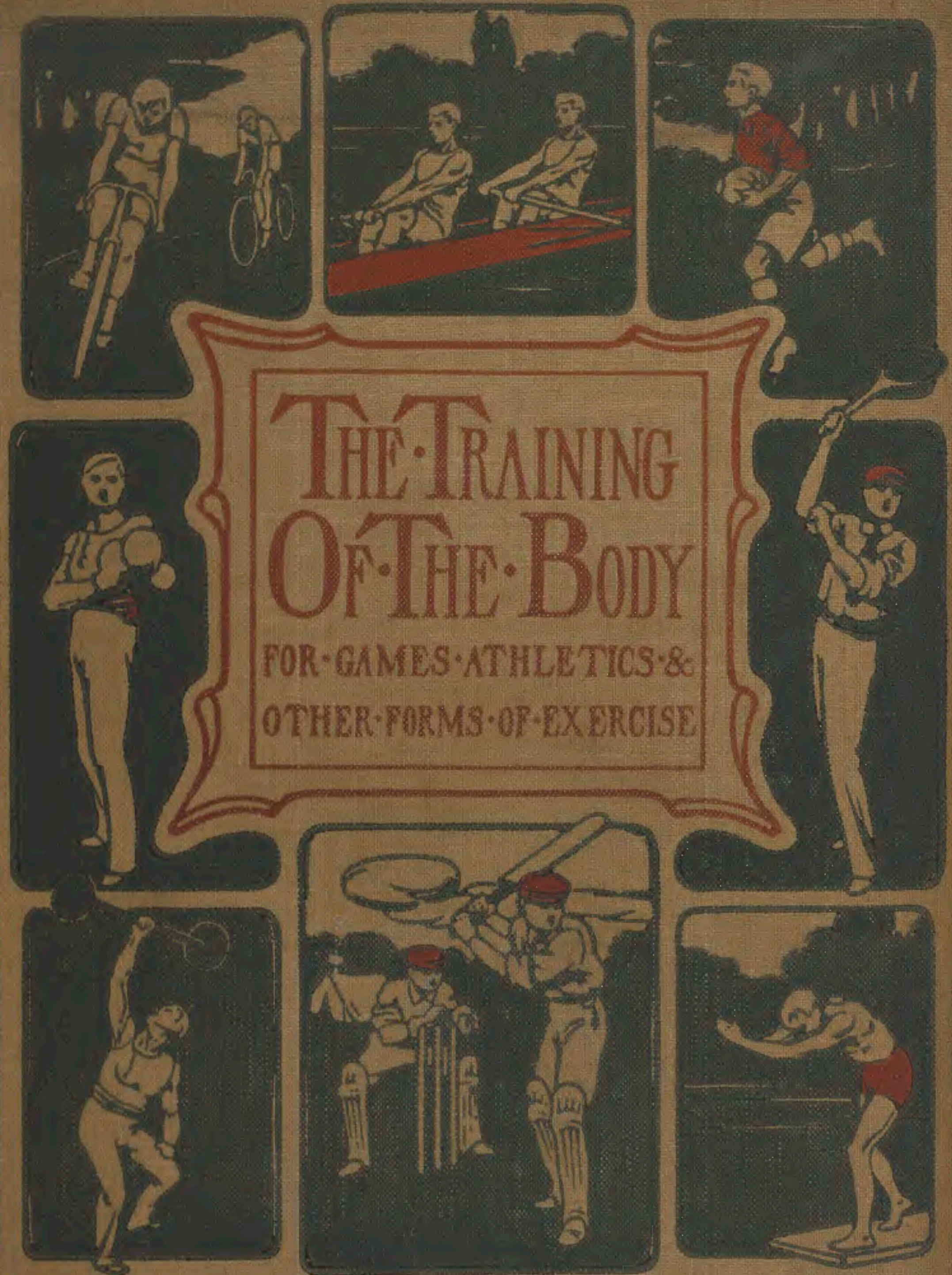

# THE·TRAINING OF·THE·BODY

FOR·GAMES·ATHLETICS·& OTHER·FORMS·OF·EXERCISE

BY F. A. SCHMIDT, M.D. AND EUSTACE H. MILES, M.A. (CAMB.)

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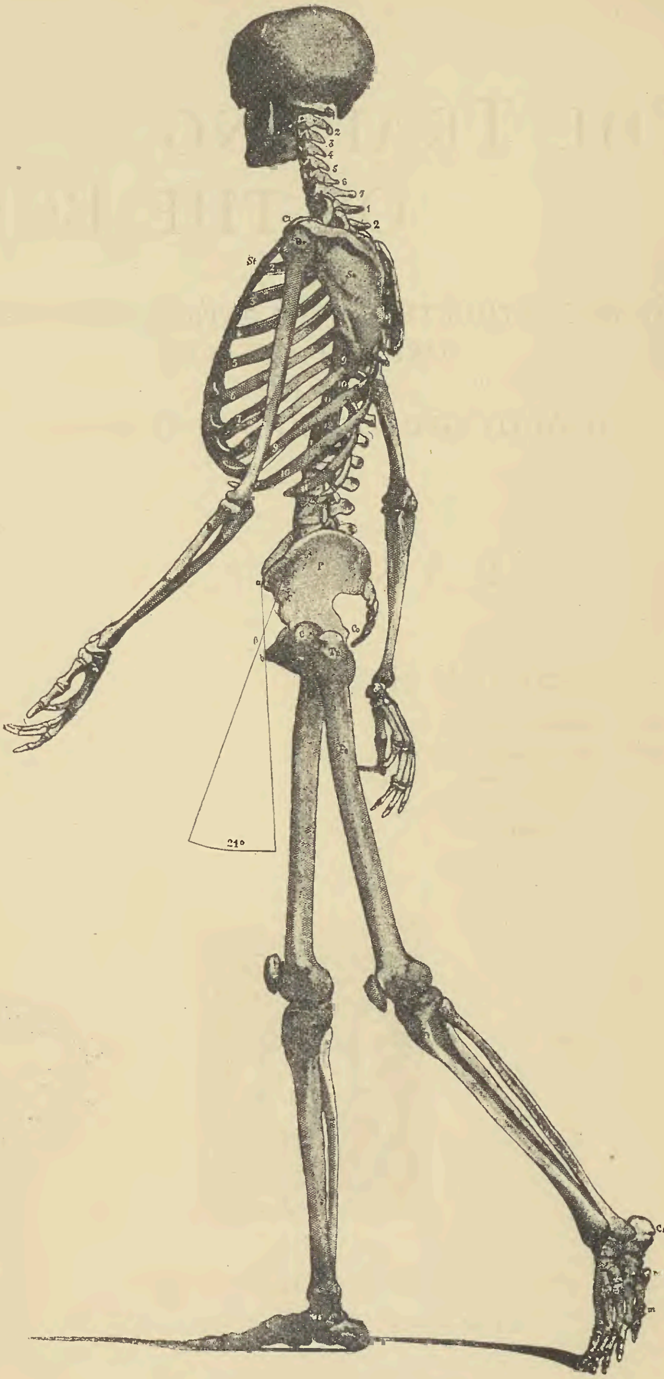

THE HUMAN SKELETON.

# THE TRAINING OF THE BODY

FOR

GAMES, ATHLETICS, GYMNASTICS, AND OTHER FORMS OF EXERCISE

AND FOR

HEALTH, GROWTH, AND DEVELOPMENT

BY

F. A. SCHMIDT, M.D.

AND

EUSTACE H. MILES, M.A. (CAMB.)

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WITH NUMEROUS ILLUSTRATIONS



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THIS IS DEDICATED

TO

ALL MY FRIENDS

AT

SCHOOLS

AND

UNIVERSITIES.

# PREFACE.

[BY E. H. MILES.]

THERE are many excellent Papers on the subject of health. In America alone there are three, viz. 'Good Health', 'Health Culture', and 'Physical Culture'. England has several similar publications, of which Sandow's is one. These are well worth taking in regularly and studying carefully, and they are very widely read, but somehow by themselves they do not produce enough effect upon the public. People rush through the pages, and then little remains in the memory. The same applies to the hundreds of Magazines which are published every year. In them are many valuable and interesting statistics, which, however, it is almost impossible to remember a week after one has read them.

Yet it is vitally important for us to consider some of these topics, and especially the topic of health and the training of the body. Most of what we do we do through the body; through it we feel, and think, and speak, and act. Hence the importance of studying health and the means to health. The St. James' Gazette, of Jan. 1, 1901, had two very interesting quotations on the subject:—

'The dead century has seen the loss of much that the England of to-day would gladly regain. The country population which gave us matchless colonists and soldiers has shrunk with the decay of agriculture: the great towns . . . have spread like some cancer.' *(Daily Mail.)*

'Amid the host of more important attributes, the last century is likely to be distinguished by its athletic zeal. Games . . . were not discovered till the late sixties. Then suddenly . . . athletics and football . . . leapt into popularity. Doctors say that the effect on the physique of the race is already marked. The omen for the century is a good one.' *(Daily Graphic.)*

Yes. The omen for the century is a good one. But still the value of Training for and by Games and Athletics has not impressed itself upon the great majority; and still the fundamental principles of Training for work as well as for Games and Athletics are daily ignored by millions. National Education on the subject of Health, Training, and Athletics is terribly haphazard, if indeed it can be said to exist at all. There is much knowledge, and there is abundant literature, but these have not yet influenced us as a Nation.

What we need is something to arrest the attention of the reader; reading seems to have become too easy. It does not impress itself upon our minds. We read without putting into practice. In this book I have tried to enforce the arguments, partly by allowing them to take up a good deal of space, and partly by marking the important words with capital letters. This method is not altogether to be approved of, but I have found it very helpful in reading many books. Capitals call the attention to the most essential points, and, if the excessive use of capitals in this book achieves the same end, there will be something to recommend the method. It had occurred to me to put stars which might remind the reader to pause and realise the meaning of certain sections, and to apply the suggestions to himself. But I preferred the use of capitals.

There have been many other difficulties in editing a book of this kind, and especially was it difficult to treat Dr. Schmidt's great work satisfactorily.

First of all, I had differences of opinion, which were based on personal experience. For example, I could not agree with him that skill cannot be increased after the age of thirty, nor could I agree with him that flesh foods are necessary for health or training.

Then, again, I had to add a great deal to his advice. There were some recent researches in America, and there was the large subject of Games. His work deals mainly with gymnastic exercises, such as marching at the word of command. I have of course been unable to treat of all Games, which would require a volume to themselves. I can only lay down general principles, hoping that readers will work them out for themselves in special Games. For the value of this form of exercise is increasing in proportion as city life is increasing at the expense of country life. So I have spent a long time in suggesting how one may improve at Games, and I have pointed out that

Games are essential to the training and education of the body, the moral character, the social faculties, and even the intellect. It is high time that we realised, and that every Nation realised, how far better Games are for this purpose than mere exercises ever can be. I have also tried to point out how one Game differs from another in its effects.

This has made the book somewhat longer than I should have liked, although I have removed a good deal from Dr. Schmidt's work. I have kept out some facts which were mentioned by Dr. Schmidt apparently because they *were* facts; for instance, the measurements and angles of the skulls of different nations. The following quotations will show the kind of passage I have thought it best to omit.

'The main body of the occipital bone is shell-shaped, with a basal 'part and two lateral or articular portions. These are so arranged 'around the great foramen of the occiput that the basal portion lies 'in front of it, the main body behind, and the articular portions at 'either side.' (Dr. Schmidt's Section 13.)

'The temporal bones fall naturally into: (1) a flat part which, joining 'with the parietal bone, forms the wall of the temporal fossa with the 'articular fossa for the articulation of the lower jaw or infra-maxillary 'bone. In front of this lies the zygomatic process, which unites with 'the cheek-bone to form the zygomatic arch, which helps to determine 'the shape and character of the face. (2) The mastoid portion....' (Do.)

The passages are full of technical terms. Such terms I have tried to simplify or have omitted. I have omitted most of the names of diseases, since the purpose of this book is to keep people well, and to guard them against disease beforehand. The names of bones and muscles etc., which would be useful for medical specialists, have also been left out for the most part, the illustrations being allowed to tell their own tale. The abstract language in which German abounds has been simplified. The following passage is an example.

'The thing which specially corresponds with the tonic automatic 'action is the semi-automatic, *i.e.* spontaneous preservation of equili-'brium by continuous muscle-tension." (Dr. Schmidt's Section 212.)

I might have omitted many pieces of advice that few readers will have the courage to put into practice; for instance, the proper shape for shoes and socks, the system of long distance walking with bent legs, and so on. But I thought it better to give everyone the chance of trying these ideas, since thousands have found them useful in their own experiences. This must be the excuse for a great deal of detail, each reader being left to accept or reject any of this advice according to his own personal experience. This applies equally to diet.

In speaking of what has come within my own experience, I may mention the effect which must be produced on the spectator by the sight of the lawn-tennis tournaments at Homburg. He could not fail to be struck by the keenness and sportsmanlike play of the Germans and other people, who are taking also to football, hockey, and rowing, and the various forms of Anglo-Saxon exercises. Nothing can make Nations respect one another so much as intercourse by means of games; and, besides this, Nations are now learning this great secret of the success of the English-speaking peoples, and will soon adopt games as a part of their education as opposed to mere gymnastics or other exercises. The German Emperor is too open-minded to neglect so valuable a means as this of helping on his nation; and here victory and the desire for victory are least likely to lead to ill-feeling and jealousy. Each Nation may add its own contribution to the total number of games, and to the ways of playing them. America can teach us the use of electric light to enable large numbers of athletes to get exercise in crowded cities. For example, one can play games with rackets by electric light on the sixth floor of a building in Boston.

Games and athletics and sport are a magnificent preparation for war, while, on the other hand, they are the great influence of the present day that is making for unity by mutual understanding and (therefore) mutual respect, while differences of language, of commercial aims, of customs, and even of dress and appearance stand in the way of this true unity. When many Nations compete in many games, as England competes with America in some few games already, and when games have become more democratic, the intercourse between nations will change for the better. Each Nation has certain games of its own and needs certain other games to develop the qualities in which it is wanting. New York business men should take up some form of sport which might develop patience. The

English, on the other hand, need more steady practice. They should borrow the Swedish system of gymnastics. The Germans sadly need games to improve them in promptitude and generosity: lawn tennis and football would be among the best. With the Germans practice is a second nature: they want to improve at games, but they have no idea how to do it. This book may show them how to improve their standard of play by cheap means, at the same time that they develop their bodies.

But the book is not only for those who do not speak English: it is for the English-speaking race in particular. We are more likely to practise exercises which are healthy, if we know that they will raise our standard at games. We have given to the world of athletics far more than we have received, and it is time that we looked about us to see what we can borrow and adopt. From America we have lately borrowed and adopted the car such as they use in New York. Let us see whether we might learn lessons from them in athletics, also, and from Germany and other Nations as well. From the German system of drill we may learn to develop the less used parts of our bodies. We have given much to others,—for example, such games as football, cricket, and lawn tennis. But we can get back from others almost as much as we have given them, if only we are on the look out for improvements.

It is an aim of my work to supplement the games which we already play, by exercises and other means—for instance, by exercises for the lungs; and to prepare for these games in a scientific way, by making sure that the correct positions and movements are mastered thoroughly as the foundations of good play. And I am trying also to offer advice about games for the benefit of the Germans and other people who need to cultivate a good eye and rapid power of adaptation in the pleasantest possible way. For the pleasure and joy of games are among their chief recommendations: this is why we prefer them to mere exercises. If, however, we could be assured that the supplementary and preparatory exercises would increase our success at games, they then would become, if not enjoyable, at least bearable. What would have to be done consciously and with effort at first, would soon become sub-conscious and practically automatic. Nor must we forget that it is on our health that the future success of our nation will largely depend. Our women must not be neglected here. Our health and our success will at present depend largely on whether we and they take exercise or not. Whether we take exercise or not will depend largely upon whether exercise interests us or not.

We need education on the subject of games as well as on the subject of health, but this latter subject is one of the most important for us, and every year it will become more so. The ordinary man, after his school and university life, begins a more or less sedentary life in an office. He may have learnt Anatomy and Physiology, but he has not learnt Hygiene. His mother has not taught it to him, since his mother has never learnt it. His teachers have not taught it to him, since his teachers have never learnt it. Throughout our highest education, at private schools, at Public Schools, at the University, most of us have no single word of teaching on the subject.

Now people can keep in health so long as they have regular exercise six times a week, but in an office, with a game twice a week at the very most, they become unhealthy and do not know of any cure. I hope that this book may do something towards enlightening the hard-workers, on this vital topic, which surely should be taught and studied from the very earliest years up to the very latest.

The scope of this book will be seen from the summary in Part VI p. 479. Here I need only give a vague idea of it by a few examples. Good sample-pages would be 35, 89 101, 138, 177, 179, 255.

Many interesting questions are wont to suggest themselves to us from time to time. We ask ourselves, for example: Which are the best exercises? Are the same exercises good for us at different times of life, at different times in the year, at different times in the day? What does exercise do for us? How can we learn to play games and to take exercise in the best way? How can we find out our faults and how can we correct them when we *have* found them out? What is the best way of walking? What is the best way of sitting? What is the best way of breathing? Why do runners frequently hold their arms to their sides while they run, and why do they frequently try to cling to solid objects when they are out of breath? Why are some puny exercises very tiring, not only to parts of the body, but even to the whole body? What is the effect of hard brain-work upon a game or upon exercise when it is done just before the game or exercise?

Or questions about details may occur to us: for instance, why should a stroll often be far more tiring to the legs and to the head than a brisk walk? Why does a fast runner so often turn in his toes? Or, what are the best kinds of shoes or boots? Or numbers of us ask what is perhaps a far more important question than all of these: Which are the best foods, and which are the worst?

These and many other questions will be answered in this book. The reader will get an idea of the scope of the work, if he looks at some answers to these questions, given in vague outline. What I say here is of course only a fraction of the whole answer.

The best exercises are those which are taken in the best air, those which bring into play the largest muscle-areas, those which give most exercise for the lungs etc., with the least fatigue, and those which are most rhythmic, and (to some extent) those which have been practised most, etc., etc.

Different periods of life demand different exercises. To take two extremes, the very young need many short exercises of speed, and not exercises of strength or endurance. In middle life we need some exercises of strength and endurance, and not so many of speed.

Exercise tends to increase the number of heart-beats. The heart pumps the blood more quickly through the body, and the blood carries with it more nourishment and force, and repairs the tissues of the body more quickly, and it also carries off the Carbonic Acid and the 'Waste-products' more quickly.

We can learn games and exercises best by practice of the right kind, apart from the real game or exercise itself. At first we should practise under the easiest possible conditions, and very very slowly and correctly, and we should practise 'Part by Part' before we attempt to combine the various parts. As to correcting faults, or rather as to finding out first of all what they are, we must analyse the whole movement into its various parts (some movements containing ten or more parts), and among these parts we must include the position of the various parts of the body, a consideration which is often neglected by teachers of games. We must find out in which part or parts our mistakes lie, and we must correct this part or these parts with great care. If necessary, we may even have to practise the opposite fault, or (still better) we may have to practise certain obstacle-exercises, after which the simple exercise itself will be all the easier.

As to the best way of walking—for long distances at any rate—walking with bent legs needs less effort, if only one dared to do it, and if only one had practised well beforehand, but not otherwise.

As to the best way of sitting, much depends on the chair, and on the desk. It is an important consideration, as such a large amount of time is spent in sitting. For instance, in reading or writing, the desk should be sloping, we should sit straight up and straight in front of it, and the paper should be also straight in front of us, so that we do not curve the Spine.

The best way of breathing is through the nose, partly because the nose filters the air and warms it. Not long ago, while walking in London, near Covent Garden, I counted only five people out of fifteen breathing through the nose; the rest were breathing through the mouth. The breathing-in should also be upwards, the chest being filled upwards, and in 'practice' the shoulders may sometimes be lifted while the breath is being inhaled.

As to why runners frequently hold their hands and arms close to their sides, and cling to solid objects when they are out of breath, it is because the ordinary breathing apparatus is not always sufficient to give them breath. We have in our bodies what may be called a 'false' or extra breathing-apparatus, and this is brought into play best if the arms and shoulders are kept firm. In other words, breathing can be helped by certain more or less artificial means.

Exercise is often tiring, quite apart from considerations of bad air and bad health, when it only affects a very small muscle-area, and a muscle-area which is little used.

The results of brain-work just before exercise are very doubtful, but experiments have been made which show that immediately after *hard* brain-work there is less power in certain muscles of the body. Much, however, will probably depend on the food which has been taken.

For the questions of detail—a stroll is apt to be fatiguing, and even to bring headache, partly because the blood settles e.g. in the legs, as it does when one stands. It does not circulate as freely as it circulates when one takes a brisk walk or when one makes 'full contractions', by the Macdonald Smith system.

Runners often turn in their toes, partly because ordinary boots and shoes turn out the big toe unnaturally. If you look at your boot or shoe, you will see that this is the case. The big-toe inside the boot or shoe does not point straight forwards, but turns outwards. Now the big toe does much to lift the body as one walks or runs. It differs from the thumb in coming flat down on to the ground, and to get the best leverage the big toe must come down perfectly flat and pointed in the direction in which one wishes to move. The only way to get it flat on the ground and in this direction is to turn the whole foot inwards, so as to make up for the big toe being turned outwards by the bad shape of the boot.

