a second measurement should be taken lower down the chest, the tape being passed, in front, over the ninth rib. A third measurement, to test the elasticity and mobility of the chest, as shewn by the extent of its expansion on the fullest inspiration beyond the point of the preceding measurements, may be taken on either of the above lines To take these measurements with perfect accuracy is always difficult, as the mere act of attention and state of consciousness or expectation of the person being measured, will affect the breathing and therefore the actual girth of chest at the time. For this reason it is always desirable whenever it can be done, or when any doubt as to the accuracy of the measurements exists, to draw the attention by question or remark to some other subject than that of the work on hand.

Fore-Arm. (*All measurements of the upper and lower limbs to be skin measurements.*) The arm extended as in the preceding measurement, but with the hand tightly closed. The tape to be passed around the thickest part of the arm, and its girth at that point reckoned.

N.B. With men who have taken little exercise this line will always be found near the elbow joint, but as the limb becomes developed, and the numerous muscles of the fore-arm acquire bulk and power from exercise, the greatest girth will be found from two to three inches below it: unless this circumstance be kept in view the actual increase will not be perceived.

Upper-Arm. The hand closed as in preceding measurement, but with the arm bent at the elbow, and the hand brought down towards the shoulder; this should be slowly and gradually done, the contractions beginning with the muscles of the palm, bending the joints of the fingers, the clenching of the fist, and bringing the fore-arm down upon the upper-arm. The tape to be passed in a straight line around the thickest part of the arm; this will always be found over the ridge of the very prominent muscle on the upper surface (the biceps). It is by the contractions of this muscle chiefly that the arm is bent in the position of the measurement, and with its antagonistic muscle on the obverse side of the arm (the triceps), by which it is again extended, forms the bulk of the upper arm[a]. The tape measurement, therefore, at this point, *cæteris paribus*, is an accurate gauge of its power.

N.B. When the whole arm is fully developed, the difference in size in an adult of medium stature will be about two inches between the fore and upper arm, and it will almost invariably be found that when the upper-arm is feeble, the upper region of the chest will be feeble also. With a chest of forty inches the arm would probably be twelve inches and fourteen inches.

Certain measurements of the lower limbs should also be taken and recorded when it is desired to ascertain their present condition or rate of development; the measurements which will shew these most accurately, and at the same time most directly correspond with those of the upper limbs, are the following :—

Calf. The limb to be held stiff and straight, the heel raised from the ground, the toes pressed strongly down and the knee braced back. The tape to be passed around the thickest part of the calf, and as the position of this line will somewhat vary with different men, and with the same limb in difference stages of development, one or two points should be tried, and that which shews the greatest girth selected.

Thigh. The limb placed as in preceding measurement. The tape to be passed in a horizontal line around the thickest part of the limb, which will be at the highest point of the thigh admitting of horizontal measurement.

A. M.

[a] See Appendix I.

APPENDIX H.

TABLE

Shewing the state of growth and development of men on arriving at this University; the averages being those of the first 100 names on the book of the Gymnasium, all 19 years of age or under.

Height	5 ft. $8\frac{1}{4}$ ins.	(68·257 ins.)
Weight	9 st. 7 lbs.	(132·970 lbs.)
Chest	33 ins.	(32·953 ins.)
Fore-arm	10 ins.	(9·792 ins.)
Upper-arm	$10\frac{3}{4}$ ins.	(10·702 ins.)

The greatest developments being :—

Height	6 ft. 6 ins. [a]
Weight	12 st. 2 lbs.
Chest	39 ins.
Fore-arm	$11\frac{3}{4}$ ins.
Upper-arm	$12\frac{3}{4}$ ins.

The smallest developments being :—

Height	5 ft. 2 ins.
Weight	7 st. 0 lbs.
Chest	$27\frac{1}{4}$ ins.
Fore-arm	$8\frac{1}{2}$ ins.
Upper-arm	$8\frac{3}{4}$ ins.

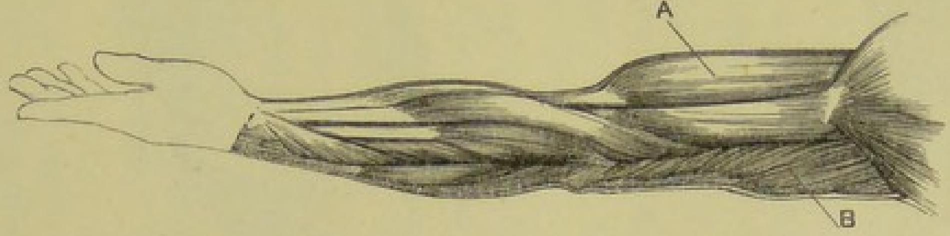
A. M.

[a] The chest in this case was only 36 inches—the age, 18.

APPENDIX I.

MUSCULAR ACTION.

Diagrams shewing the appearance of Muscles when *relaxed* and *contracted*.