The best shoes and boots would therefore be very different from the kind we are wont to wear. They would be more in accordance with the natural shape of the foot, and, if one dared to wear them thus, they would be open, so as to expose the foot to the air.

As to the great food-question—the best food will not be that which is best for exercise only, but that which is best for sustained brain-work also. And here I differ radically from Dr. Schmidt, for I insist on the personal experience of each individual as being the most important criterion; I insist that no one has a right to dictate on the subject, unless he can keep up hard brain-work and hard exercise for long periods together without feeling fatigue; and I insist on the fact that the least healthy, that is to say, the people who are the most easily affected, are the best tests. I insist on a large number of scientific experiments under different conditions, continuing for a sufficiently long time, before any general conclusion be arrived at.

Other questions, for the answers to which I must refer to the book itself, would be: What is the reason of tiredness, apart from want of practice? What does the Oxygen do in the blood? Are there any exercises that might gradually help to cure such terrible complaints as consumption and constipation? How far should the left side be developed in games and exercises?

These will be found answered in the book itself.

But my object is not merely to satisfy curiosity. It is also to encourage every one to try for himself, to observe what happens under certain conditions, to make notes of his experiences (and thus to contribute to our general knowledge), and above all to practise in the right way.

My object is to help people, and especially the young, to make the most they can of themselves. I wish to call the attention of all those who are in authority to what may seem to be small things, but which really are great. I do not wish simply to help the reader to success in games and exercises themselves, but to show their importance for health, to show how they affect the heart, the lungs, the digestion, the brain, and so on; and also to show *how games can be an education,* not merely in Anatomy and Physiology, which are in themselves very important subjects, and which are best learnt if one learns about interesting games and exercises, but also in the great lessons of life, such as obedience to the right laws, practice and habit, co-operation, and so on.

While I am showing the best conditions for exercise, and the best methods too, I wish to expose a number of popular fallacies, especially the fallacy that "A game is only a game."

Many Germans (Dr. Schmidt is a happy exception) are for the most part under the impression that a game is not even a game, but is merely the development of muscles; most English people think that it goes a little beyond this, but there are few who realise that in many respects a game may be the very finest all-round education and training which we can offer. This will be proved in Parts I and II. What I myself owe to the influences of games I can hardly estimate.

My own part in this book is based on personal experience, and I hark back to this point. The personal experience of each person must be of more value to him as his guide, than anything else. But *one object of this book is to prevent a great deal of unnecessary personal experience.* I have suggested what I have thought most useful with regard to brain-work, training, diet, and so on, and also improvements in games, and in the carriage of the body, and in breathing. I have recently found, for instance, that to keep the left shoulder back is not only useful for the carriage, and for lung-development, and so for the 'wind', but is absolutely essential for a proper stroke in a great number of Ball-games (such as Rackets). But what I have found out is probably only a small portion of what each might find out for himself. The experiences of many others are sadly needed, and it will give each reader a fresh interest in every exercise that he tries, and indeed in everything that he does, if he feels that he may be finding out something which will be useful for others besides himself. Throughout games and exercises it is of the utmost importance that everyone should realise this. It will raise the point of view from which games and exercises are regarded, and will encourage observation and memory and many other faculties. In truth, the personal experience of numbers of separate persons may some day prove to have been and to be the greatest teaching influence in the whole world. At present it is the most solid basis of the Science of Health. More on this subject of General Health will be found in a work which will be published in a few months.

Everyone wants to be healthy, everyone is interested in health; but very few take the trouble to be healthy, and still fewer dare to think for themselves. They are the slaves of habit and custom and fashion. If this book does anything towards making the majority try new methods and then rely on their own judgment, it will not have been in vain.

EUSTACE MILES.

King's College, Cambridge.

# CONTENTS.

# ADDITIONS AND CORRECTIONS.

[BY E. H. MILES.]

**For ready reference** the following list of pages will be found convenient.



The long interval between the printing of the first and last pages of this work—an interval partly due to the effects of the war on trade—has made certain corrections necessary. Besides this, it was not easy to arrange certain questions of Capitals etc. with the publisher in England and the author in America. Hence certain inconsistencies. The following corrections seem to be the most important.

Preface, p. vii. To the list of Papers add—'Health and Strength', and the German 'Sport im Bild' (Berlin).

P. 66 (bottom of page): add—'Hockey on the Ice, as played in Canada and the United States, is one of the most skilful and graceful of all games.'

P. 72: add—'*Skating* has many advantages—the cold dry air, the joy of self-command, the full contractions of the muscles, all enable one to get through more exercise with less fatigue.'

'*The Ball-Game Exerciser* enables a player to keep in training and in practice without the loss of time or money. Odd moments can be used throughout the day and the year.' See Notice on the last page but one of the book.

P. 92 (5 lines from the bottom): for 'unquestionable' read 'questionable.'

P. 119 (The Corset): add—'Mr. Macdonald Smith has shown that grace depends largely upon the base being narrow. If ladies cover up their naturally narrow base, viz. their ankles and legs, they naturally have to begin a narrow base on the second storey, as it were. Hence the small waist. Before we tell ladies not to pinch, we must first allow them to wear shorter skirts. We do not demand ridiculously small waists of ballet-dancers. Personally I think that the high heel and the narrow shoe is also due to a similar desire for grace (by means of a narrow base). If ladies would only wear lower-heeled and broader shoes, there would be far less harm in short skirts. To put it coarsely, men would not *care* to look. Our women would be more active and healthy, and there would be less tendency to pinch. A wasp-like waist with a sensible shoe would be almost an absurdity. The reform must begin with the feet. I wish some prominent ladies of fashion should set a good example.'

P. 158 (The Law of Muscular Health): add—'natural and regular exercise is perhaps not so correct an expression as *proper* exercise. A muscle's health—so Mr. Macdonald Smith has shown—depends on its right *nutrition*, and not on its amount of more or less haphazard exercise. Its nutrition, in turn, depends *partly* on its full contraction. See pp. 500—502.'

P. 162 (first line): for 'tracts' read 'tracks.'

P. 167 (9 lines from the bottom): add—'Since writing the above, I have found that Mrs. Archer derived her idea (of training for repose) from Miss A. P. Call, of Boston, America.' She in turn followed François Delsarte.

P. 171 (Headline): 'for 'Musgles' read 'Muscles.'

P. 218 (9 lines from the bottom): for 'anœmic' read 'anæmic.'

P. 244 (line 14): for 'invariable' read 'invariably.'

P. 288 (Footnote): add—'Dr. Kellogg, of Battle Creek, Michigan, has the best selection of grain and nut foods that I have tried. Such foods as Nuttose, Granut and Malted Nuts are very easily digested. They can be obtained through Mr. Bilson, 88 Gray's Inn Road, London. They form a cheap and pure and varied diet for those who can digest grain-foods. The International Health Association now manufactures Dr. Kellogg's Foods at 70—74, Legge Street, Birmingham. Dr. Kellogg publishes an excellent monthly paper "Good Health".'

P. 395 (7 lines from the bottom): for 'musclus' read 'muscles.'

P. 322 (18 lines from the bottom): for 'Heat' read 'Meat.'

P. 362 (12 lines from the bottom): for 'or' read 'and.'

P. 439 (line 14): for 'pleasant' read 'pleasure.'

# PART I.

[BY E. H. MILES.]

## HOW TO LEARN AND PRACTISE GAMES AND EXERCISES.

1.—COMMON FAULTS IN GAMES AND EXERCISES.

2.—HOW TO LEARN AND PRACTISE (GENERAL HINTS).

3.—HOW TO LEARN AND PRACTISE PART-BY-PART.

4.—A SAMPLE LESSON.

5.—OBJECTIONS TO THE PART-BY-PART METHOD, WITH ANSWERS.

6.—HOW TO CORRECT FAULTS IN GAMES AND EXERCISES

7.—WHEN PRACTICE AND EXERCISE ARE LEAST TIRING.

## I.—COMMON FAULTS IN GAMES AND EXERCISES.

The chief cause of the commonest faults is Ignorance. Many Teachers do things too easily themselves to see difficulties in what they do; and the books which do explain the processes are very often too technical in their language.

The second cause is Bad Health, which arises especially from errors in Diet. These errors, and other causes, may produce fatness, and general incapacity.

A wrong method of Breathing sometimes hinders success. People who breathe through the mouth, and who take short breaths and seldom or never inflate their Lungs fully, are at a great disadvantage as compared with those who draw deep breaths through their nose.

Bad ventilation is another cause of failure. People sometimes practise, only the rooms in which they practise are generally stuffy, and hence tiredness comes very quickly: the Practice perhaps gives them a head-ache.

A minor cause is Wrong Clothing. Most people wear the wrong kinds of Boots or Shoes, that is to say, Boots or Shoes of an entirely wrong shape. They have tight somethings round their waists, or perhaps near their knees, and although such things may produce but little effect on each particular movement, the sum-total of hindrance may be very considerable.

Again, many people play or practise at the Wrong Times; for instance, after hard work or after heavy meals.

Of course the want of previous Practice, especially of Practice of the right kind, is a constant source of failure. Many of those who put aside an Exercise for a long time, even if they are very skilful at it when in training, are almost like beginners when they take it up again.

On the other hand, some people practise too much. This may be fatal in any case, because the pupil may get 'stale', but it is most fatal when the Practice is Practice of the wrong sort.

Others continue playing or practising after Fatigue has begun. They practise monotonous Exercises when they should either change or rest. Hence comes Local or General Fatigue.

Others fail—and they form an enormous class—because they are in the Wrong Position. There are some who have almost their whole body in the Wrong Position; there are some who only have parts of it wrong.

Let me take one instance.

I have seen a player of Rackets grip his racket in the wrong way with his hand, and hold it in the wrong Position, that is to say, with its face close to the ground; thus he will get no swing. His Feet were in the wrong Position; they were facing the front-wall, instead of facing the side-wall, as he made the Stroke. The body was bent forwards instead of being upright. The left shoulder was forwards instead of being back. The head was forwards instead of being back, and he also shewed other faults which were scarcely less serious.

Among these other faults the chief was that he did not use some parts of his body at all. That extraordinarily powerful Muscle under the Arms, which we shall describe later on, he did not employ in the least, and some Muscles which he employed he employed altogether wrongly. But the strongest and the *steadiest* Muscles in his body were those which he neglected most. He left the main part of the work to his Wrist.

Hence he made many exhausting efforts which were not in the least necessary, and many sideway-movements, which might have been avoided had he first carried out the Exercises rightly. He was really using a small Muscle-area, when he ought to have been using two or three large Muscle-areas as well.

The chief cause of all these mistakes, and of his mistakes in general, was that, in so far as he *had* practised, he had practised the whole movement as a whole movement, and not Part by Part. Supposing the movement consisted of only *ten* parts, and supposing only *three* of these were wrong. If he went on practising the whole movement by itself for a whole year, it is hardly likely that those three faults would ever be properly corrected. When you have a fault in Piano-playing, you try to find out what it is—you do not play the *whole piece* again and again in the hope of doing the single part right, you try to find out (or are told by some one) which *part*, e.g., which Finger, is wrong. Why not apply this method to games?

And again. When he watched players who were playing perfectly, he did not watch different parts of them, such as the Position of their Feet and the swing of their bodies, but he watched the general effect which he tried to produce *as a general effect.* Needless to say, he failed to learn.

The fact of it is that he, like most people, did not spend time in laying his Foundation-Position and Foundation-Movements correctly and surely. Possibly this was because the Movements had no interest for him in themselves. It had not occurred to him that it was worth while to do them.

And in the Game itself he did not concentrate his attention enough. He did not throw his whole will into the work.

Of course at the root of a good deal of this there was not only Ignorance, but also Impatience and Hastiness. People wish to begin to do the whole thing right at the very outset, to reach the very highest level of excellence all in a moment, to do the Exercise at full speed directly they start. This is a grand error. In a game of Lawn-Tennis, for instance, it is a mistake not to have a preparatory gentle knock-up before the Game begins.

A common fault is for a man to play a Game which is not appropriate for *him.* He is an active man, and he tries to play standing still and reaching everywhere, or he is a man with a long reach who does not use his reach, but runs about from place to place.

He has not observed his own or his opponent's weak or strong points. He has not taken advantage of these strong and weak points. He has not corrected his own weak points. He has not studied the commonest strokes of the Game. Even the most obvious strokes always seem to come to him as a kind of a surprise.

A serious and a very common fault in Games and Exercises is that they are often pursued for their own sakes and not as a means to an end. Even for their own sakes, they are almost worth pursuing, but they are much more worth it as a means of all-round development, of Health, of Happiness, and of Mental and Moral improvement.

These are but a few of the causes of failures in Games and Exercises, a good many of which might easily be remedied by the System of practising Part by Part to begin with; and by bearing in mind many General Rules for Learning and Practising.

## 2.—HOW TO LEARN AND PRACTISE GAMES AND EXERCISES (GENERAL HINTS).

In Education there are many fundamental Laws, which are constantly ignored. Among them are the Laws of Pointing out Contrasts, of choosing and mastering Simple Beginnings, of Interest, of Concentrated Attention, and of Conscious Effort.

A beginning should by rights be made with an account of how *not* to Practise, but here mention need only be made of a few mistakes which are most common. The utter want of system in Practising almost everything in the world is most remarkable. In *some* Games and Exercises there has been found a system; I think, for instance, that for Rowing and Billiards, the present system at its best is in many ways very good. But in most matters people are entirely guided by Habit and Custom, and try to do the whole thing at once. They even go further than that, and try to learn a Game merely by playing the Game itself.

Now this may be well enough for the genius, i.e. for the person who does the thing right by instinct. But the average person is bound to make innumerable mistakes. He will often be in the wrong 'Position', and the 'Position' includes very many parts of the body; for instance, the Feet, the Shoulders, and the Head. He will often learn or practise in bad air, and will breathe wrongly all the time; he will practise also at the wrong times; he will not exert the most valuable Muscles of his body, for he will leave all the work to tiny Muscle areas, like the Wrist, which (as we shall see later) are the most easily tired. This is not all; not only will he fail, and fail to improve, but he will form a bad habit which will be very hard to get rid of. He will be filled with despair, which the teaching of the Genius-player will do nothing whatever to diminish.

Even if he does practise certain Exercises rightly, he may often choose the wrong time,—for instance, after hard work, or after a heavy meal; and he will not take pains to find out first what the real interest of the Exercise is.

But, supposing he is told that the Exercise of swinging the body round will be a very fine Exercise for his Lungs and for his Heart and for a huge and valuable Muscle-area of the body, and that it will come in useful in a great many Games, and that it will help him to avoid fatigue, and will give great power and great success to his stroke, then probably his interest may be secured, if he is really convinced. He will probably then be content to practise.

Let me first of all begin by mentioning the best *Time and Conditions* for Practice in general. Above all remember to 'Use all your odd moments'. When you are walking you can practise Wrist-Exercises; when you are sitting, you can at least sit correctly, and you can then also practise certain Exercises. Practise while you are waiting; e.g., in a room, which should always have the window open: you might easily do certain Leg and Arm Exercises. They will be a splendid relief after hard work; they will be good for the whole body. You can take also exercise before a bath, before going to bed, and before a meal; but then the exercise should not be too heavy.

*Aim at the healthiest possible conditions whenever you practise.* Get the right kind of nourishment, avoid the wrong Foods, and avoid excess or deficiency; if possible, practise at regular times, and *begin under the easiest possible conditions.*

This is of the very utmost importance—to choose the easiest possible conditions to begin with. There will be less to distract you in a bare room with an open window, and with very few paraphernalia (with just a racket-handle, when you are practising Part by Part). All this will alone make the Conditions better; and, if you practise rightly, the Exercises themselves may become easier and easier.

You should always practise *the expected and regular* before the unexpected and sudden. That is to say, you should let a movement become a habit, a regular habit, before you use it in an emergency. Therefore at the outset Rhythm is very important. Later on, I suggest a Metronome, or perhaps a Phonograph, as a great help for the maintenance of Rhythm. For, if you can see or hear anything keeping time, your motions will be far more rhythmical. Even a word of command by oneself given to oneself, may be of value.

If one thing is more important than another, in Practice, it is Interest. You should think of all the *Motives* which may induce you to practise, all the advantages to be gained from

Practice. This is no mere idle piece of advice. It is really worth while to think of all the good results *before* you do a thing. It will certainly not make you do it any worse: it will probably make you do it far better. If you can remember that your Health, your success in the Exercise itself and in Games, your success in other things as well, will be thereby improved; if you can remember that you can yourself find out for yourself a great deal that may be useful; if you can get, from this subject, lessons which you may apply to other subjects also; if you watch and note your progress;—all this will assuredly help you to take interest in the practice.

By this means you will be able to *Concentrate your Attention* and to focus it upon the matter in hand; you will be able to apply your will-power to this and to this alone. *Effort* will be essential, but it will become far smaller when you are interested in the Exercise. Sandow rightly advises people to throw their whole will-force into the movement; and the more will-force and energy you throw into it at the outset, the sooner the habit will be formed, the quicker and easier the movement will become, and the less effort you will have to use afterwards. Afterwards you will need far less nerve-force, and the action will be carried out practically automatically. The time and the energy, which you can save in this way, you will then be able to devote to other things.

*Gradually increase* the effort and the strength of your movement. This you will perhaps do almost unconsciously. At any rate the pace and rapidity will increase of their own accord. You should also increase the number of times which you do the thing, the length of time for practising, and, lastly, you should at the end do the movement with certain Obstacles. Begin with the very easiest conditions, but end up with the hardest; always do the things very slowly and carefully and part-by-part *at first*. Find out what the Foundation-Movements and Positions are, and practise them one by one, amid easy surroundings, constantly correcting them and all the time doing them consciously and with effort, until your attention begins to flag.

Directly the attention wanders and you cannot easily 'collect' it, and, still more, when a tired feeling comes, then stop, stop there at the tiring-point, and *either rest or vary* the Exercise.

At first you should not try complex movements; but, after the simple Foundation-movements have been mastered, then you can go in for special exercises, in Variety and Promptitude, for the commonest combinations and co-ordinations, as they are called.

As to Variety. Short, sharp exercises with rests in between, but alternating with slower and longer Exercises, will be practice for your Endurance. A Variation of these two classes of Exercise will be most valuable. Then, again, you can vary the pace, and you can vary the intervals between the Exercises.

It is needless to say that alterations must be made *to suit the individual.* Some Foundation-Exercises, after a fairly long trial, may perhaps be discarded; others may be slightly adapted.

It is just as well to get *the reasons* for what you do, i.e. to get the reason why such and such a movement is right and good, and such and such a movement is not. Get at the cause of your failures, and make notes of them, and correct them.

A good piece of advice is, to practise your weakest point until it becomes almost as strong as your strongest. But it may be as well to remember that, in your Match, your strongest points should be used; in a Practice-Game, however, not these so much as your fairly strong points, and some of your weaker ones. In practising Exercises by yourself, you should devote your attention almost exclusively to your *weakest points.* The weakest points you will be able to help by *exaggerating the opposite fault.* If you stand too much in one direction, then get out of the habit by standing too much in the other.

Ask hints of those who are able to give them, and keep notes in a note-book. Here you can keep records of good pieces of advice, of your strong points, of your weak points, of your progress, of the strong and weak points of others and so on. You can ask questions, you can read, you can think over the Problems, and you can *watch others*, especially the best players.

But here it is most important to watch one part at a time. For instance, if you wish to study Roberts playing Billiards, do not look at Roberts 'in general', but study, for instance, the position of his Feet in particular, then the position of his Wrist, and the position of his Fingers on the cue. Study one part at a time and, above all, *make notes* and learn them and put them into action.

A method of Practice very little known is *Imagination.* If you imagine yourself to be doing a thing rightly, it will considerably help you when you come to do the thing itself. It is not an easy habit to acquire, but it may be very valuable.

For Practice it is often very useful to form a kind of *Club*, if possible, in which to discuss points (either in conversation or in letters), and to establish certain accepted Rules of Health; for instance, Early Rising and Exercises. There are many things which are infinitely easier for you to do when you know others are doing them as well. I noticed that, in a German Nature-Cure Establishment, the habitual German beer-drinkers were not unwilling to give up their beer and go in for a simpler life, when they found that all those around them were doing just the same. The sympathy and the feeling of emulation which will arise in such a Club will be very great incentives to Practice.

Though you should *aim at a very, very high standard of excellence*, you should *begin* under easy conditions and *when the movements are quite unnecessary.* It is a common mistake to know the right way of doing a thing, but not to put it into action until the crucial time arrives. Everything should have been *already* practised and become a habit before the important event takes place; then the effort will be so much the smaller, and the certainty so much the greater. Make the scientific Method an integral part of yourself before you put it into real action.

*At first* your efforts will probably be clumsy and will require great patience and care, and constant correction. Soon they will become neat and successful. *The earlier you begin in life* and the more you concentrate your attention on the *Foundation-Positions and Foundation-Movements*, the greater your success will be in the Exercises themselves, in Games, and also in general Health and general development of body, mind, and character.

## PRACTICE IN GAMES.

A few words may not be out of place here on the right way of Practising Games, as opposed to mere Exercises, Gymnastics, and Drill. The Part-by-Part System of Practice (see page 16) is rather a Practice of Exercises than of the Game itself; it is more like Drill. But Games need other Exercises than this. These Exercises are indeed indispensable to success in Games, but to them must be added something fresh.