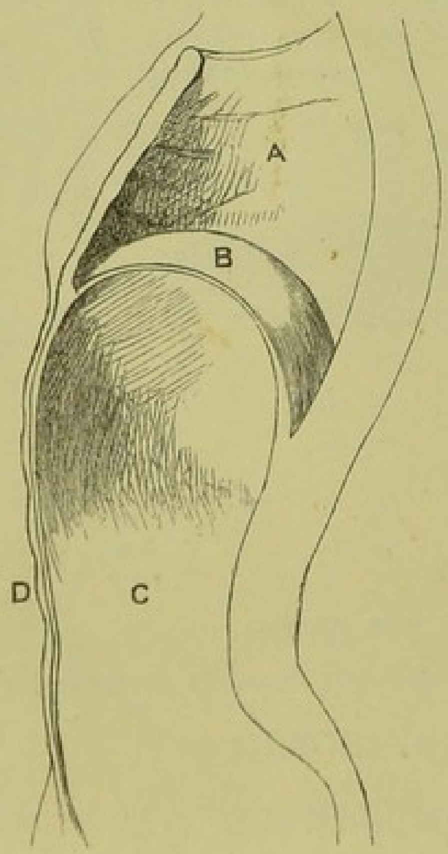


A. Biceps—relaxed.
B. Triceps—contracted (extending the fore-arm).

A. Biceps—contracted (flexing the fore-arm).
B. Triceps—relaxed.

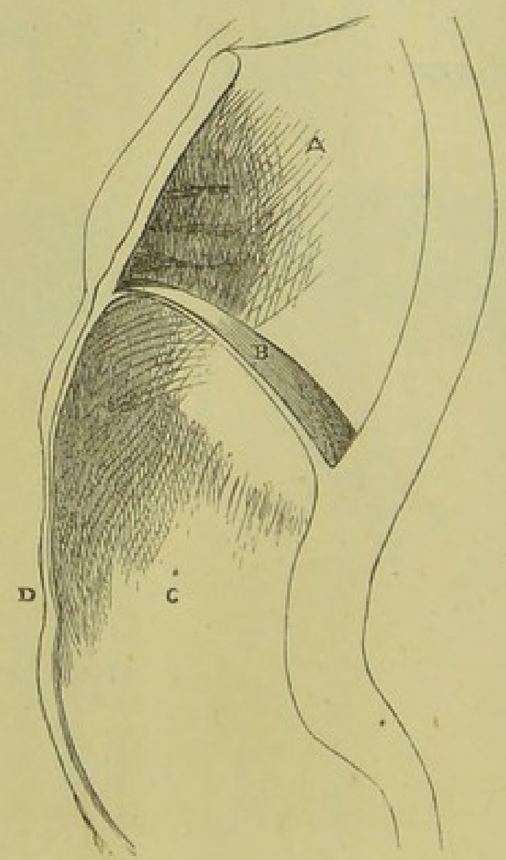
RESPIRATORY ACTION.

Diagrams shewing the position of the Diaphragm, the relative expansion of the Chest, and the distension of the Abdomen, on *Expiration* and *Inspiration*.



EXPIRATION.

A. Chest or Upper Cavity—depressed.
B. Diaphragm—elevated.
C. Abdomen or Lower Cavity—flattened.
D. Muscles of Abdomen—contracted.



INSPIRATION.

A. Chest or Upper Cavity—expanded.
B. Diaphragm—depressed.
C. Abdomen or Lower Cavity—distended.
D. Muscles of Abdomen—relaxed.

APPENDIX K.

DIGESTION OF FOOD.

Although the term Digestion is sometimes used to mean all the different processes attending the conversion of food into blood, yet the sense in which it is more usually employed is limited to the process which actually takes place within the stomach; and all observations of the complicated process of blood-making, in the living human body, after the food has passed from the mouth, have been limited to this stage. I say observations, for from an accident which happened to an American youth, (a gun-shot wound, in which a portion of the side and with it a portion of the walls of the stomach were torn away) actual observations have been made. An aperture, measuring $2\frac{1}{2}$ inches in circumference, remained unclosed after the wound in other respects had become completely healed, and through this aperture the attendant physician was enabled to watch from day to day over a series of several years the process of digestion of almost every article used as human food.

These observations were published in a collected form[a], with tables shewing the time which each separate article of food experimented on required for chymification; and it is from these tables and observations that almost all our actual knowledge of the subject is drawn. The following

[a] *Experiments and Observations on the Gastric Juice and the Physiology of Digestion.* By W. BEAUMONT, M.D., U.S. Army. Reprinted by ANDREW COMBE, M.D. Edinburgh, 1838.

table is compiled from those of Dr. Beaumont, with some abridgement and re-arrangement.

But while accepting these statements as facts shewing what, on actual observation, was the actual process and result in a living human stomach, yet it must never be forgotten that it was but *one* stomach ; and we all know how greatly digestion varies with different individuals, and how viands that are most easy of digestion with one person will be the very opposite with another.

Nor must it be forgotten that the nutritive value of any article of food and its digestibility do not necessarily bear any direct relation to each other.

TABLE SHEWING THE DIGESTIBILITY OF CERTAIN ARTICLES OF FOOD.

	Article of Food.	Mode of Preparation.	Time of Digestion.
			hours. min.
MEAT.	Beef	Boiled ..	2 45
	„ steak	Broiled ..	3 0
	„ lean	Roasted ..	3 30
	„ with mustard and vegetables	Boiled ..	3 30
	„ „ ..	Fried ..	4 0
	„ hard salt ..	Boiled ..	4 15
	Lamb	Broiled ..	2 30
	Mutton	Boiled ..	3 0
	„	Broiled ..	3 0
	„	Roasted ..	3 15
	Veal	Broiled ..	4 0
	„	Fried ..	4 30
	Pig, sucking . ..	Roasted ..	2 30
	Pork, steak	Broiled ..	3 15
	„ salted	Broiled ..	3 15
	„ „	Boiled ..	4 30
	„ „	Fried ..	5 15
	Venison	Broiled ..	1 35
	Tripe	Boiled ..	1 0
	Liver	Broiled ..	2 0
	Gelatine	Boiled ..	2 30
	Heart	Fried ..	4 0
POULTRY.	Turkey	Boiled ..	2 25
	„	Roasted ..	2 30
	Goose	Roasted ..	2 30
	Chicken	Fricaséed ..	2 45
	Fowls	Broiled ..	4 0
	„	Roasted ..	4 0
	Ducks	Roasted ..	4 0
	„ wild	Roasted ..	4 30

TABLE (*continued*).

	Article of Food.	Mode of Preparation.	Time of Digestion.
			hours. min.
FISH.	Trout	Boiled ..	1 30
	"	Fried ..	1 30
	Cod	Boiled ..	2 0
	Oysters	Raw	2 55
	"	Roasted ..	3 15
	"	Stewed ..	3 30
	Flounders	Fried ..	3 30
	Salmon, salted ..	Boiled ..	4 0
EGGS, &c.	Eggs	Raw	2 0
	"	Roasted ..	2 15
	"	Soft-boiled	3 0
	"	Hard-boiled	3 30
	"	Fried ..	3 30
	Milk	Raw	2 15
	"	Boiled ..	2 0
	Butter	Melted ..	3 30
	Cheese	Raw	3 30
SOUPS, &c.	Barley broth ..	.. .. ..	1 30
	Hash (meat and vegetables) ..	Warmed ..	2 30
	Soup (Chicken) ..	Boiled ..	3 0
	" (Mutton) ..	.. .. ..	3 30
	" (Beef)	.. .. ..	4 0
FARINACEOUS SUBSTANCES.	Bread (wheaten) ..	Baked ..	3 30
	Beans	Boiled ..	2 30
	Rice	Boiled ..	1 0
	Sago	Boiled ..	1 45
	Tapioca	Boiled ..	2 0
VEGETABLES.	Potatoes	Roasted ..	2 30
	"	Baked ..	2 30
	"	Boiled ..	3 30
	Parsnips	Boiled ..	2 30
	Carrots	Boiled ..	3 15
	Turnips	Boiled ..	3 30
	Cabbage	Boiled ..	4 30
FRUITS:—	Apples (sweet)	Raw	1 30
	" (sour)	Raw	2 0

APPENDIX L.

TABLE [a]

Shewing the average amount of Food taken by men of mean height (5 ft. 6 in. to 5 ft. 10 in.) and weight (140 lbs. to 160 lbs.), under different conditions of activity.

A man will take on an average in 24 hours :—

Condition of activity.	Water—free food in ounces.	Water in ounces.
When nearly at rest	18—5	70 to 90
When in moderate and usual exercise	23	70 to 90
Under great exertion	26 to 30	80 to 100, or more.
Undergoing enormous exertion	30 to 36, or even 40	Uncertain.

These are all averages, and there is a wide range. From day to day a man takes different amounts. Much depends also on the kind and digestibility of food. A larger quantity of indigestible food is taken; much is then lost by passing out undigested by the bowels. Of the water, about one-fourth or one-fifth is taken as water, the rest is contained as water in the so-called solid food.

[a] From *Practical Hygiene.*

APPENDIX M.

PER-CENTAGE TABLE[a].

Shewing the Approximate Composition of various Articles of Food.

The three middle columns (Mineral, Complement, Water) with either the four preceding columns (Proximate Principles), or with the four following columns (Organic Elements), make together 100 parts.

Food.	Plastic.	Fat.	Saccharine.	Gelatine Acid, &c.	Mineral.	Complement.	Water.	N.	H.	O.	C.	C. from Plastic.	C. from Respiratory.
Almonds	25·3	56·8	10·0	—	—	4·2	3·7	4·0	9·1	16·3	62·7	13·7	49·0
Apples	·2	—	13·6	·1	—	2·2	83·9	·03	·97	7·6	5·3	·1	5·2
Apricots	·6	—	19·0	1·4	—	1·6	77·4	·1	1·4	11·3	8·2	·3	7·9
Arrowroot	—	—	100·0	—	—	—	—	—	7·1	56·5	36·4	—	36·4
Artichoke	1·9	·1	18·8	—	1·8	·7	76·7	·3	1·4	10·3	8·8	1·0	7·8
Asparagus	·6	—	5·4	—	·4	—	93·6	·1	·4	2·9	2·6	·3	2·3
Bacon	8·4	62·5	—	—	·5	—	28·6	1·3	7·8	7·8	54·0	4·5	49·5
Barley-meal	12·3	1·8	71·4	—	2·5	3·0	9·0	1·9	5·6	38·7	39·3	6·7	32·6
Beans	20·2	·7	42·6	—	2·5	15·4	18·6	3·2	4·4	25·9	30·0	10·9	19·1
Beef	19·0	14·0	—	—	2·0	—	65·0	3·0	3·0	5·7	21·3	10·2	11·1
Beef, cooked	21·8	8·8	—	—	2·4	—	67·0	3·5	2·5	5·9	18·7	11·7	7·0
Beef, shin	17·0	·5	—	19·0	1·5	—	62·0	7·5	2·6	7·3	19·1	9·2	9·9
Beef-tea	3·1	—	—	—	2·5	—	94·4	·5	·2	·7	1·7	1·7	—
Bones	—	1·3	—	29·4	·6	68·7	—	5·2	2·2	7·5	15·8	—	15·8
Bread	10·0	·7	45·3	—	1·0	1·0	42·0	1·6	3·8	25·9	24·7	5·4	19·3
Broth	·5	—	—	1·5	1·0	—	97·0	·46	·14	·4	1·0	·3	·7
Butter, pure	—	100·0	—	—	—	—	—	—	11·9	14·1	74·0	—	74·0
Buttermilk	3·7	—	—	—	—	—	96·3	·6	·3	·8	2·0	2·0	—
Cabbage	1·2	·1	6·2	—	·7	—	91·8	·2	·5	3·5	3·3	·6	2·7
Carp	18·4	·8	—	—	2·9	—	77·9	2·9	1·4	4·4	10·5	9·9	·6
Carrots	1·1	·3	11·9	—	·7	3·2	82·8	·2	·9	6·4	5·8	·6	5·2
Cauliflower	·1	—	8·1	—	—	1·8	90·0	·02	·58	4·2	3·4	.05	3·35
Cheese	30·8	25·6	2·4	—	4·7	—	36·5	4·9	5·4	11·9	36·6	16·6	20·0
Cherries	·6	—	21·4	2·0	·1	1·1	74·8	·1	1·7	12·9	9·3	·3	9·0

[a] This and the two following Tables are taken from *A Manual of Diet and Regimen*, by the kind permission of the Author, Horace Dobell, M.D., &c., &c. (Published by Churchill and Sons, 1865.)

PER-CENTAGE TABLE (*continued*).