*A distinction is to be made between Matches and ordinary Games and mere Practice.* In Matches, where the object is, or rather one object is, to win, you should go in for your strongest points of all, unless your opponent is weak, in which case you can of your own free-will dock off and keep in reserve some of your special strong points. But in Matches, as a general rule, you should use all your best points.

In Practice-Games, on the other hand, it is essential first of all to have a right *Handicap*, so that a Game may be carried out on equal terms, and so that there may be *a real and hard struggle*. Handicaps need not always be used, for an up-hill Game is a fine lesson, and an easy victory is sometimes refreshing; but, as a rule, something should be done in the way of Handicaps to make the play equal. In Practice-Games you should try Experiments up to a certain extent, but above all you should practise your rather weaker points. Notice your faults, and analyse them, and make Notes of them. Attend to these Notes during the Practice-Exercises.

Always play up your hardest, but *do not begin your hardest at the very outset.* Always begin quietly and at half or three-quarters speed. In many Games there is a Knock-up before the actual Game begins. This should be quite gentle and mild, and, even in the actual Game itself, you should not put forth your full power at the start. Begin slowly, and do not expect to succeed at first. In the Practice before the Game, or in the Knock-up, *go through a few of the most typical movements* first, a few dozen times, and then a few of the more complicated and difficult strokes, so that you may see your faults and especially your faults for that particular day; and these you will then be able to correct, almost before the Game itself begins.

This will still leave you something for your Practice-Exercises as distinct from Matches and Practice-Games. In the Practice-Exercises you can correct those faults which you have been making in your Practice-Games, and you can put into action any suggestions and hints which may have been offered to you in the course of the Play.

Above all, *in these Practice-Exercises practise your very weakest points* and try to bring them up to the standard of your strongest points. Correct your faults Part by Part, and by the help of the Exercises of Exaggeration and the Obstacle-Exercises.

This seems to be the principle according to which one should regulate the work that one does in Matches, in Practice-Games, and in Practice-Exercises respectively.

On the following very important point, especially in many Ball-Games, Mr. Mahony, the great Lawn-Tennis player, has called attention to the 'mathematical' reason for the rule.

When Ball-Games—and many other forms of Exercises too—require accuracy of *Direction* and of *Timing*, as well as great *Endurance*, then *there are many occasions on which the Wrist-Movement is not the best.*

I have here in my Left hand a Tennis Racket: put your own Left hand, with something solid in it (say, a pencil), into this position (A): put your hand in front of you, so that you can see it, and move it, *by the wrist-turns only*, from (A) to (B). Now notice the Curves in which the Racket moves.

This Curve may be roughly given as (C), and, if you are moving your Wrist thus (or in some other way) during a stroke, the Ball will be hit by the Racket while the Racket is *somewhere* in this Curve.

(D) will roughly mark some of the *Directions* in which the Ball may fly off when the Racket has hit it.

If you make the least error in *Timing* the exact point when the Racket is to meet the Ball, the Direction will be altered enormously. It does not matter whether the Direction is

(i) towards the right side or the left side, or

(ii) up or down.

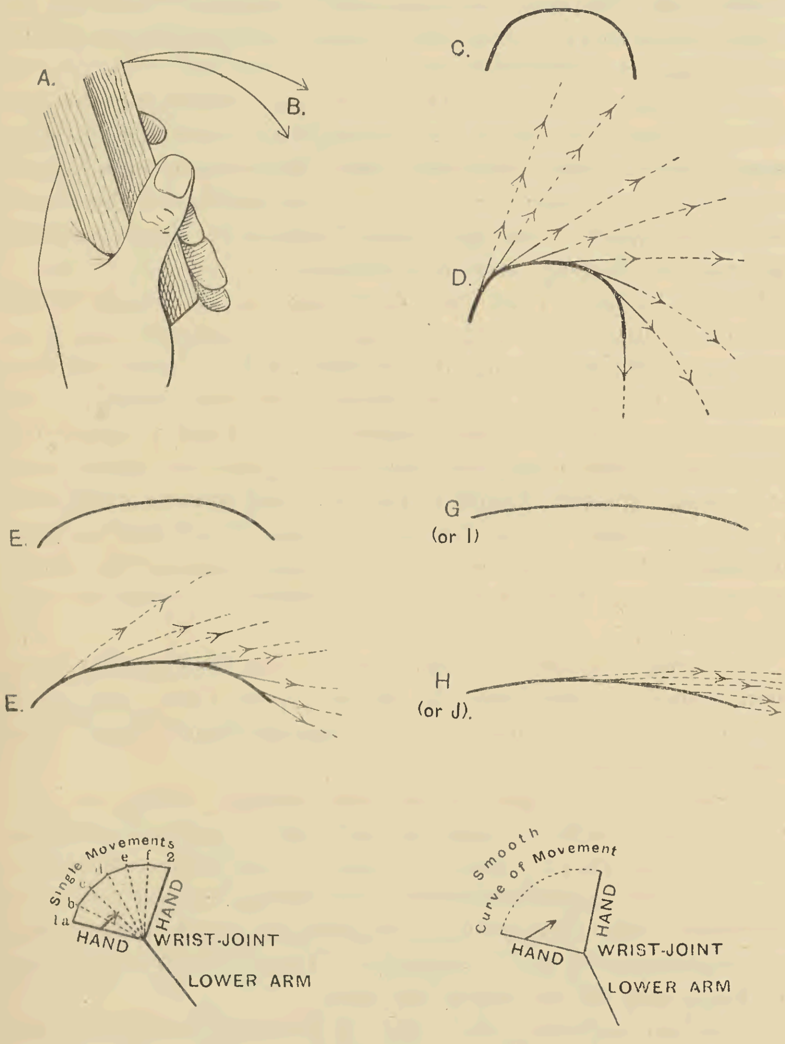
Anyhow, the slightest mistiming will make a very great difference. In Lawn-Tennis, for example, such a pure Wrist-flick might send the Ball

(i) out-of-court, on the right side or on the left, or

(ii) into the net, if you hit the Ball too soon, or too high up and out-of-court (beyond the back-line) if you hit the Ball too late.

So, unless you have a splendid 'Eye' (which does not merely mean good sight), *you run the greatest possible risk.*

Now try this second movement, still holding the handle, or whatever it is, in your Left hand. Keep your Wrist quite stiff, and keep your Left Elbow quite stiff, and down to your Left




side below the Ribs. Let the Lower Arm and Wrist and Racket form almost a straight line. Then (keeping the Wrist quite stiff and straight, and keeping the Shoulder still) turn your Lower Arm about the Elbow in various directions, as far as it will go.

The Curve made by the Racket's face will be roughly illustrated by (E). It is a 'flatter' Curve than (C), and so, if you mistime the Ball, the mistake in the Direction (F) will be far smaller than in (D): i.e. the Lower Arm Movement will be 'safer' than the Wrist-Flick.

Now keep your whole Arm below the Shoulder quite stiff. Let the Arm and Wrist and Racket form, as it were, a firm strong Stick. Then move this whole Stick about in all directions, as far as you can. (G) might give an idea of the Curve, which is almost a straight line. Hence the chance of misdirecting the ball (H) would be smaller.

Lastly, keeping your two feet firm on the ground, about 12 inches apart, and with the toes facing forwards, turn your body and Shoulders round to the left, as far as they will go; you may be able to *face* backwards, but your Shoulders will probably only make a three-quarters turn. Then, keeping your Wrist and Lower Arm and Shoulder all quite stiff, swing your body round till the Shoulders face fair and square to the front. The Curve made by the Racket-face here (I) will also be extraordinarily 'flat'; it will be almost a straight line, and the chance of sending the Ball in the wrong Direction (J) will be very small indeed.

The power of the Muscles used in this movement is enormous: and the movement is not apt to be tiring, and yet is splendid Exercise, whereas the Wrist-movement is not worth much as Exercise.

At the other extreme come the Shoulder-Swing and the Body-Swing. Both of these are very safe: a serious mistiming does not mean a very great difference in the angle. Moreover, these Movements, especially the Body-Swing, are very valuable Exercises; *some* Body-Swings, for example, may help to prevent or cure Indigestion and Constipation. Lastly, the Muscle-Groups are huge, and do not easily get tired.

There are occasions when there is no time for anything else but the Wrist-movement; it must perforce be used: and elsewhere it may be *added* to the other movements; but the Lower-Arm-movement is safer than the Wrist-movement.

The general Lesson is this—it only applies to many cases, and of course not to all; but beginners at Golf and Cricket, and at many other Games and Exercises, would do well to ponder it carefully.

*The Wrist-movement is often dangerous:* a slight mistiming may mean a very great difference in the angle. Even a slight difference in the angle when the Ball leaves the Racket, becomes a very great difference when the struck Ball eventually hits the ground or wall etc.

Therefore, above all, Practise these *large* Movements one by one, again and again, until they become Half-Automatic. Three hours of such Exercises, done properly, may well be more improving for your play in Games in general, than three days or three weeks or three months spent in playing the Games themselves.

## 3.—HOW TO LEARN AND PRACTISE PART-BY-PART.

If you wish to read a book in such a way that you may be able not only to *remember* the ideas, but also to use and *apply* them when you wish to do so; what is your best plan?

Is it not first of all to get a general notion of the book, as a whole, and to master this outline first; then to consider each part by itself, mastering the ideas of the First Part to begin with; then to run through these quickly before you attack the Second Part; and then to master the Second Part by itself; to run quickly through the *two* Parts before you attack the Third Part; and so on? Finally, you may go through the whole as a whole once more.

By mastering the outline first, you will see exactly where each Part comes in, and what relation it has to the whole; by mastering one Part at a time, you will be able to concentrate and focus your attention, instead of having it constantly distracted; by going over the old Part or Parts before attacking a new Part, you will be making sure of what you have already mastered.

Let us try to apply this system (to which, of course, much must be added before it is complete) to the mastering of Games and Exercises.

Begin, then, by getting a *general idea* of the Game and Exercise, as a whole; you will probably have to spend some time in doing this, but it will not be wasted. It will, among other things, help you to see what qualities, and what movements, are required.

But of this general idea of the Game and Exercise we shall not treat here. Here we will consider the various *Parts* of Games and Exercises.

The first question to consider is 'What is meant by a "part"?'. One 'part' of Games and Exercises which is very little considered, and which is itself capable of being divided into several parts, is the Position and the Balance. It is one of the most important of all. For many Games and Exercises we need not only the right Position of the Feet, but also the right Position of each portion of the body. These must be acquired quite separately.

Another 'part' might be Breathing. This also has to be acquired separately. One has to know how to breathe, and when to breathe in, and when to breathe out.

Both these, the right Position of the body for equilibrium etc., and the right way of Breathing, can be practised quite separately and independently. But it is not this that we will consider here. We will rather speak of the different 'parts' of the Movements, in the more ordinary sense of the word 'movements'.

When a person is young, he or she should get a good stock of as many *Simple Movements* as possible. At first only 'the coarser possibilities', as they may be called, need be considered. A certain number of the commonest movements for each part of the body should be very thoroughly mastered, and this should be one of the objects of an all-round *Education*. One of them is explained on p. 12. A large number of simple types of movements should become quite familiar, and then they will be ready whenever they are wanted.

It will be far easier to combine these together into any required action of a complicated kind, when each part has al ready become easy by itself. This new combination of old and familiar Movements will enable the beginner at any Exercise or Game immediately to start with a very great advantage, and the Practice which he will have had will have improved his general faculty of Practice. The training in these initial Movements will therefore be the very best training for almost any form of Game or Exercise which may be taken up afterwards.

And now as to the system of treating any *one Part* of a movement. First of all, after the right *Position*, should come the *Foundation-Movements*. Let us suppose that one of these is thoroughly understood, and that it has been done once or twice quite correctly.

Later on it will be pointed out that you may find out the correct Movement, partly by the help of Anatomy and Physiology, and partly by watching the correct performance of the movement when it is done very slowly, and partly by Photographs, and partly by listening to advice, and again partly by personal experiments.

The question will naturally arise, 'Why study only one part at a time?' The answer will be that it will be easier to learn the whole and to correct the whole if you know the various parts of which it is composed, somewhat in the same way as it would be easier to correct and mend a clock if you knew its different parts. Otherwise you might not know in the least where it was wrong. Each part must be almost automatic, and unconscious, before the whole can be tried with success; else the attention will be distracted between many parts, and no part will be done well. The point of these Automatic movements is that, although at first the Brain has to think about them, and concentrate its attention on them, after a time the Brain almost ceases to think about them, and the movements are directed no longer by the Brain, but, say, by the Spinal Cord. It is as if the Brain said to the Spinal Cord, 'I have now got you into the habit of looking after these Movements; I can now safely leave you to yourself, just looking in every now and then to see if you are doing them all right.'

Having first found the correct idea of the Movement, try it before the glass, or with someone looking on, so as to make quite sure that you are really doing what you now know to be the right Movement. *Begin very very slowly*, do it again and again, and *at first rhythmically*, for the more rhythmical the Movement is the less tiring it will be, and the more you will be able to practise it. It might be as well to beat time, or even to sing, during the practice (see also p. 7). The Movement will gradually become faster and faster, almost of its own accord, and more and more effort can be put into it, because the Muscles will become more and more trained and practised. Eventually it will become easy and Half-Automatic.

The *advantage* of having a part as nearly Automatic as possible has already been mentioned. It will be infinitely quicker now, because the Brain will have a good deal less thinking to do. It is well-known that habit makes things quicker, and, from the point of view of Physiology, it seems that sometimes instead of each movement being directed from the Brain, cross-actions, cross-country runs, as they might be called, cut off a great many corners. We could imagine how slow everything would be if we had to think about it. If we calculate how long it takes for an impulse to travel from the Brain to the Muscles, had we to think every time our Heart moved, our Heart would have to work far more slowly. The rhythmical and involuntary movement of the Heart is a far quicker movement, and one far less exhausting to the mind and to the Nerves. Therefore, when a part has become Half-Automatic, the Brain will have to work less, and will therefore have more chance of thinking of other things. In a Game, for example, the Brain will be able to devote its attention, say, to the pace at which the ball has to be hit. It need no longer think about the Position of the Feet or of the limbs, and the mere 'mechanism' of the stroke. Just fancy how little one would be able to succeed at Chess, if, when one began to play, one always had to think what the moves of the different pieces were. That part of the Game must be mastered long before an important match is played.

After the first part has been acquired in this way, the second part must be acquired by itself in the same way.

Then the first and the second parts can be taken together, as a single movement, *if* they are capable of combination; and these two should be practised together till they in their turn become easy and almost instinctive and automatic.

Then the third part can be added in the same way, all by itself, and so on. You will always be conquering the new ground part-by-part, and going over the old before you conquer the new.

This was how the Romans won their early Empire. They did not attack the whole of Italy all at once: their motto was DIVIDE ET IMPERA. Rome split up her enemies before she conquered them, and (in early times) did not pass on to fresh conquests till she had made sure of all that she had already won.

Hitherto we have had a fairly simple System. The Parts have been found out. A Single Part has been attacked, and mastered: a second Single Part has then been attacked and mastered: next (if it is feasible) the two single Parts have been combined and so on.

We now come to the question of *Change* or *Variety*.

If you can go through the Exercise correctly a great many times, without feeling tired or bored, so much the better: you should all the while increase the strength, the pace, and the number of times, very gradually. But, supposing this one Exercise tires you, what are you to do?

You can either rest, or you can do some other Exercise. You might, as a change-Exercise, use some other Muscle-group; for example, after your Wrist begins to feel tired, you might exercise your knees by Stooping-movements, or you might practise Breathing-Exercises.

But always rest or change *before the Fatigue point is reached*: do not wait till you feel *quite* tired.

Do not Practise *just after, or just before*

(a) severe exercise,

(b) hard work,

(c) a large meal.

A few miscellaneous suggestions may be added.

1. Keep a Note-Book for mems. as to Hints, improvements, etc.

2. Practise most of all those Exercises which bring into play the large Muscle-areas of your body.

3. Include Exercises like the following:—

(a) Breathing-Exercises;

(b) Balancing Exercises;

(c) Neck-movements; e.g., keep the Head up and Chin back, and turn your Head slowly round to one side and then to the other, and also incline it backwards and forwards.

(d) Exercises in the *use of your weight, or the weight of various parts of body*, are of the very greatest value.

Analyse a good Cricketer's Strokes: see how he often 'comes down on to the ball': he makes the weight of his body or of his Arm etc. do its proper share in the stroke.

In many Exercises and Games you must learn to throw your weight from Leg to Leg, and so on: see 'Lessons in Lawn-Tennis'.

4. Get the Parts arranged in the best order: this is easier said than done, but perhaps a workable rule would be to *get the larger Muscle-areas well trained before the smaller areas;* e.g., the Shoulder before the Fore-Arm, the Fore-Arm before the Wrist, the Wrist before the Fingers. This follows the natural order.

5. When you repeat an Exercise, never sacrifice Correctness for the sake of Rapidity: work correctly, even if clumsily and slowly and with difficulty. The neatness and pace and ease will then come *of themselves*. You may trust your Nerves and Muscles to see to this.

6. By degrees increase the number of times you do the Exercises, and alsoi ncrease their Variety, and their 'Permutations and Combinations".

Among varieties may be mentioned—

(a) Obstacle-Exercises, as when you do a Stroke with a Sandow or Whitely Exerciser, or with Dumb-bells;

(b) Voluntary 'Docking-Off' of some Part; e.g., in a Lawn-Tennis stroke, dock off the Wrist-movement. If it be necessary, tie up or otherwise Handicap the Muscles to be thrown out of play for the time;

(c) the 'Opposite-Fault' Exercises, in order to correct a Fault.

7. *Exercise the left side.* It is not advisable that you should play (e.g., Lawn-Tennis) both right-handed and left-handed during a single Game, nor that you should try to be as skilful with your left hand as with your right (for the reason given below). It is only meant that this will be a change; it will exercise new parts of your body; it will be a good Handicap; and it will make you careful. It will also show you many difficulties, unrealised before, and will show you the importance of being in *exactly* the right position *before* the Ball comes, and so on.

8. For Exercises in Strength, see later.

9. For Exercises in Promptitude, see later. Promptitude and Rapidity are not always the same. The Hundred Yards Sprint is not by any means a race of Rapidity alone: the prompt answer to the Pistol-shot is equally important.

10. Before many Exercises it is often necessary to *relax the opposing Muscles* (see later), or to draw back some way. There may be many objects in doing this, one of which may be greater ease, and another greater pace. In Racket-Games, and in Cricket, and in Golf, the drawing-back for the swing is often absolutely essential.

Nevertheless, the Preparation-movements are little studied and very little attended to. This is partly because the best players make them instinctively: it does not occur to such players that anyone *can* omit such a simple thing as *this*.

11. Find out new Exercises for yourself, according to your own needs. Don't be afraid of being original! Examine into the subject fearlessly, and *experiment freely*, always being determined to give up whatever (after repeated and fair trial) seems useless

or worse than useless, but to adopt (at least provisionally) whatever seems useful.

Watch each Game carefully, and see what the best players do: look at a Racket-player, and see him start rapidly and on the balls of his Feet, and move sideways and backwards as well as forwards. Can you do this easily? If not, then make a *special* Exercise of it. Go into a large empty room with open windows, or—if no one can see you—out into the open air, and move rapidly about on your toes *in every direction*. After this has become easy, imagine a spot away from you, where the Ball will be bouncing; move swiftly to the right Position—the imaginary Ball may be behind you and to your left, for instance, and the right Position may be well behind this, and rather to its right—and make a correct stroke, returning the Racket afterwards to the hand-mirror position.

This is merely a sample. Anyone can find out hundreds of other Exercises for himself.

12. Choose not only those Exercises which are best for the correction of your faults, for the strengthening and improving of your weak points, and for the maintaining and improving of your strong points, but also those *Exercises which will supplement* your own particular Games etc.

This advice is especially given to Rowing men and Runners; the former are usually notably feeble at most Ball-Games. They ought to practise Wrist-Exercises, Arm-Exercises, Boxing, etc., and specially the Exercises for Promptitude and quick change. For Rowing has too much of the regular Rhythm to be a good Exercise in these qualities.

When all the Parts are known individually, and when they have been gradually combined (in pairs, to begin with), then the whole will become far easier than it ever was before, and other Games and other forms of Exercise will find you already a good way advanced in them. You will be not only a Specialist at your own Game or Games, but *fairly* good all round for *any* Game.

For example, you may wish—nay, you *will* wish—to take up Golf; well, having mastered the great Foundation-Positions and Foundation-Movements, you will have a good firm *basis*. You will have to add some new and special Exercises, it is true:

but you will now know how to find them out (e.g., by watching players or by studying photos); and you will soon begin to improve *steadily*.

If I knew of any other *general* way of mastering a Game or Exercise, I would state it: I only give here the means by which I personally acquired a *moderately* good style at Tennis and Rackets, and—what is more important—a style which is constantly *improving*. Once, years ago, I had one of the ugliest styles in the world, when I played Rackets. So there is no reason why *others* might not succeed by the Part-by-Part System. And it must be remembered that I am still making researches about the various movements. I have been too busy, during these last years, to study the problem very thoroughly. Yet, even with the little I *have* found out, my game of Rackets has gone up at least 5 points (each Game being for 15 points).

But do not expect *immediate* success: personally I had to undo the habits of years, and at first my Game went down, not up. When once I did make a start, however, the improvement was not only rapid, but also sound and sure. [E. H. M.]