Food.	Plastic.	Fat.	Saccharine.	Gelatine Acid, &c.	Mineral.	Complement.	Water.	N.	H.	O.	C.	C. from Plastic.	C. from Respiratory.
Chestnuts	2·8	—	41·1	—	1·9	—	54·2	·4	3.0	22·0	18·5	1·5	17·0
Chicken	21·6	1·9	—	—	2·8	—	73·7	3·5	1·7	5·2	13·1	11·6	1·5
Chocolate	8·8	38·8	49·2	—	1·8	1·4	—	1·4	8·3	30·7	56·4	4·8	51·6
„ (liquor) ..	·44	2·0	2·4	—	·09	·07	95·0	·07	·43	1·54	2·8	·2	2·6
Cocoa seeds	16·7	53·1	18·7	—	—	6·3	5·2	2·7	8·5	18·2	59·1	9·1	50·0
„ nibs..	13·3	58·8	23·1	—	2·7	2·1	—	2·13	9·3	20·57	63·2	7·2	56·0
„ (liquor)	·5	3·0	1·0	—	—	—	95·5	·08	·4	·92	3·1	·3	2·8
Cod	16·5	·6	—	—	2·5	—	80·4	2·6	1·2	4·0	9·3	8·9	·4
Coffee seeds	13·0	13·0	15·0	3·0	7·0	37·0	12·0	2·13	3·5	13·37	25·0	7·0	18·0
„ roast, sol., &c.	·8	—	20·5	5·5	—	73·2	—	·23	1·77	13·1	11·7	—	11·7
„ (liquor) [b] ..	·05	—	1·39	—	—	—	98·56	·008	·092	·74	·60	—	·6
Cream..	3·5	4·5	—	—	—	—	92·0	·56	·8	1·24	5.4	1·9	3·5
Cucumber (peeled)..	·1	—	1·7	—	·5	0·6	97·1	·02	·12	·91	·75	·05	·7
Currants	·9	—	6·8	2·7	·3	8·0	81·3	·1	·6	5·5	4·2	·5	3·7
Dates, flesh	—	·3	73·4	—	—	2·3	24·0	—	4·9	40·3	28·5	—	28·5
„ kernel	·6	·8	38·9	7·1	—	39·6	13·0	·1	3·3	24·1	19·9	·3	19·6
Egg	15·0	10·8	—	—	2·5	—	71·7	2·4	2·3	4·5	16·6	8·1	8·5
„ white	13·9	—	—	—	2·8	—	83·3	2·2	1·0	3·2	7·5	7·5	—
„ yolk	16·9	29·8	—	—	2·0	—	51·3	2·7	4·7	6·7	32·6	9·1	23·5
Figs	5·0	·9	57·0	—	3·4	15·0	18·7	·8	4·2	30·9	27·0	2·7	24·3
Fish	16·6	·8	—	—	2·9	—	79·7	2·7	1·2	3·9	9·6	9·0	0·6
Flour (wheat)	14·2	1·0	69·8	—	1·2	1·3	12·5	2·2	5·5	38·3	39·0	7·7	31·3
Gooseberries, ripe ..	·9	—	7·0	2·7	·3	8·0	81·1	·14	·6	5·66	4·2	·5	3·7
„ unripe	1·1	—	1·9	1·9	·2	8·5	86·4	·18	·32	2·3	2·1	·6	1·5
Greengages	·3	—	26·8	.6	—	1·2	71·1	·05	1·85	15·2	10·6	·2	10·4
Green Vegetables ..	1·0	·2	7·8	—	·7	·8	89·5	·16	·6	4·34	3·9	·5	3·4
Groats, dry	4·0	1·2	74·2	—	—	7·6	13·0	·6	5·2	37·7	35·9	2·2	33·7
„ as gruel ..	4·0	—	59·0	—	—	24·0	13·0	·6	4·1	30·1	28·2	2·2	26·0
Gruel (groats) . ..	·4	—	5·9	—	—	—	93·7	·06	·44	3·1	2·7	·2	2·5
„ (oatmeal) ..	1·1	·4	4·0	—	·3	0·7	93·5	·2	·4	2·3	2·6	·6	2·0

[b] See Note to Tea.

PER-CENTAGE TABLE (*continued*).

Food.	Plastic.	Fat.	Saccharine.	Gelatine Acid, &c.	Mineral.	Complement.	Water.	N.	H.	O.	C.	C. from Plastic.	C. from Respiratory.
Haddock	14·6	·6	—	—	2·6	—	82·2	2·4	1·1	3·4	8·3	7·9	·4
Ham	35·0	32·0	—	—	4·4	—	28·6	5·6	6·2	11·0	44·2	18·9	25·3
Horse-radish	·1	—	4·7	—	1·0	16·1	78·1	·02	·32	2·46	2·0	·05	1·95
Indian Corn Meal ..	8·1	4·5	70·0	—	·8	2·8	13·8	1·3	5·6	36·8	38·9	4·4	34·5
Kidney	21·2	·9	—	—	1·4	—	76·5	3·4	1·6	4·9	12·2	11·5	·7
Lamb	19·6	14·3	—	—	2·2	—	63·9	3·1	3·0	5·9	21·9	10·6	11·3
Lard	—	100·0	—	—	—	—	—	—	11·1	9·8	79·1	—	79·1
Lentil	29·7	—	39·2	—	1·4	15·2	14·5	4·8	4·6	26·4	33·1	16·0	17·1
Liver	26·3	3·9	—	—	1·2	—	68·6	4·2	2·3	6·4	17·3	14·2	3·1
Meat (butchers') ..	19·4	14·2	—	—	2·1	—	64·3	3·1	3·0	5·8	21·7	10·5	11·2
,, (cooked)	22·5	8·9	—	—	2·5	—	66·1	3·6	2·6	6·0	19·2	12·2	7·0
,, (gravy)	15·0	3·7	—	13·3	1·4	7·0	59·6	5·8	2·4	6·1	17·7	8·1	9·6
Milk (new)	5·0	3·5	4·2	—	·6	—	86·7	·8	1·1	3·6	7·2	2·7	4·5
,, (skimmed) .	2·8	—	3·5	—	·8	—	92·9	·45	·45	2·5	2·9	1·5	1·4
Mutton	21·0	14·3	—	—	2·0	—	62·7	3·4	3·1	6·2	22·6	11·3	11·3
,, (cooked) ..	24·9	8·8	—	—	2·5	—	63·8	4·0	2·7	6·6	20·4	13·4	7·0
,, (neck)	13·0	6·8	—	7·6	1·4	14·0	57·2	4·0	2·2	5·0	16·2	7·0	9·2
Oatmeal	15·0	5·8	53·2	—	3·0	9·6	13·4	2·4	5·0	30·6	36·0	8·1	27·9
Onions	·5	—	5·2	—	·5	—	93·8	·08	·38	2·84	2·4	·3	2·1
Oysters	12·6	—	—	—	·2	—	87·2	2·0	·9	2·9	6·8	6·8	—
Parsnips	2·1	—	14·5	—	1·0	3·0	79·4	·3	1·1	8·0	7·2	1·1	6·1
Peaches	·2	—	21·2	1·8	—	1·9	74·9	·03	1·57	12·6	9·0	·1	8·9
Pearl Barley	4·7	—	78·0	—	·2	7·6	9·5	·8	5·4	39·9	36·6	2·5	34·1
Pears (ripe)	·1	—	9·6	·1	—	3·9	86·3	·02	·6	5·28	3·9	·05	3·85
Peas (dry)	21·9	1·5	46·9	—	2·7	13·3	13·7	3·5	4·8	28·5	33·5	11·8	21·7
,, (green)	2·7	—	6·6	—	·1	12·5	78·1	·4	·6	4·1	4·2	1·5	2·7
Pigeon	23·0	1·9	—	—	2·7	—	72·4	3·7	1·8	5·5	13·9	12·4	1·5
Pork (fresh)	17·5	16·0	—	—	2·2	—	64·3	2·8	3·1	5·5	22·1	9·4	12·7
Potatoes .. .. :	1·4	·1	15·7	—	1·1	7·1	74·6	·2	1·1	8·1	7·8	·8	7·0
,, (peeled) ..	1·7	—	23·0	—	1·1	1·6	72·6	·3	1·6	12·4	10·4	·9	9·5
Prunes (flesh)	3·9	—	78·6	—	4·5	—	13·0	·6	5·6	41·7	34·6	2·1	32·5
Pudding (flour) . ..	7·7	7·4	23·3	—	·9	·3	60·4	1·8	3·0	14·0	19·6	4·1	15·5