If you do not believe in this System, study the way in which the French learn Fencing—find out how long they spend merely in learning to use the weight of their body, apart from any other Exercise; or ask a fairly good Violin-player whether he or she began by playing hard pieces, and did not first learn how to stand, how to hold the bow, how to hold the Violin, how to use the Fingers of the right Hand, and so on—it is not necessary to multiply Examples. But we may predict that this System, by which the average person shall gradually master Part by Part, slowly and correctly, and with conscious effort and concentrated attention, and with the many objects and advantages of such a System constantly before him, will some day become universal in the teaching of *every* thing that is to be taught, even of virtue itself.

## 4.—A SAMPLE LESSON.

As a sample let us take the teaching of a Lawn-Tennis Stroke.

Nothing need be said here about Health, or good general Training, or good Air, or the correct way of Breathing, though these things are very important for various reasons; for instance, for endurance and strength.

Nor need we say anything about the grip of the Racket; e.g., the right way of holding it so that the ball may be met by the open face of the Racket.

For the purpose of practice a Racket-handle would be quite sufficient: it may be cut off sharp and left as a stump.

One point should first of all be noted, and that is that a swing is necessary for the Stroke, and the Racket should therefore be held up before the Stroke, and returned to the high position after the stroke. If we held it as a hand-mirror, that would be a near approach to the best place for it before and after play.

We should begin with the position of the *Feet*, the object being here to make the Muscles all work together, and so get the maximum of health, strength, pace, safety, endurance, and success. Much of this will depend on the right position of the feet, and it will be necessary to find some form of Practice which the learner can use under the greatest possible number of conditions; for instance, in his bedroom, in rainy weather, and all the year round, and with the least possible expense.

As opposed to the common advice, 'Practise the actual Game', in which perhaps the player's stroke will often be a kind of flick with the Wrist as he stands square with his body facing the net, and with the face of the Racket held near the ground, he is advised to adopt quite a different method of Practising, one which will not be so tiring, and yet will be better exercise for the Heart and the Lungs; one which will not be practised in the Court alone, or in actual Games alone (for Games generally improve the player very little): it will be Practice outside the court, and practice of a much simpler kind.

It is not suggested that the *Wrist* should not be employed at all; in fact, certain special Exercises would be adopted for the Wrist, so as to make it firm, and so as to make it move easily in various directions. These Exercises could be done by themselves; at first they should be slow, and the whole attention should be given to them.

A main object should be to bring the *large groups of Muscles* into play, because these Muscles will enable us to get the most possible Exercise, and so the best Circulation of the blood, and the greatest improvement to Health, with the least effort and the greatest endurance. Moreover, these large Muscles are far more reliable and far safer and far stronger than the smaller Muscle-groups, such as those of the Wrist, and they will add considerable pace as well. Therefore it will be necessary to practise *the Body-movements*, which will bring these large Muscles into play. These very same Body-movements would be good for games in general, and for the Health, and might do much to cure constipation, for example. They are described elsewhere, so that here it need only be said that they should be begun slowly, and repeated till they become quite easy: they will be far easier if the Feet are first placed in the right position, and so we come to what was mentioned just now, the Position of the Feet.

As one stands and swings the Racket, one should notice that *the natural swing* is not backwards and forwards, but rather across the body. It is as if one were a Clock, and the Racket were a Pendulum. The pendulum does not go backwards and forwards, but from side to side (when the Clock faces you). Hence, for ordinary Strokes, it will be necessary to face, not directly towards the Net, but sideways. Either your right Shoulder, or your left, will face the Net, and the Feet must be moved so as to ensure one of these two positions. The Foot-movements and Positions I have also suggested elsewhere; viz., in 'Lessons on Lawn Tennis'.

The learner will see that this is not sufficient; that if in an actual Game he tries to keep his Racket up, and a Volley goes about on a level with the middle of his body, his Racket will be far too high. What is he to do then? The answer is that he is to lower his Elbow and Arm, and to *stoop*. It will therefore be necessary to practise Stooping-Exercises, letting the body down by bending the Knees. This will probably need a great deal of Practice, but it will also be good for health.

The learner (let us suppose) will now have acquired the right Positions of the Feet, and the powerful Body-swing, and the faculty of bending his body down quickly and easily: but he will say he does not yet hit the ball fast enough; his stroke needs more *pace*. Hence the next Exercise would be an *Arm-Exercise*. The whole Arm should be moved as a stiff mass, and Strokes should be made with this Arm as if it were almost a straight stick. The strokes should be made from the Forward-facing position of the body, but more often from both the Side-facing positions (see 'Lessons in Lawn Tennis'), and after each stroke the Racket should be returned to the hand-mirror Position. Then this Arm-stroke should be *combined with* the Body-swing.

For the purpose of giving more pace, the Lower Arm or *Forearm* may be moved by itself; and then, when this movement has become easy, it can be added to the movement of the Arm. To ensure still more pace, the actual rate of movement of the Body-swing, and of the whole Arm, and of the Forearm, can be increased by degrees. Finally, all three can be practised in combination.

Still further rapidity can be added by an extra movement, the movement of the *Wrist*. Thus, to ensure the fullest possible force and pace, there would be combination of a Body-swing, an Arm-swing, a Forearm-movement, and a Wrist-movement. The sum-total would be enormous, for the Body-swing alone is able to make the Stroke at a fairly good pace.

Next it will be necessary to *vary the pace;* for the full amount will not be required on every occasion. Hence the various pairs of those movements should be combined; for instance, the Body-swing and the Wrist, the Forearm and the full Arm, and so on. The other movements should be docked off.

Even yet the Practice for the single Stroke will be far from complete. Besides the Practice in the Position of the Feet, in the Bending of the Legs, in the Body-movements, in the Arm-movements, the Forearm-movements, and the Wrist-movements, and the various combinations, it will be necessary to practise *Promptitude*. After going through the various Exercises very slowly, one at a time, it will be necessary to practise them with very quick variety, constantly changing from one to the other (see p. 13). But this should not be done till each has become quite easy by itself. The learner should imagine that balls are coming at him from all directions, and should adapt his stroke accordingly.

Then, and not till then, he should test his skill by actual Practice, or by a Game, and during and after the Game he should notice where he fails, and find out exactly *the part* of his movements which is wrong,—for instance, is it the wrong Position of the Body?—and then correct that part. To do this correction thoroughly he may have to *exaggerate* the correctness, in fact go into the opposite fault, and practise some Obstacle-Exercises (e.g., with Dumb-bells instead of a Racket, or with a Whitely-Exerciser).

Last of all, he may follow the advice on page 9, and watch some of the best players, part-by-part. For instance, he could watch the position of the Feet of one player, or the position of the Racket of another, and he could also ask advice; and then could and should make Notes.

This is the sample of a Lesson in the ordinary Lawn-Tennis Stroke; it does not describe the Stroke itself. It just shows the principle of dividing up a complicated movement into its various parts, and practising these parts one by one, till each by itself is not only easy and Automatic and instinctive, but also correct, and then, combining two or more parts together, and 'co-ordinating' them till they become one.

## 5.—OBJECTIONS TO THE PART-BY-PART METHOD, WITH ANSWERS.

1. It may be said that the Movements are *too leisurely*, too deliberate. But in answer to this it has been pointed out that the pace must be increased, or rather that it will increase almost of itself. With greater ease will come greater rapidity. And as to the deliberateness, no Exercise is really of much good unless it *is* deliberate to start with. Afterwards the will-power need not be exerted to the same extent.

2. The Exercises may be *tedious*: for people are by nature, or for some other reason, impatient. But this way is certainly the only way. It was through slow and somewhat tedious care and pains at the very outset, that Rome succeeded, and England also. The more thorough and more patient the beginning is, the quicker and the greater will be the success that follows.

3. It might be said that these Exercises have no *interest*. Rather let us say that the interest is not yet known or thought about. I have tried to point out what the interest is. In the first place, it is interesting for everyone to teach himself, and it would be still more interesting for him to feel he is teaching others or helping them. Secondly, his improvement is always interesting for him, and if he registers his own experiences and progress the Exercise surely cannot be dull. His progress itself will make the subject interesting to him. If he once sees and then remembers that it may help on whatever he may be doing in after-life, then surely the Exercises will not any longer be lifeless drudgery. If he feels they may make him healthier and happier, and may improve his intellectual and moral qualities, such as pluck and promptitude, as well as his success in Games, then he cannot complain that they are wanting in interest.

4. It may be thought that *the result at first may be very small.* If so, consider for Example the art of Building. It may seem strange at first that a man who wishes to build a high house should dig down deep in the ground. 'Why,' you

would say, 'he is doing quite the worst thing!' But the foundations are absolutely necessary if the house is ever to be high. The results do not appear at once; in fact, there seems to be a movement in the wrong direction. Nevertheless, after a little time, the building itself will begin to rise: and, when it *does* rise, it will be firm; a breath of wind will not scatter it. If we only remember that a seed takes a long time before it develops into a plant, and that we do not demand that it should be a seed one moment and a plant the next, we shall cease to demand that all the success of such Exercises should appear at the very outset. Do not imagine that no progress is being made, merely because no progress is visible the moment afterwards. It is never waste of time to send the foundations deep down and to build them firmly.

5. Many will say that it is no use for you to try to teach the '*duffer*'. 'The duffer will always be a duffer'—so speaks the genius. But see what his words really mean. When the genius says that the 'duffer' cannot be taught, we ask ourselves 'By whom?' And the answer is ready to hand—viz., 'By the genius.' And we must admit that a genius very seldom *can* teach a 'duffer'. A Senior Wrangler can seldom teach a beginner at Mathematics. The reason is that the genius instinctively does the whole complex Exercise as a kind of single movement: he may even deny that it *can* be divided up into parts. Never mind what Anatomy may tell him (if he knows it), he will still say 'I do the thing as one single action.' No: when the 'duffer' has learnt each single part, by constant Practice of the right kind, and when he has combined two parts together, and then three parts together, *then*, and not till then, will it be time to say whether he will always be a 'duffer' or not.

As a matter of fact no one is *so* great a 'duffer' that he is incapable of improvement. It is not to be supposed that these Exercises will make him play Games perfectly, but, if he is playing them badly now, they have a better chance of improving him than any other method of which we know.

6. *Custom* and *habit* are most serious obstacles. It is customary for most successful players to play in a certain way by the light of Nature, and they try to teach others to do the same. There is a customary method, not only of playing, but also of

teaching, and this is the great obstacle to any new Method. It will be said, 'Others who have succeeded have gone through no such stages as you suggest; why should we mere beginners go through these stages?' Appealing to the past, we may say that the 'successes' in Games are the exception. Most people are extraordinarily bad, at both Games and Exercises. If a few have succeeded, that is probably because they did the movements rightly by a kind of instinct; but, where the instinct is lacking, there some other Method must be adopted. The customary Method is condemned as a failure for the average player. By its fruits ye shall know it. For the genius, it may be all that is needed, but my book is not for the genius; it is for the average man and boy.

7. It might be thought that it is bad to go through these movements *consciously*. There are those who say that Games lose all their value if one thinks about them. This is a terrible mistake. At the outset the movements should be thought about. Nay, more; the whole will should be thrown into them. Anything that is worth doing is worth doing well, and the whole energy should be used during the initial stages. This does not mean that *afterwards* these movements will need the same amount of will-power. Quite the reverse. Very soon the will-power may not be needed at all, and the player or exerciser can devote his attention to other things. But, unless the Exercises are done consciously and with concentrated attention at the outset, they will never come to be done correctly and properly and with advantage. So far from unconscious Exercises being of value, an unconscious Exercise, at least in Practice, has (in some ways) only a quarter of the value of an Exercise done *with* concentrated attention.

8. The *difficulty* of Practice will always be an obstacle. This cannot be avoided. All Complex movements will always be hard, for the attention will be distracted between the various parts of the movements. For instance, in a Lawn-Tennis or Golf Stroke there will be the position and balance of the body and of its various parts. There will be the movement of the body, and those of the Arm, of the Fore-arm, and of the Wrist. These will make Practice hard whenever a Complex-movement is to be done; but in itself this is no sufficient objection to Practice. In fact, it is rather an incentive. To overcome

these difficulties, to acquire the movements one by one, and then to be able to apply these same movements to other things as well, that surely, is something worth having done.

9. Among other objections would be that the Exercise of a single part, such as is suggested, and especially the exercise of a small Muscle area, will be very *tiring;* and so it may be at the outset, but with Practice it will cease to be so.

10. It might be also said that the effect of practising the whole movement part by part will be to make it *jerky*. If each part is done by itself, then, when the parts are combined together, the whole effect will be that of jumping from part to part, and not a smooth single action. But this can be avoided if one always joins the parts together, two at a time, then three at a time, and so on. On this special stress should be laid. The jerking gradually disappears by Practice; unless the Exercises *are* practised part by part, each part is apt to be imperfect in itself, and it is well known that no whole can be perfect unless each of its parts is perfect. This is a *sine quâ non.*

11. A more general objection will be that such Exercises and such Practice are *not worth while.* A Game, people will say, is a Game and nothing more; it ought to be simply a recreation. There never was a greater fallacy. Apart from the fact that a Game is far more than a recreation, apart from the fact that it is or should be a most splendid Education (see p. 47), anything that is worth doing is worth doing with energy and with attention. It is worth calculating beforehand how it should be done best. Games really are, or should be, most important for Health, and if they are played wrongly the Health will not be properly developed. If a boy at Cricket simply uses his Wrist and stands in the wrong position, he will fail to develop some huge Muscle-areas of his body, and may be breathing wrongly also. Games are most important, therefore, for Health in general, and they are also most important for Happiness. The full enjoyment, however, cannot come unless the Games are played rightly, unless the Player feels that he is doing himself justice. Games, in fact, are important not only for every part of the body, but also for every part of the mind, and for lessons with regard to every department of life. A Game is more than a Game; it is, for instance, a grand Lesson in Emulation. Scarcely anywhere else can one so easily learn

the noblest form of rivalry as opposed to the petty forms which appear almost everywhere else in life. Some qualities, in fact, both moral and intellectual, can be best developed only by Games. And it is certain that Games are the most interesting way of developing them, and therefore probably the wisest. Where else can we better learn Honour, Obedience to Discipline, Originality, and Promptitude, and the great lesson of Co-operation? A Game of Football is a far better lesson in Co-operation than a thousand Text-books of Political Economy. In fact, so far from being merely a Game, a Game (when rightly learnt and rightly played) is among the highest educational influences in the world. By means of Games we can best learn, not only how to acquire the above qualities, but also how to bear success and defeat, and how to judge others' failures and successes.

## 6.—HOW TO CORRECT FAULTS IN GAMES AND EXERCISES.

*To correct a fault is often harder than to learn a thing from the beginning.* Those who have to teach Military Riding say that it is generally easier to teach one who has never ridden than one who has learnt Riding in the ordinary way, because the latter has acquired a habit (a bad habit, from the Military point of view), whereas in the former a habit can be developed by degrees.

Now the first thing to do, before correcting a fault, is to find out *precisely what the fault is.* It is not enough to say 'I do that thing wrongly'. It is necessary to find out *what part of it or what parts of it* you do wrongly. You can only find out this by asking advice by watching, the best players and the various *parts* of their play,—for instance, their Position [of Body, Feet, Arms, etc.],—and by looking at photos of the best players and afterwards comparing these with your own play.

If one tries to correct a whole thing all at once, a stroke at Cricket or Lawn-Tennis or Golf, let us say, one is met by a very great obstacle. *There is too much to think of at once.* There may be so many faults that no single fault can be properly corrected. But if you take some one fault, perhaps small itself, some one part of the whole, and 'go for' that, and master it absolutely, and correct it, then you will have done a certain portion of the correction. The whole thing may not be perfect yet, but, at any rate, you will be one sure step ahead of your previous condition. Supposing you are holding your Shoulder in the wrong way, then it is useful for you to exaggerate the opposite fault. Hold it, not only in the right way, but also (sometimes) in the wrong way, the mistake being the exact opposite of the mistake you have been making before. Obstacle-Exercises (on which more hereafter are also worth considering—and trying! Some of them are mentioned on page 21. After these Exaggerated-Exercises and Obstacle-Exercises, the simple Exercise itself will have become comparatively easy.

The danger will be that in these Exercises you may sacrifice *Pace.* You may come to do a thing too slowly and deliberately; but this is not hard to remedy. You can intentionally increase the pace.

One of the chief faults which may be remedied by itself is the fault of *Slowness* and Unreadiness. You can cultivate the habit of *Promptitude* best of all, I think, by working out the whole movement beforehand, Part by Part, so as to have all the Parts ready when the time comes for using it. When the time *does* come, you must not have to think of what the movement is, and of how to do it correctly. That must all have been got over already. You must have worked that out beforehand. You can do this by means of Theory, by the study of Anatomy and Physiology, by asking advice, by thinking over the Problems, by watching the best players you can, and so on. But you will never be prompt unless you have the movement ready *before* it is wanted. It must be part and parcel of yourself already. So the first help towards Promptitude will be—strange as it may sound—careful Practice beforehand.

The second help will be *Imagination*. If, during Practice, you imagine to yourself and say to yourself, 'A ball is coming in this direction', and if you then do the right Exercise for the stroke, and, at a later stage in Practice, do a quantity of Exercises to meet imaginary balls in *all* directions, then, when the real balls come, they will not take you so much by surprise. They will find you ready to meet them. Most of them will be old friends, whom you have met in something better than a dream.

Again, *any* kind of Promptitude will help your Promptitude in Games. Even the habit of answering letters quickly, of keeping appointments, of getting up punctually, of not wasting time, even these habits will increase your habit of Promptitude in Games. Just as, if you learn to be prompt in Games, you will also be more prompt in all departments of life.

Some other helps have already been suggested. They deserve careful study, because so many Exercises, and even Games, neglect this valuable quality. If everything is being done in a regular Rhythmic sequence, at fixed times, with fixed intervals, in a fixed order which is known beforehand, then the whole thing may be done, so to say, sleepily.

Those whose Games or Exercises are chiefly of this *regular and expected* kind, should make a point of practising Promptitude. Boxing, Fencing, Cricket, Football, and Eton Fives—these are among the very best of helps.

## 7.—WHEN PRACTICE AND EXERCISE ARE LEAST TIRING.

Whether Practice and Exercise are tiring or not depends a good deal upon *the time of Life*. Exercises of Speed are less tiring to the young. Exercises of Strength and Endurance are less tiring for those who are in their prime. And a good deal also depends on *Good Health*. *Good Sleep* beforehand is also (usually) important. In some cases it has been found that nothing tires so much as having eaten certain *Foods*, or having drunk certain Drinks. And, again, it is often very tiring to play *after* a heavy meal, or after hard work (at least, so many people find), or after hard Exercise of some other kind, or after worry.

The time of year makes a great difference, of course. Fancy Football in July.

Good Air, especially Cold Air in the Mountains or at the Seaside, is far less tiring for Exercise than stuffy hot air; look at the huge distances covered by tourists in Switzerland, though they may be regular 'crocks' in their own country. If you cannot get the actual open air itself, the next best thing is a well-ventilated room. Exercise in an almost hermetically sealed room is probably much worse than no Exercise at all. The Americans err much in this respect.

Clothing is by no means unimportant: tight boots alone may produce *general* Fatigue, and so may most tight things and some loose things.

Exercise is always far less tiring if the *Breathing* be scientific. There is a correct Position for Breathing, as there is for all Exercises. And there is a correct Method of Breathing which must be studied as a special Exercise. It is wonderful how it will lessen the Fatigue.

The *correct Movements* perhaps do more to keep a man fresh and to prevent fatigue than anything else, except Foods, and the correct Positions. If you watch a Lawn-Tennis player like H. L. Doherty, you will be surprised at the small effort which the stroke seems to be to him. He hits at a tremendous pace, and yet scarcely seems to be making any effort. The reason is that he uses exactly the right Position and exactly the right Muscles, and so economises his efforts well. We shall see below that it is generally far less tiring to use large Muscle-areas than small Muscle-areas, and experience shows that, so far from being less effective, they are far more effective in many cases and far more reliable.

A principle often neglected is this, that where there is most *Enjoyment*, here there is least fatigue. In School Gymnastics the principle is almost absolutely ignored. Perhaps with enjoyment we might class the feeling of Emulation, though it is somewhat different; but *Emulation* undoubtedly helps to prevent Fatigue. If there is not actual enjoyment, mere *Interest* in the Exercise makes it less fatiguing. To do a thing of which you do not see the point, and which bores you, is ever so much more tiring than to do a thing in which you are interested, even if the Muscular exertion itself is not nearly so great.

Another condition under which Exercise is not tiring is that much of it should have become *already Automatic*, or that it should be Automatic to start with. Some Exercises and Motions are quite Automatic. The Heart, for instance, does a stupendous amount of work, but it does it quite Automatically. Our Will has nothing to do with it except indirectly. In many other actions our Will once took a part, (for instance, in Walking,) but now our Will has very little to do with Walking. We simply say we will go for a walk at a certain hour, in a certain direction, and at a certain pace, and we scarcely think of the matter any more. Every now and then (as when we knock against a large stone) it occurs to us that we *are* walking, but otherwise the Movement has become more or less Automatic. And the more Automatic a Movement becomes, the less thought and Nerve-effort it requires, and therefore the less tiring it will be. It follows from this that the more you practise a thing, and the more you get it, not only easy, but also Automatic and Instinctive, the less tiring it will be whenever you come to do it. The more you have to think about Exercises, the more tiring they are likely to be. But many *Games* form a marked exception, because of the Interest and Enjoyment.

The Heart teaches us another lesson. The Heart works *Rhythmically*, and any Rhythmic Exercise is far less tiring than irregular Exercise. The beating of time or the singing or humming of a song, or the sound of music will make Exercises not only far less exhausting, but also far quicker than they would otherwise be.

Again, not only is Exercise less fatiguing when it uses a large Muscle-area (Walking is a good instance), but it is also less fatiguing *when each action itself begins and prepares the way for the next action.* Walking is an instance of this also. The one step prepares the way for the next step.

The Fatigue is also less *if we stop before it reaches a certain point,* and then rest or have a change; afterwards we can come back to the Exercise almost or quite fresh. The amount that could be got through in a day if it were done in short spells, with rests or changes between, would perhaps be five times the amount which could be done if we went on continuously. This is not a universal rule, for an hour's practice may help us to do a thing better and better, and it applies very little to certain kinds of Brain-work, but to many kinds of bodily Exercise it applies with great force.

What one person can acquire only by Practice of the right kind, another already possesses by Nature and Instinct. One man after constant Practice finds that a certain Exercise ceases to tire him. At first it tired him very much, but soon it ceases to be any effort at all. With another, however, the ease and endurance have been noticeable from the very first. The Movement has always seemed natural to him, and there has never been any difficulty at all. It is as well to remember this, as far as possible, so that you may choose (to some extent) Movements which are easiest for *you* individually.

Finally, certain Movements go well together, while others disagree. A good instance would be the Movements that go best with In-Breathing, and those which go best with Breathing-out. If you were to breathe in and out, as a simple Exercise, for one minute, and then do each of the Exercise Movements separately 15 times, or if you Breathed-in while doing the movements in the Breathing-out Column, and vice versa, you would be far more tired than if you worked the Breathing and the special Exercises together in harmonious co-operation.

# PART II.

[BY E. H. MILES.]

## ADVANTAGES OF GAMES AND EXERCISES AND OF PRACTISING THEM RIGHTLY.

1.—SOME FALLACIES EXPOSED.

2.—GENERAL ADVANTAGES OF PRACTISING GAMES AND EXERCISES RIGHTLY.

3.—ADVANTAGES OF GAMES OVER EXERCISES.

4.—ADVANTAGES OF SPECIAL GAMES.

5.—ADVANTAGES OF SPECIAL EXERCISES.

## I.—SOME FALLACIES EXPOSED.

In what I say here, I wish, with one necessary exception (p. 43), to make no allusion whatever to the motives of those who hold, or are held by, these and many other Fallacies. I merely wish to state what the Fallacies are, and to mention that these Fallacies are very widely spread.

In the course of this work many particular Fallacies will be mentioned and exposed—e.g., that *all* mountaineering or 'ascending' is bad for people with weak Hearts, and that it is always a mistake to do any Brain-work while walking; but here let us discuss some of the more *general.*

1. That '*Practice makes Perfect*' is a grand Fallacy. One may go on practising Rackets for years without any very appreciable improvement, if one Practises *in the wrong way.* And the same would be true in thousands of cases. Practice must be of just the right kind if it is really to improve the Practiser.

2. That a Genius ought to be chosen as a Teacher is a Fallacy very common in actual life. Not only in Mathematics, in Classics, in Science, etc., but also in Games, we have thousands of people chosen as Teachers who have never really been learners. Their skill has been partly inherited, perhaps, but anyhow there it is. It has not been acquired by gradual steady and laborious effort. Yet this latter is the only process for the average person.

It is assumed that, because the Genius (A) does a thing really well, therefore he will be best able to teach the average person (B) to do it well also. This might be true, to some extent, if B would only watch A, and watch all the different Parts of his Method, but, unfortunately, Learners are not wont to observe such things for themselves. If they try at all, they try to imitate the whole action, and perhaps ten parts at once, and so, as a rule, fail lamentably and to the verge of despair.

A moderately skilful person who *can remember the difficulties he has overcome* or (perhaps better still) *is overcoming*, is a far better teacher for ordinary beginners, even if the Genius-

Teacher may be useful for doing the 'polishing' and perfecting work at the end.

3. That Games themselves are the best Practice for Games is another notion closely akin to this. It is true that a Game itself may give the Learner a *general* idea of what Exercises etc. will be wanted, but, when once this general idea has been acquired, then the Exercises themselves must be done one by one.

Nay, even individual Exercise had often better be done Part-by-Part. It is quite probable, indeed, that certain apparently simple Exercises, such as a Wrist-Movement (a), had better be done Part-by-Part, to begin with, as in (b): the Smoother Single-Movement (a) may gradually be developed out of (b). The original Jerkiness will soon disappear.

That each thing, as a whole thing, is the best Practice for itself, ignores the fact that many a whole thing is made up of Parts, and that any Part (i.e. any one of *ten* Parts) is likely to be more or less wrong, but that this error is little likely to be found out, and still less likely to be corrected, if the thing is done *as* a Whole. How absurd it would be to play a whole piece on the Piano all over again, because *one* Part was wrong.

4. That '*Custom* is a safe guide' is not openly admitted, but it is the most powerful rule of life for the millions, in actual experience. In learning Games and Exercises this is usually the case, and elsewhere also. No matter how great the Failures, no matter how meagre the progress, no matter how revolutionary the discoveries of Science or of Personal Experience—still Custom goes on and on, ruling most of the World. One of the greatest of Jesus' Commandments, 'Be not conformed to this world', is one of the most constantly broken.

Badly-ventilated School-rooms, Lecture-Rooms, Gymnasiums, Living-Rooms, Sleeping-Rooms; bad Desks, bad Forms, bad ways of Sitting; long hours of Sitting; Stimulating or Excessive or Deficient Food; absence of Exercise, especially of proper Exercise (for the time of life) in the Open Air; bad Fashions in Boots and Shoes, and in Clothing; the List of bad Customs might fill whole pages, or even volumes.

When we ask why people who really know will not *insist* on reform, and will not convince and compel those who really *do not* know, we often come down to something despicable at the root of this unwillingness to insist. Laziness and Cowardice and Selfish Interest too often go hand-in-hand.

5. That 'What is "*Natural*" to each person is also "Best" for him or her' is another error. On a bad form, without a back, it is absolutely 'Natural' for an ordinary child or boy or girl, under present conditions of Health, and after a long spell of Sitting, to Curve the Spine; and similarly also if the book is in wretchedly small type, or if the person is short-sighted. When this same person is tired, after long work, how 'Natural' it is that the Head should sink forwards, and the Shoulders sink forwards too, to relieve certain Muscles. Yet neither of these things is 'Best'.

And so of Playing Games: many play Rackets in what they think the 'Natural' way: that is to say, without a thought of playing the Game in any other way. Yet (probably) at almost every stroke they do at least five things which are in reality *very* serious and fundamental mistakes.

Akin to this Fallacy is another: that any Mother must know better than anyone else, better than Science, better than all the accumulated experiences of past ages, what is good for her own child. Why?—Because she is a mother, and 'loves' her own child more than any other person can.

If these two points are granted, it does not follow in the least that her own theory is necessarily right.

In the first place, she, little as she may know it, is generally guided almost entirely by Custom, which, as we have seen, is full of errors. But, besides, there is yet another Fallacy involved here.

6. 'A kindly intention must be sufficient: the resulting act must be good.'

Yet how kindly-intentioned, how earnest in their efforts to save, by whatever means they could, the erring souls of the 'going-to-be-damned', were the members of the Spanish Inquisition! How kindly-intentioned is the good lady who sends the poor starving person Stimulants to eat and drink, and to help to use up reserve-funds of tissue and energy, but no Proteid 'without which we die'! How kindly-intentioned are those who give wine and indigestible and heating Food to tiny children! Yet is the wine any the less Alcoholic because the intention is kindly? Is the excess of harm-producing material any the smaller for this?

It is hackneyed, but it is true as a bullet that hits the mark, that more harm is done (at least to the 'recipient') by 'want of thought' than by 'want of heart'.

7. Speaking of Foods, we may notice that error 'that *the Amount of Food* swallowed equals the amount of Nourishment and Energy added to the body.'

'You must eat *more*' says the anxious parent or friend. So, to pacify them, you eat a lot of something—never mind what—it may be chiefly stimulating or Fattening: it is all the same, so long as it is a *lot.*

But how about too little Proteid, or too much Proteid, or too much Fatty and Heating material, or stimulating materials, or Irritants? How about Digestion? Is *that* nothing?

The truth is that Nourishment and Energy depend not only upon *how much* we eat, but also upon:

α. what kind of things we eat, and

β. how we eat them.

To give an instance illustrating both α and β, supposing you eat, very quickly, four Potatoes with Butter: well

α. you have not here got enough Proteid, if the Tables made out by Scientists are true;

β. you have not here digested and got ready for use what you *have* eaten. You might almost as well pass iron-bound chests of Food through a county, and expect them to nourish the people there!

Only what you can turn into Tissue and Energy etc., only what you have within you *ready for use*, only *this* is to be reckoned as of importance, with the exception of certain 'Salts' and certain 'Fibrous' stuff.

8. As to the Fallacy of judging by Amounts, it is often thought that *the Amount of Exercise* taken must be judged by the Amount of *Fatigue*, whether that Fatigue be only Fatigue of a part (e.g., the Fingers) or of the whole body, or of the body and mind as well.

In Walking, for example, you may exert a most extraordinary amount of force, without feeling appreciably tired, whereas in an Exercise for your little Finger alone, you may exert only a tiny 'thimbleful' of force, and yet feel quite tired.

9. A still more serious Fallacy is to judge people, one and all, by an *Arbitrary Standard.* You may praise A, because

he *succeeds* more than B: you forget that he has had greater natural advantages (e.g., a more Athletic figure), greater chances of good Practice, and so on. As a matter of fact he may still have failed to do himself justice, as compared with what he might have done, and *ought* to have done, if he had worked hard. You forget that B had an unathletic figure to start with, and unhealthy surroundings, and little chance of good Practice. As a matter of fact, you would see that B has been *amazingly* successful, *considering the conditions*, if only you would look at his results in this light.

You may forget, also, that A is 'only a body': he is grossly stupid and unreasoning and pig-headed; whereas B is 'a mind as well as a body', and has not developed only one part of himself. A man has a Brain as well as Muscles, and he is not truly a man if either part is grossly undeveloped or else 'atrophied'.

10. For this error of *judging the Whole* by fixing the attention on *one Part*, and omitting to consider the other Parts, is terribly common: it leads people to call a country prosperous when its millions, its majority, are miserable. It leads people to call a man Healthy, (e.g., when he is skilful at Games,) quite apart from his intellect or his morals. Still worse, it leads people to call a man Healthy when he is only Strong and has large Muscles: just as if Man were meant to take the bull for his ideal. Mere Muscle is very different from Health, Activity, Skill, Development.

Health, again, is not proved by the redness of the face (which should be closely looked into before it be classified as the redness of Health), nor yet by Fatness, with which may go many evils.

11. Speaking of Health brings to my mind yet another error—a terrible error of 'genteel' people, and one due to a most 'worthy' motive—the error of *Prudery*. The harm done by Prudery, by reluctance or refusal to allude to some of the most important things in life, is incalculable. We need only take one example—viz., Constipation. Only those who have known the terrible depression it causes will realise what the mistake of not mentioning the subject, amounts to. I have had no scruple in suggesting some remedies on this point, and on one

or two others as well. Unhappiness, restlessness and inability to work, these are not the sole evil results: for the grumpiness and pessimism of the sufferer are bound to affect those about him.

12. Fallacies about '*Causes*' are very serious, and especially about Causes of Ill-Health. Few mistakes are commoner than to fix on *the Immediate and most Obvious Cause*, and to consider it as the sole Cause. A little draught, wet Feet, a good day's Brain-work, something 'worrying', one bad night's rest, anything in fact—so long as it is *small* enough!

Heredity, again, is a scapegoat: people forget how often the *tendency* to Disease is inherited rather than the Disease itself. Before this Disease itself can break out, there must be the right conditions also.

To take an instance.—Fatigue, you say, is caused by a good long Walk: yes, this may be the immediate Cause; but how is it that such a Walk would often make you feel actually healthier? There is something else to be considered.

It is still worse where people single out as *the* Cause what is not even a Cause at all, but only a Hindrance.

13. *Results* also are often wrongly estimated: here, again, we find people quoting *the Immediate and Obvious Results* as if they were the Full Results. Tea and Coffee, they say, are good for them (perhaps they are in 'moderation').—Why?—Why! because they produce such good Results.—When?—Immediately. And supposing they feel depressed, or get a headache, after continuous use of Tea or Coffee, or suppose they suffer from Nerves, how is that?—Oh that, they say, is not the Tea or Coffee: *that* is the hot room, the worry, or some Immediate Cause. It couldn't be the Tea or Coffee, of course, because they produced such a decided feeling of well-being at the time!

Such people fail to observe the ultimate effect, the accumulated effect, of many doses.

14. And the pleasant *Taste* is no guide. For the Healthy, Taste might be a safe guide: but for the Unhealthy it is unreliable. A grossly over-fed Alderman craves for a huge yet dainty dinner, including among his failings a Dipsomania that stops short at sleepiness and inanity and does not go on to violence. Can his Taste, his liking, his very craving—for

its existence is undeniable—be a safe guide? Can it be Healthy for any man, leading a sedentary life, to eat five times as much Proteid as suffices for the hardest day's work of Body and Brain; to say nothing of masses of other Food-stuffs and Stimulants? Heaven forbid that it ever should be healthy!

15. That 'it is not *worth while* to trouble about the Training of the Body' may be called a gross and sensual Fallacy. 'Enjoy yourself and do not pause to think' is this Fallacy expressed in the form of a commandment.

To pretend that we can perform our 'Duty towards God,' and our 'Duty towards our Neighbours,' without performing our Duty towards Ourselves, including our bodies and every part of them—the more we think of this, the more misguided it appears.

Indeed, if Education is needed anywhere, it is needed here: and yet, when does the student hear a single Lesson on Health and the Training of the Body, throughout his whole course of Education? It would surely have been better than knowing the genitive of *supellex*, the Dual of γραῦς, and the treasures in King Solomon's Temple!

That the young should never hear a word about Lung-Development and remedies for Consumption, about the effects of Alcohol, and other matters, is surely a fatal omission.

16. Speaking of Education, another Fallacy must be exposed, which is disappearing indeed, but very slowly: the Fallacy that 'Education' which is *pleasant and interesting* cannot be good 'Education'. '*Discipline and Drudgery*'—these are still the watchwords and of many pretended 'Educators'.

But, even if the 'Educators' do not go as far as this, still they have never yet realized—apparently—that most Games can be made to teach some of the grandest Lessons that we wish to teach at School: it is not merely that they can be made to develop qualities, for this *has* in fact been partly realised: but that they can be made the 'Object-Lessons' of such grand Principles as Co-operation, Independence, Obedience to Law and to Honour, and so on; and that no other 'Object-Lesson' will be so interesting, so pleasant, so easily understood, and *therefore* so excellent, for the boy, as (let us say) an Object-Lesson on Co-operation, taken from Association Football. Can anyone suggest *any* better means of teaching the Principle?

17. That '*a Game is only a Game*' is an error that has already been exposed. One might expect it from the lips of those who have never played Football, for example, but from the lips of those who *have*, well at least it shows a wonderful lack of observation and of careful thought.

For a Game, *when rightly practised and rightly played*, may not only teach certain most necessary Lessons, and develop certain most necessary mental and moral qualities in man, but it must also develop Health, and Strength, power to do good, Happiness, and—last, but not least—all-round activity and all-round excellence. To assume that the Body and Mind are like OO, like 'two separate Circles that meet, but do not cut one another' is to misunderstand the very nature and essence of Man.

## 2.—GENERAL ADVANTAGES OF PRACTISING GAMES AND EXERCISES RIGHTLY.

It is necessary to take into account not only immediate results, but also *ultimate results*. They have not been in the least realised, even in Germany, where such questions are usually so conscientiously considered.

*The habit of Practice*, at least of Practice of the right kind, is one of the most valuable which we can acquire. Doubtless the test of the habit of Practice would be that it would seldom be any longer an effort to begin to practise at any odd moment. So long as Practice is drudgery, and so long as one usually has to drag oneself reluctantly to do it, it cannot yet have become a habit.

*Practice does not mean the mere repetition of a thing:* it means a Scientific Method of repeating it. The thing must not only be repeated, but must be repeated correctly, and according to certain principles. It is extraordinary how little method and how little science we introduce into the practice of the very highest things in life. Franklin was one of the very few men who suggested a Scientific Method of *practising* morality and virtue. And yet, of course, this subject is better worth Practice than any other. Again, if we take a subject like prayer, it is not often 'practised' in the right way; there is much repetition, but very little Scientific Method. Again, take Health: how unwilling people are to practise that which will conduce to Health, and yet there certainly are schemes by which one can become ever so much healthier. It is possible to 'practise' Healthy conditions until they become a very part of oneself.

Now Games and Exercises form a very good sphere in which to begin, and in which to acquire the Habit of Practising; and when this habit has been acquired in Games and Exercises, where in fact it is most easy to acquire, because Games are so pleasant, then it may be applied also to other spheres, such as virtue, prayer, and Health; for the principles of Practice will be found to be universal. Most of the Principles which are found of use in Teaching, and in Remembering, and in Essay-writing, and in many other subjects, are found also to apply equally to Games and Exercises; and no doubt they will apply to almost every subject, if not to every subject, though there will still be many further Principles to be added to these.

It is our intention in this Chapter to show the objects and advantages of learning and practising Games and Exercises in the right way. We shall show immediately afterwards what the right way seems to be.

As to the *immediate advantages*, the right kind of Practice will increase your power and your *success* at Games and Exercises. One of your aims should be to make easy and Half-Automatic as much of the Exercise as you possibly can; and you should increase—

1. the skill, which means the correct combination of many correct parts;

2. the correctness itself; this will come with constant self-correction, though at first it will only come very slowly;

3. the speed, which will come with habit and repetition, and with the intentional quickening of movement;

4. the strength, which will come with repetition, with the increased number of times which one does the Exercise, and with the various Obstacles; Effort and Force are closely akin to Strength, and they also will certainly come with Practice.

This looks like the sum-total, but there is still something left; and that is

5. *Promptitude* and Readiness. It is here that Germans and most other Peoples are generally very weak as compared with Englishmen. There is among the German Gymnasts a large amount of skill and correctness, a large amount of rapidity and force and strength, but there is not much promptitude; there is a slowness and as it were a waiting for the word of command. Now this promptitude will not only come together with a general promptitude in all spheres of life; it will also come with changed conditions and Exercises, and it will also come with Obstacles; though these Obstacle-Exercises should not be introduced till the end of the period of practice.

6. Practice aims at *correcting faults*, and this has to be done part by part. Here also the Obstacle-system will be of great value.

It is often assumed that a habit, tho' it may be made up of many parts, yet is itself a whole habit; and people try to correct the habit by correcting the whole of it at once, and not by concentrating their attention on single parts of it in turn. The best way of correcting most habits is to correct their several parts one by one.

These Advantages will be found to be the result of Practice of the right kind, and it is on some of these advantages that most people are wont to insist when they recommend others to Practise. But, as a matter of fact, the advantages of Practice are far more general than these.

Let us consider the *Bodily Advantages* first of all.

We notice the more complete *development* of the body as a whole, and of its various parts; and it must be observed that parts of the body are bound to affect parts of the Brain, as well as to affect one another. This is owing to the Circulation of the blood throughout the body, and to other reasons.

The *Breathing* becomes quicker and fuller after exercise, so that the whole of the Lungs can be brought into play, and less Lung is left idle. This is important because it is in the idle part of the Lungs that Diseases such as Tuberculosis so often arise. Exercise also gives extra Muscles for Breathing.

The Lungs also help the *Heart* to work more quickly. The reason is partly muscular. The Heart when it works quicker, will carry Oxygen (taken in by the Lungs) all over the body, and will also help to expel the Carbonic Acid and Waste-Products; of which we shall speak later.

Practice of an Exercise will also directly quicken the Heart, apart from the Lungs, and the Heart when it is properly Exercised will be better able to bear strains in the future.

It is needless to say that on the Heart depends to a great extent the Circulation of the blood, so that Exercises will quicken the Circulation: there will be more rapid Changes, new tissues in the body will be formed more rapidly, nourishment and force will be brought more rapidly to the places where it is wanted, and the poisons which are the result of used-up materials etc., will be carried away more rapidly as well.

But, with regard to Ill-Health, Exercise should aim at *Preventing* as well as at Curing: and this is just what it is likely to achieve

—it is more than likely to prevent Consumption, for example, and Indigestion, and Headache.

These and other results of the Practice of Exercises and Games will improve the Health generally; and it must be remembered that the improvement in Health, even in the general Health of the body, means undoubtedly an improvement in *the moral tone and in the intellect.* Improved Health also means *money saved and gained, and time saved.* The difference in work during Good Health and Ill-Health is almost incalculable.

With Exercise will often come Perspiration, which in its turn will carry off a great deal of Waste and a great deal of poison. Of such poison very little is known, but it is known that, if the pores of a dog's skin be closed by something air-tight and water-tight, so that the dog can no longer sweat or breathe through the skin, then the dog will very quickly die.

And with Exercise will also come a tendency for Fatness to disappear. Exercise alone will not remove Fatness in most people; but it will be a great help.

These are only a very few of the advantages of the practice of Exercises and of Games upon the Health generally.