PER-CENTAGE TABLE (*continued*).

Food.	Plastic.	Fat.	Saccharine.	Gelatine Acid, &c.	Mineral.	Complement.	Water.	N.	H.	O.	C.	C. from Plastic.	C. from Respiratory.
Pudding (rice)	5·4	5·4	16·3	—	·7	·4	71·8	·8	2·1	10·2	14·0	3·0	11·0
,, (suet) ..	7·1	13·0	34·9	—	·6	·6	43·8	1·14	4·3	20·96	28·6	3·8	24·8
Radishes	1·2	—	7·4	—	1·0	1·3	89·1	·2	·6	4·1	3·7	·6	3·1
Rice	5·1	·4	81·7	—	·5	3·3	9·0	·8	5·8	41·4	39·2	2·7	36·5
Rump-steak	21·7	1·9	—	—	2·4	—	74·0	3·5	1·7	5·2	13·2	11·7	1·5
Rye Flour	12·1	2·9	69·6	—	2·6	1·8	11·0	1·9	5·7	37·7	39·3	6·6	32·7
Sole	17·0	·8	—	—	2·5	—	79·7	2·7	1·3	4·0	9·8	9·2	·6
Suet	—	100·0	—	—	—	—	—	—	11·7	9·3	79·0	—	79·0
Sugar (crystallized)	—	—	90·0	—	—	—	10·0	—	5·3	42·3	42·4	—	42·4
Soup (invalid)	4·3	—	2·9	14·1	1·2	—	77·5	3·2	1·5	6·0	10·6	2·3	8·3
Sweetbread	28·0	·4	—	—	1·6	—	70·0	4·5	2·0	6·5	15·4	15·1	·3
Tea (leaf)	4·6	1·7	28·9	26·7	1·7	36·4	—	·74	3·5	27·96	29·7	2·5	27·2
,, (sol. &c.)	·5	—	19·0	22·5	1·0	57·0	—	·14	2·2	19·7	20·0	—	20·0
,, (infus.) [c]	·007	—	·32	—	·02	—	99·66	·001	·02	·16	·14	—	·14
Treacle	—	—	75·0	—	—	—	25·0	—	4·7	37·0	33·3	—	33·3
Trout	16·6	·8	—	—	4·3	—	78·3	2·7	1·2	3·9	9·6	9·0	·6
Turnips	1·2	·2	7·6	—	1·0	—	90·0	·2	·6	4·2	4·0	·6	3·4
Veal	17·7	14·3	—	—	2·3	—	65·7	2·8	3·0	5·4	20·8	9·5	11·3
Vegetable Marrow ..	·5	—	6·4	—	3·9	—	89·2	·08	·42	3·5	2·9	·3	2·6
Venison	20·4	8·0	—	—	2·8	—	68·8	3·3	2·4	5·4	17·3	11·0	6·3
Vermicelli	47·5	•	38·8	—	1·2	—	12·5	7·5	6·0	29·7	43·1	25·9	17·2
Whey	—	—	4·6	—	·7	—	94·7	—	·3	2·5	1·8	—	1·8

[c] One pint of Coffee contains Caffeine, gr. 4·37; one pint of Tea contains Theine, gr. 61.

APPENDIX N.

DIET TABLES[a], constructed to shew how the essentials of a normal diet may be secured, whether the diet be complicated and expensive, or simple and cheap.

Liquid Food. ozs.	Dry. ozs.	Food for 24 hours.	Water ozs.	Plastic. ozs.	Fat. ozs.	Saccharine. ozs.	Carbon. ozs.
	6	Meat, Poultry, or Game (cooked)	3·97	1·35	·53	..	·42
	4	Fish	3·19	·66	·03	..	·02
	10	Bread	4·20	1·00	·07	4·53	1·93
	8	Potatoes	5·81	·14	..	1·84	·76
	2	Rice	·18	·10	·01	1·63	·73
	2½	Sugar	..	..	..	2·50	1·05
	2½	Butter	..	..	2·50	..	1·85
5		Milk	4·34	·25	·17	·21	·22
16		Coffee	15·77	..	..	·22	·10
16		Tea	15·95	..	..	·05	·02
17		Water	17· 0	..	..	..	..
54	35		70·41	3·50	3·31	10·98	7·10
				In Plastic matter ..			1·89
						TOTAL	8·99

Liquid Food. ozs.	Dry. ozs.	Food for 24 hours.	Water. ozs.	Plastic. ozs.	Fat. ozs.	Saccharine. ozs.	Carbon ozs
	16	Bread	6·72	1·60	·11	7·25	3·09
	3	Peas	·41	·65	·04	1·40	·65
	4	Bacon	1·14	·33	2·50	..	1·98
	2	Cheese	·73	·61	·51	·05	·40
8		Milk	6·94	·40	·28	·34	·36
20		Coffee	19·71	..	.	·28	·13
	1	Sugar	..	..	..	1·00	·42
35		Water	35·00	..	..	..	..
63	26		70·65	3·59	3·44	10·32	7·03
				In Plastic matter ..			1·94
						TOTAL	8·97

[a] See Note, page 80.