The effects upon Happiness are by no means to be neglected. Here again it is very seldom pointed out how Happiness improves the Health, for purely physical reasons apart from others. The effect of Happiness upon the red Corpuscles of the blood is very considerable. For emotion changes the character of the blood, and the emotion of Happiness has an excellent effect.

And the proper development of the body, the clear skin, the clear eye, the upright and graceful Carriage, the free swing of the body and limbs when they move,—all this gives happiness to the possessor as well as to others. The 'Aesthetic' Advantages of Health are very considerable.

Happiness affects Health incredibly, not because of mere imagination, but partly for scientific reasons. The pursuit of happiness has been considered in all ages to be worth almost endless sacrifices; even Contentment alone is a great blessing. And happiness and contentment are not purely 'physical'; they also have a moral side, for with them, it is interesting to note, there comes a feeling of pity, for instance, rather than a feeling of anger. It should be regarded as a sign of Health when a person *generally* feels towards others pity rather than anger, and there certainly would be no better means of turning the feeling of 'destructive' anger into the feeling of 'helpful' pity than Good Health.

It will be as well also to consider some of the *moral* qualities which would be the result of the right kind of Practice at Games and Exercises.

Apart from the habit and faculty of Practice, which we mentioned just now, there comes a greater amount of self-control, of persistence, of regularity, of promptitude, and of general self-confidence. Here one may learn the best aspect of Emulation. This is not by any means the full list, but it may suffice for the present purpose.

Very much the same qualities will be found in the intellectual sphere. Both in Morality and in Intellect we shall acquire, by means of this Practice, a habit of using our own personal experience, and of improving ourselves thereby, and perhaps of helping others.

There is a great chance, in this sphere, of finding out something which will be permanently useful to humanity. There is perhaps no department of education where there is so much to be found out, which may be a universal blessing to mankind, as in Exercises and Games. There is most chance here for *Originality;* as well as for Observation.

As to *intellectual* advantages, besides the knowledge of such subjects as Anatomy and Physiology there is also the interest which comes in a number of new subjects and new topics: everything in life becomes interesting; moreover, we shall find that this Practice will be useful to anyone who wishes to learn any particular subject, or who wishes to teach it. For here the principles would be exactly the same. If he has practised and learnt Games and Exercises in the right way, he will be able to practise and learn other subjects also in a similar way, and will know how to teach them to others.

Add to this, that Exercises and Games will explain to us in an interesting and clear way (because we ourselves do them and do not merely read about them in a book), the Great Principles of mutual dependence, Co-operation, Division of Labour and specialisation; of Independent Self-Activity, combined with obedience to certain Written Laws and to a still stricter but unwritten Code of Honour; the need of Careful Accuracy, especially in the beginnings and at the foundations. And they are a wonderful means of Social Intercourse and National and International Unity.

Last of all, they help to bring us face to face with Scenery and with Nature; they should lead us to consider our members and faculties, and to compare them with those of the brute creation, and they should make us not only thankful that our bodies are so wonderfully made, but also determined to use and develop these bodies by the best possible means, and therefore first to find out what these best possible means may be.

## 3.—ADVANTAGES OF GAMES OVER EXERCISES, WHEN PRACTISED AND PLAYED IN THE RIGHT WAY.

We can scarcely imagine an International Competition in Gymnastics would do much to help the relations between two Nations, but when we actually see *certain Games* used in this way, the effects of the Competitions are most extraordinary; and under the heading of Games we shall, for the present purpose, include Athletic Sports. The friendly feelings and the mutual respect and the social influence of a Competition between any two sides in certain Games is almost incalculable. Games must be reckoned as one of the most powerful Bonds of Union that we have. Probably nothing else is so likely to further International Peace as International Competitions in Games.

Let it be understood that this is only when Games are played properly. And, first of all, they must be practised rightly. It is only then that the Mental and Moral qualities result from them, as well as the full 'Physical' advantages.

With regard to *Exercises*, they certainly have their value, and their value is almost unique. They should certainly be used to *supplement* Games far more than is the case at present. There are some Games which are so one-sided that Exercises are really needed if the development of the whole body is to go on; and not only this, but Exercises of the right kind must invariably be the *Foundation* of Games. No Games can really do what they should do, or be what they should be, without firm Foundations of the best kinds of Exercises.

The Learning and Practice of games should deal with those Exercises which are the most *Fundamental* and the most *Healthy* of all. Games can be therefore taken as *including* these same Exercises. This then will be the first Advantage of Games over Exercises, that the former include the latter and take them for granted. All the qualities, therefore, that Exercises help, all their Advantages, will indirectly and directly be the Advantages of Games also.

Among these may be mentioned the all-round development and improvement of *the Body*, its Muscles, its Heart, its Lungs and Chest, and the good state of its Blood, and so on. Health also, whether we consider the Circulation, the Breathing, the Digestion, or the getting rid of Waste-products, etc., is another result of the right Exercises. Such Exercises, too, may teach us lessons in Obedience to Law, in Self-control and Regularity, in Promptitude and Readiness to meet fresh conditions or emergencies, in Persistence, in Pluck, and in the Co-operation of the Nerves and Muscles. These are to some extent the result of simple Exercises, but to a far greater extent they, and especially the Promptitude, are the result of Games.

But mere *Exercises have certain Disadvantages*. The movements in many cases are too uniform and too regular, They may produce rapidity, they may produce Endurance; but they do not produce much lively Self-activity and Independence and Originality and free Self-movement and Choice, or much Emulation. These are sadly lacking in most Exercises, apart from Games. The old theory of 'Education' would perhaps rather be in favour of Exercise as compared with Games, because the old theory was that nothing could really be 'Education' unless it were unpleasant Discipline—conformity to a certain pattern and a dull dead level of imitation of a given model, the model, by the way, not always being a very good one. But Modern 'Education' thinks far otherwise.

Let us see in what respects Games would have the Advantage of mere 'Exercises' from the point of view of Modern 'Education' in its highest ideal.

There can be no doubt that Games are a splendid training in *Honour*. Such a feeling of Honour is (or rather should be) acquired in Games, as lasts even in commercial life; and this is saying a good deal. By Honour we mean not merely conforming to a certain fixed set of Laws, but also conforming to them when it is possible, perhaps, to gain some extra advantage by going beyond them and by cheating. The Standard of Honour at Games is perhaps the highest standard of Honour in the world, that is to say, when actual practice is the criterion as opposed to mere theory.

Secondly, Games have undoubtedly more *Interest* than Exercises, partly owing to their *Emulation*. Their effect might be still better if (see 'Lessons in Lawn Tennis') a good system of Handicaps were introduced so as to make the Competitions more even, to prevent the better player from winning too easy a victory, and so perhaps becoming careless and conceited, and to prevent the worse player from being beaten too easily, and so perhaps becoming careless and despairing, though an occasional up-hill Game when defeat is certain is by no means without its compensations; nor is an (occasional) easy victory without its refreshing effects.

But there is no doubt that one of the chief merits of many Games over mere Exercises is that they are one of *the best* forms of *Emulation* which we can possibly have. Emulation in Brain-work and Emulation in Business is apt to be extraordinarily *selfish*, but Emulation in many Games is far less injurious. It often means an attempt to excel, not another, but one's past self. One tries to excel, not so much a rival, as one's former standard.

Games are about the finest kind of *Competition* that we have. They are not too frivolous nor yet too serious; of course they *can* be the one or the other. Perhaps as an extreme they are apt to become too serious *, but in their ideal they would not be so. Certainly there is no other way in which two Nations could meet in such friendly rivalry. When we contrast the Brain-Competition in a Class with the Competition in a Game the difference is extraordinary. How petty and selfish the aim of the boy seems with regard to a Prize for Brain-work, as compared with his aim in Athletic success, especially when the success comes to him, not simply as acting for himself, but as having worked for his 'side' as well.

Games also are far more *Sociable* than Exercises. Those who meet together in a Gymnasium, or go through certain Gymnastic Exercises, do not feel this to be so powerful a Bond of Union; whereas those who play Football together on the same side, or on opposite sides, do feel a bond of sympathy. Few foreigners understand this. Only those who constantly play Games know what the feeling is.

Above all, in Games as opposed to Exercises, there is a *Pleasure* and Joy. And the result of this is not a mere word 'Pleasure', or 'Joy', but it means that the blood is favourably affected; it means that the Health is improved; it means that

* This extreme is seen in France, Germany, and America.

more Exercise can be done with actually less effort; and it means a good deal more besides.

And in Games, too, we learn *to bear Failure, and to bear Success* (which is harder still). There is no such easy field for this lesson as Games.

Games are, again, a very good exercise and preparation for *Patriotism* of the best kind, and for feelings which we way call 'Group-feelings,' that is to say, feelings of Loyalty to groups of people outside the family group.

Not only is their *Social* Influence considerable; not only do they bring about intercourse such as no amount of mere conversation, no amount of mere meeting in an ordinary way, could possibly produce; but they are a great *Equalizer*, at least some of them, Football perhaps among the chief. Football and the cheaper Games are a powerful influence in the direction of Democracy, though the same cannot be said of all Games—rather the reverse.

Games also, as we have said, are a strong Bond of Union. The effect of a school-fight between two boys is often to lead to a life-long friendship, and the effect of the milder Competitions and Games is generally the same. Such friendships can be formed in very few other ways. Such friendships also would not be formed (at least in England) merely through Gymnastic Competitions.

As we have seen also, Games can give us certain *Lessons*, such as that of Co-operation and of Honour; for the Code of Honour is very strict here, and such a Lesson is sadly needed in this commercial age.

As compared with Exercises, Games are *more varied;* they combine many more changes than the mere Exercises could; more sudden, more rapid adaptation is needed, and the result of this is that Games are less fatiguing, and can be played longer, and in fact one is more ready to play them than one is simply to take Exercise.

And undoubtedly it must be a great aim of 'Education' to give people *a Motive for taking Exercise.* If you say to people, 'Take Exercise so as to get Health,' few of them will follow your advice. But if you say to them, 'Play a Game which you will enjoy and which will *also* make you Healthy,' then few will object. The immediate Motive for playing a Game need not necessarily be Health or the development of Mental and Moral qualities: it may be sheer Enjoyment, or Emulation. But the final result of it is none the less Health, and, if the Games are played properly, the development of these qualities as well.

The fact is that Games give an Object for Exercise, which mere Exercises of themselves seldom *can* give. It is of no use to recommend Gymnastics if people who have free choice *will* insist on choosing to avoid Gymnastics. Health by itself should be a great aim in life, and everyone wishes to be healthy. But it is a sad fact that, although masses of people are convinced that certain Exercises *will* make them Healthy, they will not go through those Exercises. Take, for instance, Running. You cannot get masses of people to run: you have to get some further Motive. The motive is often a low one; for instance, running after some animal. And the same will apply to Riding. Some people will not go in for Riding simply as Riding. They need a further inducement. That inducement may be one of a low kind, as we see in the case of Hunting; nevertheless the good effect of the change, the Open Air, the Exercise (and some of the Enjoyment, perhaps), may be considerably greater than the bad effect produced by the taking of animal life.

A *proviso* must, however, be made here.

On all that has been said above, Games have been spoken of *in the ideal* rather than as they actually are. Games can be carried on with unthinking stupidity. Their Motive may be a mere desire to win, and even Honour may be thrown to the winds. The Motive may be simply to make money. The Motive may be simply to get cups and prizes. Games may lead to terrible over-training and over-straining of the Heart and Lungs. These in their turn may lead to excesses afterwards.

Games have another Disadvantage, and that is that they are not always easy to get. A Game needs *two* players at least, and it is not always possible to find an opponent who is not too good or too bad, and who is keen, and so on: though Handicaps would help very much. And, besides an opponent, one also needs a 'Ground' (or a Court), and one usually needs Apparatus. All these are not always ready to hand.

Some 'Games' there are, also, that are seldom ennobling, partly owing to their very nature, partly owing to their usual

'Environment'. Certain Games of chance, for example, are not ennobling: and Billiards and some Card-Games often mean bad atmosphere, late hours, and too much Stimulant.

All this must be fully realized, and our idea of the Advantages of Games may be far too optimistic.

But it is always best to point out the Ideal. By this means, perhaps, *some* people at any rate may be convinced that in playing Games they are not doing anything at all low, but are doing something which is noble if it is done in the right way. It is clear that if you can show that any occupation, so far from being taken up for its own sake alone, can also serve a high end, without doing any harm, then you give an extra Motive for the taking up of that occupation, and you raise its level. So long as a Football Player (a Football Professional, let us say) thinks that Football merely consists in winning, even if that winning is for his side, so long as he thinks this, the Game of Football will not affect his character as it ought to. But point out to him that, if he looks at it in the right way, it is as fine a thing for his character as he could get, then you ennoble Football—you make it a thing worth doing. Football certainly *will* be played, and it is just as well for the people who play it to see its noblest side, its best results.

Let it be said, in conclusion, that *Games should become a School study*. Strange as it may sound, it is none the less true that Games should be a subject taught in every school throughout the country and throughout all countries. It is not merely that by means of them could be taught such subjects as *Anatomy and Physiology*, and that these subjects could be taught by Games and Exercises far better than in any other possible way. It does not mean merely this. Nor does it merely mean that Games should be studied because they are so important for Health. It means far more than this. Games should be taught as a *subject*, so that those who play them may get Lessons from them, may see their grand side, and may see how they develop whatever is best in man, if only they are done rightly. All those Lessons which *are* taught from more or less dull Text-books and which *can* be taught from Games should be taught from Games, at any rate to start with. What need is there to go to a dull statistic-book to get such ideas as Co-operation, Division of Labour, Independent Activity and

Originality, Honour, Discipline, and so on, into a boy's mind, when there is a special field for study in every School worthy of the name, and a field of study in which the boy is *bound* to be interested, if he *is* a boy. Throughout the writer's course of Education he has never yet heard any such allusion to any Game in School-time. It has been a terrible omission.

## 4.—ADVANTAGES OF SPECIAL GAMES, PARTICULARLY BALL-GAMES.

England is *the* Country for Games: America is hardly behind England here. In fact, wherever Englishmen have an influence, *there* we find Games, especially Ball-Games—in America, in Australia, in New Zealand, at the Cape, in China, in India, and elsewhere, English Games flourish. It was acutely observed, not long ago, with reference to our new Chinese possessions, that we go and lay out our Cricket or Football Ground, where perhaps the Germans or Russians might first seek to build fortifications, and never trouble about Games at all.

Behind this apparent love of recreation, there lies a true though half-unconscious idea: side by side with self-preservation we here study the art of self-development and Health. And, though Germany can teach us much, if we would only learn, yet in *this* we are the wisest of Nations, and set the example for the whole world.

But it is not every Game that is good for every one. Later on we shall see that Games of Speed are best for the young, whereas Games of more complex skill and strength are best for those who are no longer young.

Besides this, certain Games are, by their very nature, ill-suited for certain people, at least as special forms of Exercise. For the Sedentary Worker, if he is fairly young, one would not recommend Croquet or even (except occasionally, when it is a splendid change) Golf. For the busy, again, Cricket takes up too much time; and it also takes too much time, in proportion to the Exercise, for those who have a bad 'Eye', and get out almost immediately.

The Hearts of some, the Lungs of others, and various complaints in others, prevent certain Games and other forms of Exercise from being useful or even safe. Games involving Straining are probably the type to be avoided by the largest number of the 'in any ways afflicted'.

Expense, also, puts some of the very best and grandest Games out of the reach of thousands. Tennis and Rackets are magnificent—but, under ordinary conditions, the cost is a serious drawback: whether, in many such cases, the certainty of Healthy Exercise, and of its many results, would not actually bring back the spent money in better work, is a question worth considering.

Before discussing the Games one by one, let us notice that *the value of a Game will depend a great deal upon the amount of pleasure and interest which it has for us, individually:* and that we are little likely to find its full interest and pleasure, unless we learn and *practise* it rightly.

Secondly, only a very few points can be given here. Roughly speaking, the remarks suggested here are about *a quarter* of those which might be suggested.

Thirdly, many Games are omitted, and especially those that are least known. No one can ever hope to play *all* Games: there would scarcely be time! Possibly, if this work ever reached another Edition, the help of the great players might be secured, such as Messrs. W. N. Cobbold (for Association Football in the still recent past), C. B. Fry (for Cricket, and the Long Jump), S. M. J. Woods (for Rugby Football), and so on. For some Athletics (e.g., the Hammer and the Weight) we should probably have to go to America.

But it *is* important for everyone to know even only this much, so that he may, after fair trial, choose the best.

In the following pages, when a certain Game is said to be good exercise for *Rapidity* it must be remembered that Rapidity itself (at least in Running) will be good Exercise for the Lungs, and for the Circulation of the Blood, and for Changes within the body, and so on. And so also an Exercise for Endurance will bring with it the special advantages of *Endurance*.

**FOOTBALL,** at its best, will develop the powers for Co-operation and Mutual Help, without sacrificing the power of free original activity (within the Laws of the Games and the Laws of Honour). For Promptness and Readiness as well as Speed, for Pluck and Endurance, for Strength (esp. in playing forward at Rugby), for giving exercise in most weathers (except when it is too hot or is freezing too hard), in the open air, to large numbers of people of different Classes, so that Classes may intermingle, and also for Cheapness, and for the short time it takes, considering not only the huge energy expended, but also the occasional rest or change within the Game itself—for these and for other reasons Football stands rightly first among our British Games.

Its occasional violence and strains, its excessive 'keenness', and 'professionalism', and also its confinement (as a general rule) to the earlier years of life—these few drawbacks must not be forgotten, but they are small compared with the Gains. For the list of Gains is not exhausted here—far from it. The use of both Legs, the rapid Twisting of the body, the rapid Stooping (in Rugby), the use of the Head (in Association), these would be a few of the extra advantages.

**FIVES** (in the open air) should be placed second on the List.

While Football exercises both Legs and (to a smaller extent) both Arms, so Fives develops both Arms, left as well as right. In fact Fives develops nearly all the Muscles of the Body, and with its rapid twisting and stooping and 'crouching' may do much to prevent Constipation and Indigestion. The Single Game demands Rapidity and Endurance, and both Games demand Promptness and rapid adaptations. Both Games harden the hands. The Four-game has the extra advantage of allowing more pauses for rest, and of being more friendly and sociable. These two reasons show that people should *never give up* Fives (or Lawn Tennis): the 'Fours' are among the best Games for elderly people.

Both Games need very great accuracy both of Body-Position, and of pace (matters little studied by average players), and of Direction. The 'Eton' Game needs more 'niceness' and has more variety (at least for the ordinary player) than the 'Rugby' Game, which asks for more steadiness and endurance.

But both have their drawbacks, apart from the expense of balls, and the need of getting a Court (every Country-house and large Town-house should have one). If they are in the open Air, they depend on the weather (unless roofed over), whereas if they are in a closed Court their effect on Health is not so good. Moreover, Fives admits of only four players at the most.

SQUASH RACKETS (or 'SQUASH') is one of the most popular of Games, and it seems to be growing more popular every year. Nearly everyone can play it up to a certain standard: the rallies are long, the Exercise good, and not too violent. It is, in fact, a modified form of Rackets—easier and cheaper, and therefore more generally liked.

In many respects it has the advantages and disadvantages of Fives. It does not exercise the left-side so much, but then, on the other hand, it does not hurt the fingers so much (especially during the first few minutes in very cold weather). Both are excellent preparation for other Ball-Games, especially Tennis and Rackets.

No man ever heard of any one who regretted having a Squash-Court of his own—this is a hint to all who can afford to take it.

RACKETS is very expensive, and requires a certain standard before it can be properly enjoyed. Moreover, it is not in the open air, and does not admit of more than four players.

Nevertheless, as a Game that can be played in all weathers, and that demands very great activity, promptness, accuracy, and endurance, and only takes a very short time (say an hour), it is doubtful if it has its equal. There is no Game in which a stroke gives so much pleasure as a really good Half-Volley in Rackets, unless it is—as I think Alfred Lytleton says—a good Half-Volley at Cricket or a good Drive at Golf.

REAL TENNIS, as it is played to-day, is a little less 'rapid' than Rackets, but has much the same general merits and defects, including the expense, and the small number of Courts: England has only about 30.

It excels Lawn Tennis in its variety and in the need for greater versatility and ingenuity. This would be still more the case if the many kinds of Handicaps were more commonly employed. It can be played till comparatively late in life, and here (as in the Four at Lawn Tennis) increasing experience to some extent makes up for diminishing activity. Though played in Closed courts, it is one of the best Exercises for hard Brain-workers. The great advantage is that there is usually a Marker (and a Professional) ready to play with you, in case you cannot get an opponent.

LAWN TENNIS. Here it need only be said that Lawn Tennis has the advantages and disadvantages of being moderately expensive, of not being too violent, (the 'Four' is not at all violent) and of being played (as a rule) in the open Air and in Summer, and of being a Game for Ladies.

If is an excellent Game for Social purposes, and can be kept up till late in life. It has just the right amount of variety, activity, and endurance, and takes just the right amount of time to suit hundreds of people who would be averse to milder Games (like Croquet) or to more energetic Games (like Rackets), or to longer Games (like Cricket).

GOLF has affinities with Rackets in its hard Drive, with Tennis in the variety and pace and nature of its Strokes, and with Croquet and Billiards in its Putting (with a stationary Ball), also (especially with Croquet) as a Test-Exercise for the temper; but it has some features of its own.

The Scenery, the quiet Walking, alternating in the Healthy Body-swings etc., the accuracy needed, the (almost-too-good-to-be-true) distance of the Drive, the variety of Implements as well as of Strokes, the most excellent system of rising and falling Handicaps, these and many other features make it a most splendid Game for elderly men (as well as for ladies and for younger men occasionally), if only the time can be given, and the temper can be curbed. To the average player, especially, (and still more especially if he is losing) the element of Luck seems too great.

But against it there is also to be considered the expense, and the absorption, shown by the exasperating tendency to talk "shop."

Of CROQUET very little need be said: many people dislike it because they yearn to run about, and to hit hard now and then—even if it were only their opponent. Yet it is a Game of tremendous accuracy and among the best for ladies and old gentlemen.

HOCKEY is among the finest of Games; it probably has a great future before it, for ladies as well as for boys and men. It has most of the advantages of Football, especially of Association-Football, and it has many of the advantages of Cricket, without the disadvantage of taking up too long a time.

For ordinary people, and for ordinary purposes, it should rank at least among the first three of our British Games. It is, moreover, very cheap to play.

CRICKET is the worst Game in the world for the person whose side is making hundreds while he himself is either already out for O, or is to go in last (if the Captain does not "declare"). But for the Fielder it is good, for the Bowler still better, and for the Century-Maker perhaps the best.

Against it is the dependence on the weather and time of year, the length of time (and time-wasting), the occasional excessive importance of a single mistake (if it is a mere chance), the frequent inequality of the two Elevens, and (often) the Expense.

But yet it is a very king among Games: the Scenery and Air, the variety and changes in the work of the Fielding side, the Division of Labour, the need of Promptness and activity and endurance, the social effect (especially the mixture of class and class), these are just a few of the merits. But the true charm—a subtle charm unknown in the playing or watching of any other Game—can be appreciated only by the past or present player: it is in the field and in the memory of the field—it cannot be put on paper.

Let us say two or three words in conclusion.

1. There is no Game which would not be improved by a more or less frequent use of **Handicaps.**

The choice of opponents is not unlimited, and to have an almost certain victory, or an almost certain defeat, may be valuable occasionally, but this must not be repeated too often. An equal Competition, in which *both sides have to do their level best to win,* is again and again impossible, and *must be* impossible, unless *some* Handicap is arranged.

The Handicap may add to the number of one team, or take from the number of the other (as a rule the latter by preference); or it may give 'points' to one side or take away 'points' from the other side (as a rule the latter by preference); or in some way it may give one side some extra freedom, or it may take from the other side some of its ordinary freedom, e.g., a smaller bat or racket being used (here the latter might also be preferable).

The Handicap of *left instead of right* (e.g. Left-handed play at Lawn Tennis) is among the best.

2. **Left-handed** and Left-sided play, or at least Practice, is most excellent, not only as a Handicap and Equaliser, which forces the stronger player to play up tremendously hard, and *carefully*; but also for all-round development, and for the Health in general.

It is not meant that both Right-hand and Left-hand should be used, e.g., during a single Game of Lawn Tennis, nor that the player should try to make his Left-side as good as his Right; but merely that he should see that it reaches a certain Standard of Skill, and has a certain amount of Exercise and Training.

This is one reason why Fives and Boxing are so good.

3. While nearly everyone should make the Foundation-Positions and the Foundation-Movements an integral part of his very self, while nearly everyone should then, at least occasionally, try as many forms of Exercise and of Games as he possibly can, still, the older he gets, and the busier he gets, the more need he will find for **Specialising**, for going in for *one or two forms par excellence.*

In the choice, after a fair trial, much will depend, as we said above, upon his opportunities, much upon his enjoyment and interest, much upon the state of his finances, much upon the amount of time he has to spare, much upon his personal aptitude and therefore upon his figure and limbs.

Much will also depend upon his age, upon the time of year, upon the weather and even upon the time of day.

Fresh Air and Good Scenery, it must be remembered, are of value in themselves, quite apart from whether the special Exercise is a relief from the previous occupation or not. It is surprising that so few places, open to the Air of heaven, are set aside in England for Boxing, Tennis, Singlestick and some kinds of Gymnastics. Surely the close Gymnasium (i.e. as it generally is to-day) is *not* the best place even for Gymnastics.

Last of all, let special *Exercises* be made not only to pave the way for Games, but also to supplement them. Thus the success of the Games themselves will be enhanced, and the body itself will be trained and developed all-round.

## 5.—ADVANTAGES OF SPECIAL EXERCISES.

We have given above an account of some of the Advantages of certain special Exercises: e.g. of Walking, Running, Swimming and so on. This Section, therefore, will merely *supplement* those remarks; *it will not deal with many forms of Exercise*, and is only intended to give a few more or less fragmentary remarks here and there.

Here, as in the Games, much will depend on the Individual and his body, his occupation, his health, the time and money that he has to spare, his age, the time of the year, the time of the day, and so on. 'Run while young, and in winter, and in the early morning' would give some idea of what differences there may be in the advice according to the differences in the conditions.

Apart from Bodily Development, and General Health, let us consider one or two points in connexion with one or two Exercises, always supposing that these Exercises are Learnt and Practised rightly.

FOUNDATION-EXERCISES (e.g. see pp. 12 foll.) We shall see that some of these are good helps against Constipation, Indigestion, Consumption, etc.; and (on p. 22) it is shown that, if once mastered, one by one, they form a most admirable basis on which to build up almost *any* Game or Exercise.

For other Advantages, see pp. 18 foll.

Under these might be included the best of the

GYMNASTIC-EXERCISES, and special HEALTH-EXERCISES (Swedish Gymnastics), with or without Apparatus.

GYMNASTICS, as a rule, fail as a complete all-round means of development, because the movements are too regular, too *expected*, too deliberate. As has been shown above some of them are invaluable

*a* for Health and Physical Development;
*b* as Foundations for many Games and Exercises;
*c* as Supplementing many Games and Exercises.

But they are not, as a rule, good practice for rapid and sudden change; moreover, they are often a Strain, and they may over-develop the Muscles, or the Chest.

They therefore need to be arranged and used very carefully and scientifically.

BOXING (with which Fencing may roughly be classed, especially if Left-hand Fencing be added) is a most magnificent Exercise for the Lungs, for both sides of the body, for Balance, for Rapidity, Endurance, Variety, for Promptitude and sudden Adaptation, and for Originality (up to a certain point). It may become brutalising, but it seldom does among Amateurs, to whom it rather gives the better qualities of Self-reliance, and of Fearlessness, especially when the weaker have to be protected. It is wonderfully cheap, and should be practised in the open Air. Alternating with it there should probably be Running, and perhaps Golf, as a practice in more Deliberate movement.

ROWING has the advantage of the scenery, of the non-dusty (if sometimes sewery) River-air, or the Ozone Sea-air, breathed in very freely, owing to the Exertion; it is excellent Exercise of a sort, especially for Strength, Rapidity and Endurance. The Rowing in an Eight or a Four is a fine lesson in Discipline, and in Co-operation and working, not for Self, but for a Whole, of which one forms only a part.

Single Rowing or Sculling may also be an exercise for other qualities, not only affecting both sides of the body, but also encouraging more Independence.

Nevertheless there is too much regularity and rhythm of movement, too little free choice; Rowing is one of the worst Exercises for sudden and prompt change, for special *ingenuity* and orginality. It encourages 'Conformity to a type'.

Therefore it should never be the sole Exercise: Running alone is not enough to supplement it. For Promptitude and readiness, for a sudden change of action (and not merely for a sudden increase, e.g. of Rapidity), Boxing or Fives or some such Exercise should be tried constantly.

SWIMMING is of value for Cleanliness, for the tonic and invigorating effects of the Cold Water, for the (usually) good air breathed in, as well as for the saving of life. It may be made to exercise nearly all the Great Muscles of the body, as well as the Lungs, and to exercise them in a very short time. There is enormous force expended with comparatively little Fatigue, and with very little expense.

But it may produce sleepiness, and some people find that it puts out their 'Eye' for Games.

CYCLING has these two last Advantages of Swimming to a high degree. It must always be valuable for the purpose of covering ground cheaply and quickly, and so saving money and time, and for getting out of a City into the open country.

But those who have once Cycled rarely go back to Walking, and still more rarely go back to Running—and the loss is enormous. Nothing can quite take the place of the Walk and Run.

Might we suggest something to the Cyclo-maniac? Ride out into the country, by all means, but don't ride out in the wrong attitude, and, when you have ridden out, then leave your Bicycle and Walk from and back to the place where you leave it (e.g. a Cottage). Use your Cycle in going to play a Game, and in coming back, but let us entreat you not to give up your Game itself.

RIDING will always be a fine thing for those who are healthy enough to Ride, and who can afford it. The Open Air and Scenery, the Liver-shaking (for which there are substitutes, however, e.g. Massage), the excitement, and other merits, are well known. But the pleasure depends much upon the weather.

FISHING and SHOOTING. Both are in the open air, often amidst the finest scenery; and both are exercises of skill—Fly-fishing in particular. Shooting is found by many to be a splendid form of Walking, the pleasure and excitement enabling them to cover huge distances over the most uneven ground with the minimum of Fatigue.

The killing of Animals is a means to a most valuable and desirable end, fine Exercise, and Health, and Recreation: one cannot presume to say that Animals are not fulfilling their God-given function at least as well in this way as when they are killed merely to be eaten. In fact, is it not preferable to see Animals killed by sudden death to promote the Health of men by means of Exercise, than transported by ship and driven along dusty roads and crowded streets, and then killed, to feed those who might get far cheaper and perhaps healthier Foods? It is better to see them killed by sudden death in the service of Health than fattened and made grossly unhealthy—deny it who can—like many pigs and some geese, to give men Luxuries for the taste; or killed, sometimes by a slow death, to give women Luxuries for their clothing.

For, after all, Exercise is a necessity to most of us, but Luxuries cannot be.

# PART III.

## THE BONES AND JOINTS, BALANCE AND EXERCISES.

1.—BONES AND JOINTS.

2.—THE BALANCE AND CARRIAGE OF THE BODY, AND EXERCISES.

3.—BONES OF THE CHEST.

4.—BONES OF THE SHOULDERS, ARM, AND HAND.

5.—THE LOWER LIMBS, AND THE CARE OF THE FEET.

6.—THE MUSCLES, FATIGUE OF THE MUSCLES; STRENGTH, ENDURANCE, SPEED.

7.—MUSCLES OF THE ABDOMEN, AND EXERCISES.

8.—MUSCLES OF BREATHING.

9.—SOME OTHER MUSCLES.

## I.—BONES AND JOINTS.

In Children the Bones are very flexible because they contain a great deal more 'Gelatine' than the Bones of grown-up people; they have (in proportion) more of the soft Gelatine and less of the hard Earthy and Chalky Material. In old age, on the other hand, the Bones are stiff and brittle—they have more of the hard Earthy and Chalky Material.

The lesson is that it is of the very utmost importance for Children to learn the right Positions and Exercises before their Bones are 'fixed'; and Positions and Exercises include those of the Shoulders and Lungs, for example. If these Positions and Exercises are properly practised before the Bones become 'fixed', the Bones will then become 'fixed' as they should be. Good Habits, a good carriage, good balance, and a fine faculty for Exercise, and a great deal more besides, will have been acquired as a firm foundation on which to build up the later growth. If, however, the Positions and Exercises are left till the Bones have become more or less 'fixed', or if the wrong Positions and Exercises have been acquired, then the whole of the future life must suffer: the evil can never be thoroughly repaired.

The Bones may be classified as Long, Flat, Short and Mixed. They are composed of different parts, e.g. the spongy cells inside, the surface-layer, the membranes, outside this layer, that feed it and help it to grow, and the nerves and blood-vessels in these membranes, and so on.

There are little channels in the bone itself, and in these little channels are blood-vessels.

The Bones are formed by the blood, which, as it passes through, drops and leaves behind certain materials such as Lime.

Some Bones are firmly connected together, so that there is scarcely any movement, i.e. they cannot change their positions with regard to each other; while other Bones are more loosely connected, so that there is a freer movement. They are joined by bands or Ligaments, and some of these can bear an enormous strain without snapping. Cartilage also connects the Bones: it is firm and elastic, and covers the ends of the Bones with a smooth strong coat, so that the hard Bones do not knock together with a crack: the force of the crack or jerk is deadened. If you look at the Spinal Column (pp. 80 foll.), you will see that there is Cartilage between the joints. Otherwise, when you trod sharply on your heel, the hard points would rattle against each other.

Cartilage is also to be found in the windpipe, the eye-lids,

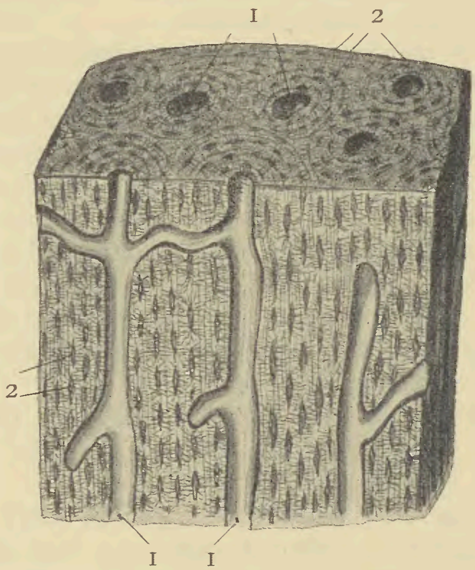



Fig. 2. Section of a piece of bone magnified 150 times.
1. Haversian canals. 2. Bone corpuscles.

etc. Without it our bodies would not have their firmness and elasticity.

Joints are of many kinds, but, generally speaking, they are where two Bones meet; the meeting ends of the Bones are

(i) covered with firm and strong Cartilage, and

(ii) fastened together more or less tightly by firm and strong Bands or Ligaments. Thanks to these, the Bones can move without actually separating.

The following Illustrations will show what some of the Joints are like. First move and turn your body about on your Hips and Thighs, and then look at figs. 3 and 4.

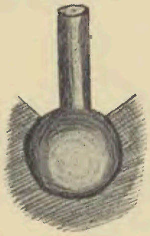


Fig. 3.
Mechanical Cup-and-ball joint.

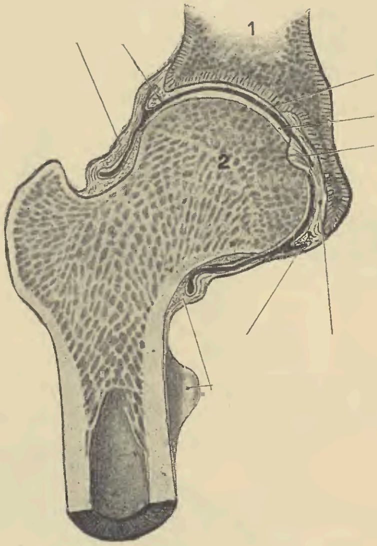



Fig. 4.
Cup-and-ball joint of the Hip and Thigh.

Or put your hand up to your head, and then look at the Elbow-Joint in fig. 5.

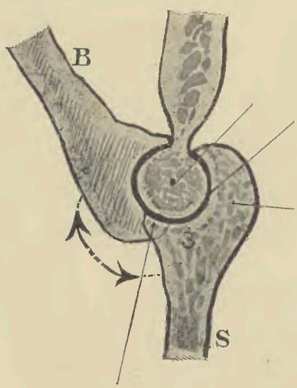



Fig. 5.
Hinge Joint of the Elbow.

Of course there are other Joints as well; besides the Cup-and-Ball Joint, and the Hinge-Joint, we have the Saddle-Joint also.

The floor of the Skull has many holes and canals through it, so that the Nerves and Blood-Vessels may pass through and wander here and there.

Fig. 6 shows the Skull of a child one year old, of a child ten years old, and of a grown-up person; the latter is also seen (front view) in fig. 7.

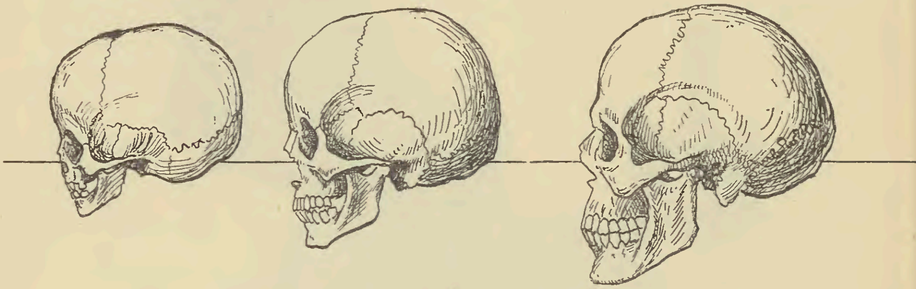


Fig. 6. Skulls of (1) a child one year old, (2) a child ten years old (3) a grown-up person.

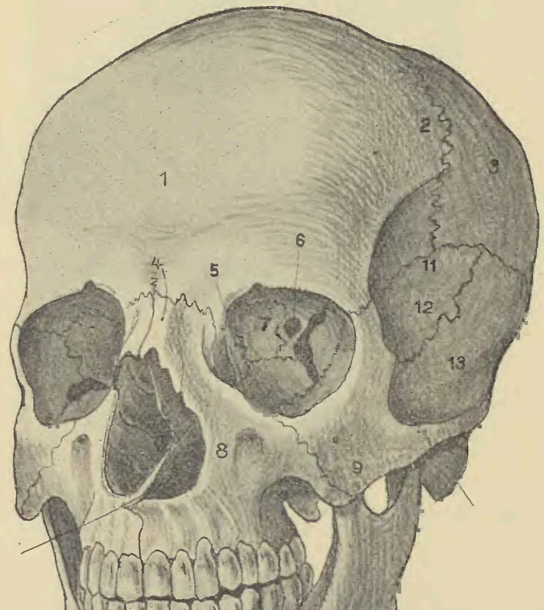



Fig. 7. Skull of a grown-up person.

## THE NOSE.

The Nose is the usual air-passage when we close our Mouths, and breathe in or breathe out. The air then has to make its way through the nose-passage, which has a lining of moist stuff called Mucous Membrane. By this means the air, before it reaches the deeper air-passages and passes into the Lungs, is *warmed and moistened in the Nose.* Moreover, many of *the coarser specks of dust* which are drawn in by the breath, stick to the wet and sticky membrane, just as they might stick to an Oyster if you dropped it in the road on a dry day, and are so kept from getting into the Larynx and what are called the Bronchial Tubes. Much of the dust is thus made harmless: for it is carried off by the mucous when you blow your nose—this accounts for the dark and even black appearance of the former after you have been in foggy or sooty or dust-laden air.

Hence it is of very great importance to breathe through the Nose: we have not such good Noses for breathing through as some Races have (e.g. Negroes), and it may not be easy to keep from breathing through the Mouth, especially when you are exerting yourself. But with habit it becomes easier and easier. It should be practised as a special Exercise all by itself, best of all in the early morning. If you shut your mouth whenever you remember that you have it open, you will soon find that you will naturally keep it shut even during sleep and hard Exercise. An open mouth is often a sign of stupidity or even idiocy, and is still more often a sign of Ill-Health. As it means that the Air is going down into the Lungs practically unwarmed and unfiltered, it is also a cause of Ill-Health.

## THE TEETH.

The Teeth have an outer layer of Dentine (which can be spoilt by various Foods), and inside them is the Pulp which holds the tender Nerve and Blood-Vessels of the Tooth.

In the lower Races, the Jaw and Mouth project most, but not so much as in the Apes. Camper, the Dutchman, collected notes on the angles of the Face.

## THE SPINAL COLUMN.

Right down your back you will feel a number of ridges. These belong to the Spinal Column, which is one of the most important parts of the body. It is not a single bone, but is made

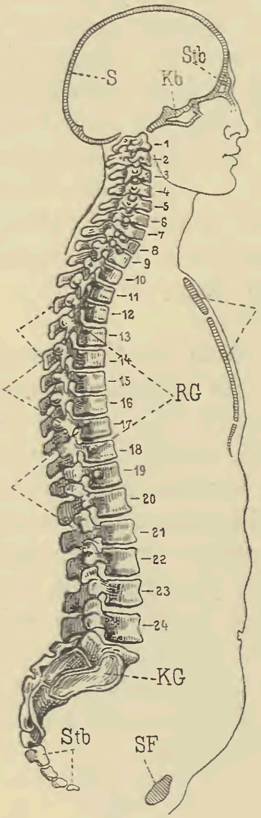



Fig. 8. The Spinal Column.

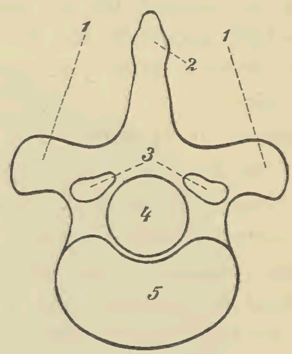


Fig. 9. One of the Vertebræ seen from above (4).

up of many flat bones piled on the top of each other. These pieces of flat bone are called Vertebræ. Figs. 8, 9 and 10 will show what they are like.

Each of the true Vertebræ is a kind of ring. The front part is solid. These rings are put one above the other, in such a way that the hollows of all of them form a continuous canal, the Spinal Canal, which contains the Spinal Column. The Spinal Canal is connected with the Brain-cavity of the Skull; in fact, part of the Brain may be said to run down right through the many Bones of the Spine.