APPENDIX O.

TRAINING TACTICS.

TABLES

Shewing in outline the principal features of several systems of training recommended for Rowing.

No. 1. THE OXFORD SYSTEM. Summer Races.

The racing course at Oxford, from the White Willow to the Winning-post above the University Barge, is reckoned at $1\frac{1}{4}$ miles; but this is not quite correct: the distance (ascertained from actual measurement) is 1 mile, 251 yards; but as the greater number of the boats are placed above the Willow, and taking into consideration the number of boats (about twenty), the length of each boat (56 ft.), and the distance between them (two lengths[a]), the actual course rowed over in the races, in average work, may be reckoned at a mile. The races are rowed at 7 o'clock, on eight consecutive nights, about the middle of the Summer Term.

A Day's Training.

Rise about 7 a.m...	.. ..	(So as to be in Chapel, but early rising not compulsory.)
Exercise..	A short walk or run. ..	(Not compulsory.)
Breakfast, 8.30 ..	Meat, Beef or Mutton.	(Underdone.)
	Bread or Toast, dry	(The crust only recommended.)
	Tea..	(As little as possible recommended.)
Exercise (forenoon).	None.	

[a] This year (1866) the distance between the boats was reduced to a length and a half.

A Day's Training (continued).

Dinner, 2.0 p.m. ..	Meat; much the same as for Breakfast	
	Bread	(Crust only recommended.)
	Vegetables (none allowed)	("A rule, however, not always adhered to.")
	Beer, one pint.	
Exercise..	About 5 o'clock start for the river, and row twice over the course, "the speed increasing with the strength of the crew."	Crews are taken over the long course to Nuneham and back, once or twice during their practice.
Supper, 8.30 or 9.0	Meat, cold.	
	Bread; perhaps a Jelly or Watercresses.	
	Beer, one pint.	
Bed about 10.0		

Summary.

Sleep	About nine hours.
Exercise.. ..	Walking and Rowing about one hour.
Diet	Very limited.

N.B. It must be remembered that perhaps no two Colleges train precisely alike, differing however almost solely in diet. In one College I find that although beef and mutton form, as usual, the staple of all three meals, yet the "mode of their presentation" is judiciously varied on different days of the week,—as chops, haunch of mutton, loin of mutton; steaks, sir-loin of beef, ribs, &c. Here also abundance and choice of vegetables is given,—as potatoes, cabbage, brocoli, spinach, and stewed-rhubarb; with sago, tapioca, and jelly; also watercresses every day, morning, noon, and night. The dietary of this College, and that of the one tabulated, represent, perhaps, the two extremes of variety and restriction.

Winter Races.

The Winter, or, as they are called, the Torpid Races, take place in Lent Term. They are rowed over the same course as the Summer Races, and about the same number of boats start. The races are rowed at 3 o'clock on six consecutive days, about the middle of the Term.

A Day's Training.

Rise about 7.30 ..	.. ..	(Early rising not compulsory.)
Exercise..	A short walk or run	(Not compulsory.)
Breakfast, 9.0 ..	As for summer races.	
Exercise (forenoon)	None.	
Luncheon about 1.0	Bread, or a sandwich. Beer, half a pint.	
Exercise..	About 2 o'clock start for the river, and row twice over the course.	Crews are taken over the long course to Nuneham perhaps once or twice during their practice.
Dinner, 5.0 .. .. (In Hall.)	Meat, as for summer races. Bread. Vegetables, as for summer races. Pudding, (Rice) or Jelly. Beer, half a pint.	
Bed, 10.30.		

N.B. It is particularly impressed on men in training that as little liquid as possible is to be drunk, water being strictly forbidden.

Summary:

Sleep	As for summer races.
Exercise.. ..	As for summer races.
Diet	Nearly the same as for summer races; luncheon being about equivalent to supper.

No. 2. *THE CAMBRIDGE SYSTEM. Summer Races.*

The racing course at Cambridge is a little longer than the course at Oxford, being reckoned at 1 mile 487 yards. The races, as at Oxford, are all "bumping" races; the length of the boats and the distance between each is also the same. The number of boats, however, is fully double that in the Oxford summer races. They are separated into two divisions of twenty boats each: the first division rows only for six nights in the Summer Term; the second division rows for three nights in the Lent Term, and for five nights in the Summer Term. In the Summer Term both divisions begin rowing on the same day, the second division at 2.30 p.m., and the first division at 7 p.m.; each division numbering twenty boats[b]. It will be seen that the second division of the Cambridge Racing Eights thus corresponds to the Oxford Torpids; except that the former row in both summer and winter races, the latter in the winter only.

On the Cam men have to row about $1\frac{1}{2}$ miles before they reach the *top* of the course, or winning-post, the starting-point being about $1\frac{1}{4}$ miles lower down. Thus the rowing to the starting-point and then rowing home somewhat exceeds the rowing twice over the Oxford course, as followed in training practice.

A Day's Training.

Rise at 7 a.m.		
Exercise	Run 100 or 200 yards "as fast as possible."	"The old system of running a mile or so before breakfast is fast going out, except in the case of men who want to get a good deal of flesh off."

[b] In 1864 there were three divisions, of 20 boats each, making in all 60 eight-oared racing boats—nearly 500 oars.

A Day's Training (continued).

Breakfast 8.30 ..	Meat, Beef or Mutton. Toast, dry. Tea, two cups, or towards the end of training a cup and a half only. Watercresses occasionally.	Underdone.
Exercise (forenoon).	None.	
Dinner about 2 p.m.	Meat, Beef or Mutton. Bread. Vegetables — Potatoes, Greens.	Some Colleges have baked Apples, or Jellies, or Rice-puddings.
	Beer, one pint. *Dessert*—Oranges, or Biscuits, or Figs; Wine, two glasses.	
Exercise	About 5.30 start for the river, and row to the starting-post and back.	"Most men get out for a little time before rowing back."
Supper about 8.30 or 9.0	Meat, cold. Bread. Vegetables—Lettuce or Watercresses. Beer, one pint.	
Bed at 10.0		

Summary.

Sleep	Nine hours.
Exercise.. ..	About an hour and a quarter [c].
Diet	Limited.

N.B. On Sundays men generally take a long walk of five or six miles.

[c] Reckoning half an hour in rowing to and half an hour in rowing from the starting-point, and a quarter of an hour for the morning's run—in all, say, one and a quarter hours.

Winter Races.

The Winter Races are rowed over the same course as the Summer Races. They take place in Lent Term and are rowed on three consecutive nights.

A Day's Training.

Rise about 7.0. a.m.	
Exercise	As for Summer Races.
Breakfast, 8.30.	As for Summer Races.
Exercise (forenoon).. ..	None.
Luncheon about 1.0 ..	A little cold Meat. Bread. Beer, half-pint, or Biscuit with glass of Sherry; perhaps the yolk of an egg in the Sherry.
Exercise	About 2.0 o'clock start for the river and row over the course and back.
Dinner about 5.0 or 6.0 p.m.	As for Summer Races.
Bed about 10.0 p.m.	

Summary.

Sleep	Same as for Summer Races.
Exercise	Same as for Summer Races.
Diet	Nearly the same as for Summer Races; luncheon being about equal to supper.

No. 3. H. CLASPER'S SYSTEM[d].

A Day's Training.

Rise between 6.0 and 7.0 a.m.	
Exercise	A country walk of four or five miles.
Breakfast, 8.0	Meat, Chop or Couple of Eggs. Bread. Tea. ("We never drink coffee.")
Exercise	Rest for half an hour, and then a brisk walk or run. If morning exercise has not been heavy, a row on the river, terminating about 11.0 a.m.
Dinner, 12.0	Meat, Beef or Mutton (broiled). Egg-pudding, with currants in it if desired, or other light farinaceous pudding. Ale, one glass. Wine, one glass (Port) or Ale, two glasses, without Wine.
Exercise	Rest for an hour, and then on the river again for a hard row. "Rowing exercise should be taken twice every day."
Tea	"Tea, with toasted bread sparingly buttered, with one egg only—more has a tendency to choke the system."
Supper	Not recommended. When taken, to consist of new milk and bread, or gruel, with raisins and currants and a glass of Port Wine in it.
Bed about 10.0.	

Summary.

Sleep	Between eight and nine hours.
Exercise	Walking and Rowing about four or five hours.
Diet	Limited.

[d] *Training.* Mode employed by HARRY CLASPER. Rowing Almanack for 1863.

No. 4. C. WESTHALL'S SYSTEM[f]. *For Amateurs.*

[A course of preliminary training is prescribed, to be varied according to the condition and habits of the individual. "If a man is fleshy, and of a full habit of body, a dose or two of mild purgative medicine should be taken, and slow walking exercise only taken on the days the doses have been administered; after the medicine has done its duty, if the amateur is very fleshy, a Turkish bath or two may be taken with advantage, the usual precautions against cold being used. The subject, after one or two of these sweats, is prepared for more arduous work, which may be taken at a fair pace in the form of good sharp runs and fast walks, which, like all other training, will become easier of accomplishment at each repetition."]

A Day's Training

FOR ROWING.

Rise at 6 a.m...	Or earlier in the summer.
	Cold bath and rub down.
Exercise	Sharp walk about a mile out, and run home; or
	A row of a couple of miles at three-parts speed.
	A dry rub down.
Breakfast (time not stated)	Meat, Mutton Chop or Steak (broiled).
	Bread, stale, or Toast.
	Tea, half a pint.
Exercise	(Not stated.)
Dinner, 2.0 p.m.	Meat (as at Breakfast).
	Vegetables, none; "except a mealy potatoe."
	Bread, stale.
	Beer, one pint.
Exercise (afternoon) ..	Rowing.
	If Dinner be late, Luncheon to be taken, to consist of
	Meat, Beef or Mutton, hot or cold.
	Bread.
	Beer, one glass.

[f] *Training for Running, Walking, Rowing, and Boxing.* By C. WESTHALL, the pedestrian Champion of England. London: S. O. Beeton, 248 Strand, W.C.

A Day's Training (continued).

	(If Dinner be early, "Tea with viands and liquids as at Breakfast" to be taken.)
Supper	Half a pint of thin Gruel, or dry Toast and a glass of Ale.
Bed	Time not stated.

N.B. It is added "that the above Rules are of course open to alteration according to circumstances, and the diet varied successfully by the introduction of fowls, either roast or boiled—the latter preferred;" and "it must never be lost sight of that sharp work, regularity, and cleanliness are the chief, if not the only rules to be followed to produce thorough good condition."

Summary.

Sleep	Say eight hours (not stated fully).
Exercise.. ..	Say four or five hours (not stated fully).
Diet	Limited.

No. 5. "*STONEHENGE*"'*S SYSTEM*[g].

TRAINING FOR ROWING.

A Day's Training.

Rise at 8.0 a.m. ..	According to season and weather. Cold bath.	
Exercise, 8.30 to 9.0	Walking or Running.	"Let all take a gentle run or smart walk." "In most instances a smart run of three miles will be about the best distance."
Breakfast, 9.0 to 9.30	Oatmeal Porridge, with Meat (Beef or Mutton, broiled) and Bread. Tea or Coffee, *or* Table Beer, one pint.	"Tea is preferred to Coffee. Cocoa is too greasy."
Exercise, 9.30 to 11.30	Billiards, Skittles, Quoits, or other light exercise;	
11.30 to 1.30	Rowing.	
1.30 to about 2.30	Running. Rubbed dry and linen changed.	"According to circumstances."
Dinner, 2.30 to 3.0 or 3.30	Meat—Beef (roast) or Mutton (boiled Mutton occasionally), Roast Fowl, Partridges, or Pheasants (allowed), or Venison (nothing better). Bread (*ad. lib.*) Puddings occasionally, made of bread, eggs, and milk, and served with preserved fruits.	"It is generally directed that the steak or chop should be underdone; this I am sure is a fallacy."

[g] Article "Boat-racing," in *British Rural Sports*, by STONEHENGE. London: Routledge, Warne, and Routledge, 1861.

A Day's Training (continued).

	Vegetables,—Potatoes (one or two only), Cauliflowers, and Brocoli (only as an occasional change). Beer, from a pint to a pint and a half. Wine, a glass or two, Port or Sherry.	If training is protracted, fish allowed (Cod or Soles).
After Dinner, until 5.0 or 6.0	A gentle stroll or book.	
Exercise, 6.0 to 7.0	Rowing.	
Supper, 8.0	Oatmeal Porridge with dry Toast, *or* Chop, with glass of Port.	
Bed at 9.0 or 10.0		

Summary.

Sleep	Ten or eleven hours.
Exercise.. ..	Say four hours (exclusive of Billiards, &c.)
Diet	Varied.

No. 7. THE AUTHOR OF "ROWING AND STEERING"'S SYSTEM[h].

CREW ON MONTH'S TRAINING.

[This System is for the Thames, on the course from Putney to Mortlake, reckoned at 4 miles, 3 furlongs.]

A Day's Training.

Rise at about 7.0 a.m.	.. ..	(Glass of cold Water recommended.)
Exercise	The crew meet at 7.0, walk and run for four or five miles ; or, in later practice, quick run of two miles.	
	Wash and dress.	
Breakfast, 9.0 ..	Meat (broiled).	
	Bread (brown) and Butter.	
	Tea, two cups.	'Cocoa made of the nibs boiled for four hours is better than Tea for breakfast."
	Smoking allowed (conditionally).	"Smoking is barred. For though here also a man's habits are to be taken into account, the subjects of training in match boats are usually too young to have contracted a custom of smoking so inveterate as to have made tobacco indispensable to the body's internal functions, though it is not unfrequently so in older men. After breakfast is the only time allotted to the pipe."
Luncheon at 1.0 ..	Beef Sandwich with half a pint of Beer, *or*	
	Biscuit and glass of Sherry, *or*	
	Egg in Sherry.	
Exercise	At 2.30 go out to row, and row over the whole course.	"This altogether depends on the state of the crew."

[h] *The Principles of Rowing and Steering.* Slatter and Rose, High Street, Oxford.

A Day's Training (continued).

Dinner at 6.0 p.m.	Wash in tepid water.	
	Meat (roast, broiled, or boiled).	"Any kind of wholesome meat thoroughly cooked." The course is varied daily, so that no two days together shall see the same articles on the table.
	Vegetables—"The green foods permissible contain in their list spinach—the very best of all; sea-kale, asparagus, but without melted butter; turnip-tops, young un-hearted greens, but not solid cabbages; brocoli, carrots, parsnips, and cooked celery. Turnips are also favoured, and peas condemned; also cucumbers, and all salad mixtures. But boiled beet-root is good, and Jerusalem artichokes; and French beans stand next to spinach in virtue."	
	Pudding	"Light puddings may be eaten."
	Bread.	
	Beer, one pint.	
	Wine, two glasses of old Port or Sherry, or three of Claret.	
	Biscuits and dried fruits, as cherries, figs, &c., allowed.	"All fresh fruits are avoided."
	Jellies	"Plain jellies are innocuous."
	Water	"As much spring water as they have a mind to."
Supper, 9.0	Oatmeal Gruel	If desired.
Bed at 10.0		

N.B.—On Sundays a brisk walk of three hours or so is taken.

Summary.

Sleep	Eight or nine hours.
Exercise ..	About three hours.
Diet	Very varied.

TABLE

Shewing the Chief Points in the Preceding Systems of Training.

System.	Sleep.	Exercise.		Diet.															
				Solids.									Fluids.			Stimulants, &c.		Substitutes.
				Meat.	Fish.	Vegetables.		Puddings and Jellies.	Fruit		Bread		Water.	Beer.	Tea.	Wine.	Tobacco.	Gruel.
	Hours.	Kinds.	Hours.	Kinds.	Kinds.	Raw. Kinds.	Cooked. Kinds.	Kinds.	Fresh. Kinds	Dry. Kinds.	Bread.	Toast.		Pints.	Cups.	Glasses.		Pints.
No. 1. The Oxford System																		
Summer Races .	9	2	1	2	0	1	1—5	1—3	0—1	0	Stale.	Dry.	0	2	1—2	(*i*)	0	0
Winter Races .	9	2	1	2	0	1	1—5	1—3	0—1	0	,,	,,	0	1	1—2	,,	0	0
No. 2. The Cambridge System																		
Summer Races .	9	2	$1\frac{1}{4}$	2 Underdone.	0	2	2	3 (*d*)	1	1	,,	,,	0	2	$1\frac{1}{2}$ or 2	2	0	0
Winter Races .	9	2	$1\frac{1}{4}$	2	0	2	2	3 (*d*)	1	1	,,	,,	0	$1\frac{1}{2}$	$1\frac{1}{2}$ or 2	1	0	0
No. 3. H. Clasper's System .	8 or 9	3	4 or 5	2	0	0	(*c*)	1	0	0	,,	,,	0	$\frac{1}{2}$	(*h*)	0	0	$\frac{1}{2}$
No. 4. C. Westhall's System	8	3	4 or 5	2	0	0	1	0	0	0	,,	,,	0	$1\frac{1}{2}$ or 2	$\frac{1}{2}$	0	0	$\frac{1}{2}$
No. 5. "Stonehenge"'s System	10 or 11	3	4	6(*a*) Well done.	2 (*b*)	0	3	1	0	0	,,	,,	0	3 or 4	0	3	0	(*l*)
No. 6. "Rowing and Steering"	8	3	3 or 4	(*a*)	0	3	12	2	(*e*)	(*f*)	Brown	,,	*ad. lib.* (*g*)	1 or $1\frac{1}{2}$	2	2 or 3	(*k*)	(*l*)

(*a*) Any kind of wholesome meat. (*b*) Conditionally. (*c*) Not stated. (*d*) Allowed. (*e*) Condemned. (*f*) Allowed. (*g*) At night. (*h*) Quantity not stated. (*i*) Some Colleges allowed. (*k*) Allowed. (*l*) Quantity not stated.