In this Canal are important Nerves: as we walk along, we do not as a rule direct our legs and their movements from

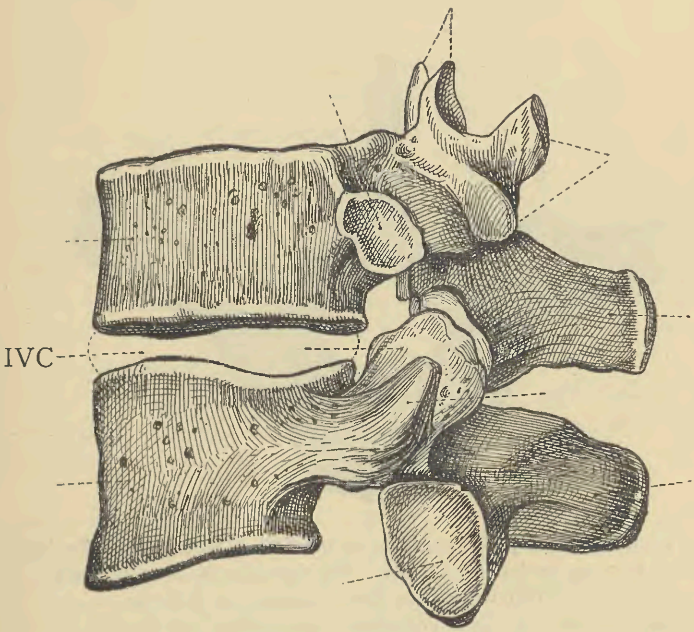



Fig. 10. Part of the Spinal Column, viz., the last piece of the back (Dorsal Vertebra) and the first piece of the Loins (Lumbar Vertebra). IVC marks where the Cartilage comes in.

our Brain, but from our Spinal Column. Hence cold water down the Spinal Column is a very powerful tonic, if rightly used.

The Spinal Column, the firm pillar of the skeleton, consists of 33 Vertebræ.

The body of a Vertebra is flat on the upper and under surfaces. It consists of spongy and bony substance. The firmness of the Spinal Column is chiefly due to its powerful Bands or ligaments.

Thus, in fig. 11, notice the band or Ligament which joins one of the pieces or Vertebræ of the Spinal Column to one of the Ribs.

Between every two of the vertebræ lies a disc of firm elastic Cartilage, which solders firmly together the rough opposed sides of the pieces. The Back part of the Column of a grown-up person will bear an average strain of about 275 to 285 lbs., the Loin part an average strain of about 165 lbs., without

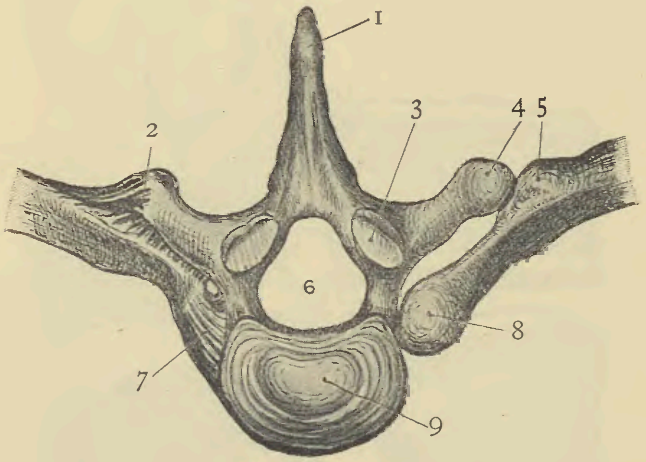



Fig. 11 (cf. fig. 9). A joint (Vertebra) of the Spinal Column, and the head of a rib: on the left are the ligaments that join the two together; on the right these have been cut away (2, 6, 8, 9).
2. Ligaments between the joint (Vertebra) and the Head of the Rib. 6. Vertebral Canal. 8. The Head of the Rib. 9. The Cartilage between the joints (Intervertebral Cartilage).

giving way. This Cartilage, like cushions between the many bony pieces of the Spine, greatly weakens the force of any shock or blow which strikes the column from above or below, e.g. the shock of jumping down suddenly on to the feet.

The total height of all these discs of Cartilage amounts to a fourth part of the height of the whole Column. In the Skeleton they shrink, and must be replaced by leathern discs if the skeleton is to retain the full height of the living body.

The various pieces or vertebræ of the Column are not of the same size, but gradually increase in size and height as we go downwards. The thickness of the cartilage between the vertebræ also varies.

This cartilage is gradually flattened by pressure (e.g. when we stand up), but it swells to its original thickness when the pressure is removed; so the length of the body is greater in the early morning, after a night's rest, than in the evening.

The different parts of the Column are not equally flexible, and few parts are at all flexible by themselves. But 'many a mickle make a muckle'—the littles added together make a large total. Moreover, people differ very much in their flexibility, according to nature and practice, especially practice while they are young (e.g., Circus-performers). But ordinary people can command a view of the whole horizon (360 degrees) from a single position, if they turn their face to the right and to the left.

This is of great importance in Games: for instance, in Cricket or Rackets or Fives a player can be using his huge body-muscles for a stroke while he is still looking at the ball which is coming towards him. With constant attention to the Neck-Movements this soon becomes quite easy.

This movement of the trunk, as well as those below, should be practised throughout life. Many of them are very valuable in helping to cure constipation.

Where the Skull meets the top piece or Vertebra of the Spinal Column there is a Hinge-joint (p. 77), which allows of the movements of bending and stretching, as when we wish to say Yes, or to bow the head forwards. But the joint between the first and second pieces or Vertebræ of the Spinal Column is a Rotatory-joint, which allows of the movements from side to side, as when we wish to say No.

The head and the top Vertebra (or Atlas as it is called) can turn to right or left through an angle of 45 degrees. This would be impossible if the bands or Ligaments between the Atlas and the next Vertebra were not very elastic.

The ingenious device of distributing the movements of the head between these two joints at different parts of the Spinal Column gives a great variety of movements without the twisting or stretching of the Spinal Cord.

So far we have spoken of turning the body round: it can also be bent over to the right side and to the left, and down forwards when we stoop in the direction of touching our toes with our foreheads. Notice that in this latter movement the Spine does not form a round arch, as one might be inclined to think at first, and as one might naturally draw it in a picture. See figs. 12 and 13.

The Spinal Column in grown-up people has a triple curve like a double S, made from back to front: it curves forwards, then backwards, then forwards again.

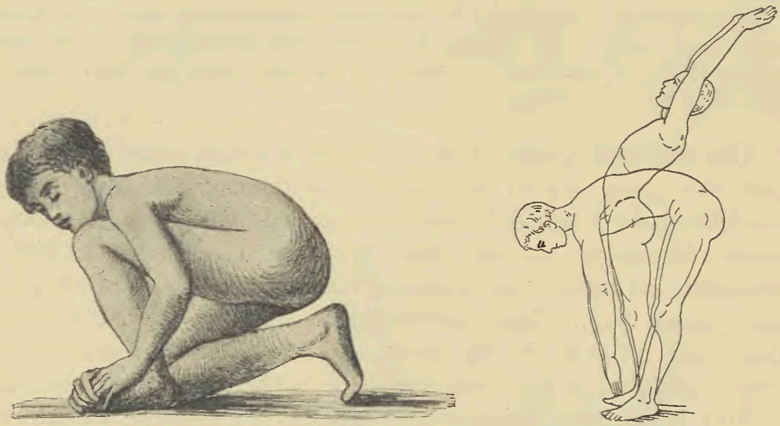


Fig. 12—13. Deep bending of the Spinal Column. Notice that the bending is of the lower part rather than the upper part, i.e. of the Loins-part (Lumbar) rather than the Back-part (Dorsal).

Curves are not present in the Column at birth, but come with advancing growth, because of the weight of the body, and of efforts to sit upright and to walk upright. The Spinal Column of a new-born child

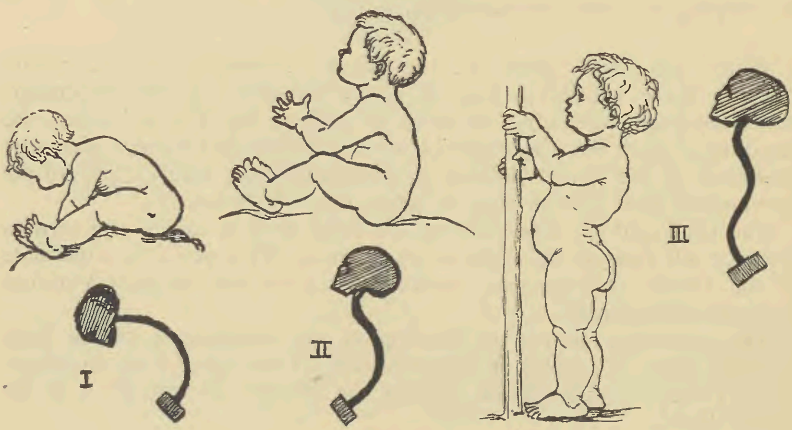



Fig. 14—16. How the Spinal Column is curved.

is generally quite straight, and remains so as long as the child is kept lying down.

Not till the child begins to sit upright does the weight of the head and arms (resting on the upper part of the Column) begin to take effect;

the head then sinks forward on the breast, and the Spinal Column bends and forms an arch.

The child, having learnt to sit up, now tries to lift its head so as to look forwards or upwards; in this it soon succeeds, after the Muscles and bands or Ligaments of the Neck have grown strong enough. But it can only do this by bending the top part of the Column in the opposite direction to the rest of it, i.e. by forming a Curve towards the front. See figs. 14—16.

The third and most important Curve, lower down in the Column, begins with the upright position.

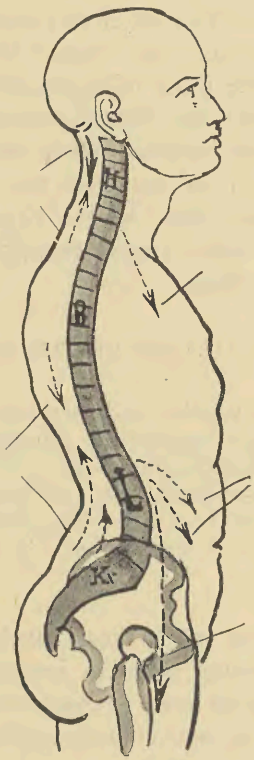


Fig. 17. The direction of the forces that keep the Spinal Column curved.

Fig. 17 will show some of the forces that help to form the Curves of the Column.

These natural Curves, caused by sitting, looking up, and standing, are straightened out when the child lies down. It is not until the seventh or eighth year that they become permanent, and remain even when the person is lying down. At times, of course, they disappear, i.e. when movements act upon the Column in an opposite direction; sometimes, again, they are more strongly marked, i.e. when movements act in the same direction as the forces which we have just mentioned.

## 2.—THE BALANCE AND CARRIAGE OF THE BODY, AND EXERCISES.

*The Curves of the Spinal Column are of great value in helping the activity of the Brain, as they weaken the force of any shock* which, striking upon the bones of the foot, passes upwards to the Brain. The effect of various blows, or of violent running, walking, jumping, etc., would injure the Brain if they were to pass up to the head in a straight line.

Hence it is essential for Nurses and mothers (for they generally have the care of children up to the age when the Curves tend to become fixed) to see that the Curves are developed rightly. A little care taken at the beginning will save much tiresome trouble in after years, though the mischief is not without remedy even then.

### THE BALANCE OF THE BODY.

We can get into one position and then into another only according to certain 'Laws', certain mechanical principles on which the human body is constructed. Of these the tendency to move downwards, owing to weight, must be considered first. In every position of the body this Law must be reckoned with; we have either to use some support, as when we lean against a tree, or on a stick, or we must bring our Muscles into action.

In most positions we try to keep our balance by (consciously or unconsciously) exerting more or less muscular force.

When the body is at rest, it must be remembered that the sides of the body do not contain similar Organs throughout, and that one side is apt to be more muscular than the other.

In the living and erect body, again, Balance and the Centre of Gravity are liable to be shifted by any movement, even by the lifting of the arm or leg, or by the bending of the head.

In the erect position, our Centre of Gravity is perpetually in the balance; it is like a stick on the finger-tips of a juggler. Muscles must be perpetually exerted to correct every movement and to ensure that a line dropped straight down from our centre of gravity shall always fall within the 'base' upon which we stand.

The smaller this 'base' is, or the greater the distance between it and the Centre of Gravity, the more danger there is of a fall. The base of the erect human body of course consists of the soles of the feet. If the body rests on both feet, the line straight down from the Centre of Gravity falls within a space enclosed by imaginary lines which connect the ends of the outlines of the feet.

The 'base' is smallest when we stand on the toes, and this is consequently the least steady position.

It is worth while to remember this in many Games: in Ball-Games especially, that players very often strike a ball while standing on their toes. In this position the full weight and force of the body cannot be used; they dare not trust themselves to use it.

The Centre of Gravity can be shifted forwards to a greater extent than backwards, i.e. the danger of falling forwards is less than the danger of falling backwards. Diagrams 51 and 53 should be studied here.

### BALANCE, AND EXERCISES IN BALANCE.

The Muscles of Balance are called into play when one stands upright instead of lying or sitting, and when one stands or walks in the ordinary way. Much more is this the case when either the 'base' is made smaller, or when, by certain movements, the Centre of Gravity is very considerably shifted, or when a burden is put on the body: for this of course will displace the Centre of Gravity. So if it is desired to exercise and use the Muscles attached to the Spinal Column, the Muscles by which it is held up and balanced, the best way is to aggravate the difficulties of keeping the balance, since by this means we force the Muscles to be extra-active, and, when only the ordinary Balance has to be kept afterwards, the task becomes easy. This is what is meant by Exercises in Balance: they are of the special class called Obstacle-Exercises, and are of great value in helping a graceful and upright bearing, and in preventing deformed Curves of the Spine, and even in curing any slight Curve where it already exists.

1. A good Exercise is to balance oneself while *making the 'base'* on which one stands, *smaller and smaller*, e.g., by

standing on tip-toe, or on one foot only; or by standing or walking on a stretched rope, as in Diagrams 18 and 19.

This might well form part of every Gymnasium, and would be easy to set up in gardens etc. It need not be more than a few inches from the ground.

The Balance can be helped by the arms, as in fig. 19. A still harder Exercise is where the arms are kept down to the sides. The Spinal Column then has to bend about and to do the work instead.

It is so difficult to walk erect along a narrow thing (e.g. a wall) with the arms hanging down, that we instinctively use the Muscles of the arms and shoulders; the arms are extended to either side, ready to bend the Column at need; one or the

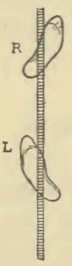



Fig. 18.

Fig. 19.

other is slightly raised or lowered, so as to keep the Centre of Gravity right. It is easier done if a balancing-rod, a long stick which must not be too light, is held in the outstretched arms.

Here also comes the Exercise of Walking on Stilts, of Skating, which is most excellent practice for Balance, and Bicycling, which at first makes great demands on skill and adaptability. Unfortunately the good effects of Bicycling, on the Muscles of the Back are very often spoilt by the common stooping posture.

2. A good Exercise, as we have seen, is to make the 'base' smaller, e.g., to stand on one foot. A still better Exercise is to do this and also to move parts of the body at the same time. When the body rests on one foot, or even on one

toe, and the leg is moved, we have fine practice in Balancing. To combine several Exercises is still harder. In the French Manuals of Gymnastics there are special Exercises, called *Equilibres*. Among them we may mention those in figs. 20—23. Stand on one leg, and bend the other sharply at hip and knee,

Fig. 20.

Fig. 21.

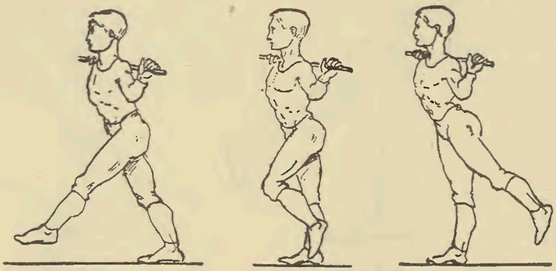
Fig. 22.

clasping the hands about the middle of the shin (20); or lunge forward and lift the back leg (21); or stand on one foot and stretch the leg in every direction (22); or bend and then stretch out the lifted leg (23); or move in a circle the toe of the raised

Fig. 23.

and stretched-out leg, and so on. The leg-actions may first be combined with the Arm-actions which would make them easier; then they should be done without Arm-actions at all (the Arms being kept to the sides); and finally with the Arm-actions which would make them harder (i.e. Obstacle-Exercises).

Stand on one leg, with the other at first stretched out backwards and with its foot pointing downwards and slightly bent (so that the toes will move close to the ground without touching it); then bring it forward and raise it and set it down flat on its sole in front of the other foot. The weight of the body is now transferred to it, while the other foot is in its turn lifted and stretched out backwards with the toe above the ground, etc. Here we have the exercise known as *the 'Goose-Step'*. This is of great value, not only as a preparation for




Figs. 24—26. The three stages of the 'Goose-Step'.

military service, but also because the Centre of Gravity is constantly shifted from one foot to the other, *while the body must be held absolutely erect* all the time. It is one of the most useful Exercises in Balance.

In Gymnastics, these Exercises are often called 'Leg' and 'Foot' Exercises. But undoubtedly they need far more effort than the movements of Hand or Foot.

3. *The Centre of Gravity can be changed by the holding of some extra weight* (*e.g. a dumb-bell*).

A burden carried on the Head can be safely balanced only by a faultlessly upright position, which again means that the spine-muscles must be powerfully stretched.

As a matter of fact, those who habitually carry burdens on their heads, such as peasant-women who carry vegetables in baskets on their heads, as in the Rhine-Province, or the women who carry water in the mountain-districts of Italy, are remarkable for their graceful and upright carriage, *even when their* *heads are not burdened.* The 'regal bearing' of the women of the Sabine Mountains has often been praised.

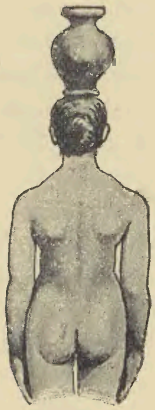


Fig. 27. The Spinal Column during the upright position.

Gymnastic Science has profited by this knowledge. The Centre of Gravity is raised, when we put a weight on the head. Heavy cushions, books, and the German Gymnastic 'crown' may be used for this purpose.

Fig. 28.

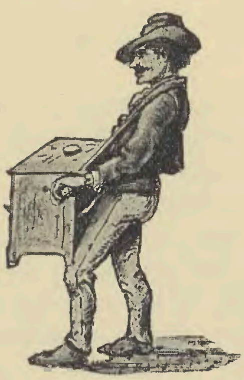


Fig. 29.

Fig. 30.

The weights may also be put in other places besides on the head, as in figs. 28—31.

Persons thus burdened will usually take very short and careful steps, or will hold a stick or staff in their hands to keep themselves from falling forwards. The organ-grinder, of course, who walks with bent knees, bends his body further backwards.

If the body is burdened on one side only, Balance is kept by the Spinal Column being curved sideways, i.e. towards the opposite or unburdened side. When the burden is carried on one shoulder, this burdened shoulder must be raised higher than the other, which at first seems strange. Leonardo da Vinci (30) drew attention to this fact.

If two equal weights are hung on the equal arms of a lever, they will balance each other. But let one of the arms be prolonged to three times its original length, and it is as if a weight three times as great were hung from one of the equal arms: the longer arm will balance three times its own weight on the

Fig. 31.

shorter arm. Hence *an outstretched arm on one side of the body acts like a burden on that side*, and will balance something of a certain weight on the other side (31). The effect of the weight thus produced is equal to about one-fourteenth of the weight of the whole body, i.e. to about the weight of the head. Therefore if one arm hangs down, carrying some burden (e.g. a bag), the other is instinctively held out to the opposite side. (English people shrink from using this help, as they do from using their arms while skating. In both cases the advantage of the refusal to use the arms is unquestionable. E. H. M.) By this help the weight, or part of it, would be balanced, and the unburdened side would not need to be bent so much. If the burden carried by the arm which hangs straight down is not too great, the Spinal Column will keep quite straight.

## THE CARRIAGE OF THE BODY.

The way in which the Spinal Column is carried by the Pelvis decides the way in which the whole body is carried. As a graceful and upright carriage in standing and walking is one of the objects of Exercise, it is as well to know the chief rules and also the several kinds of carriage which we meet with.

A good carriage of the body is necessary for the Healthy development, i.e. the proper development, of certain parts of the body, and more especially of the Chest. A good carriage should therefore be insisted on, not merely for athletic reasons, or because it looks better and pleasanter, but because it may check or even prevent the unhealthy tendencies and the partial loss (or atrophy) of important organs, such as the Lungs.

In a proper carriage the natural curves of the Spinal Column form a graceful undulating line, with a fairly even rise and fall, when the body stands straight upright without any particular muscular effort.

From this carriage we may, by a muscular effort, pass to the stiff Military Carriage.

The stiff *Military Carriage* is not a natural type: for even the old soldier, long-drilled, does not hold himself in ordinary life as he does when standing at attention on parade. It is a Gymnastic and Athletic attitude, in which the muscles are being stretched: the person is ready to pass from it without a moment's pause after the word of command, into the long stride of the march. This attitude, in fact, expresses *alert energy*, readiness for an immediate start. The tension of the Muscles and *the pressure of the weight of the body on the front part of the foot* makes this attitude tiring if it is kept up for any length of time. Hence prolonged and painfully exact dressing of ranks and files, after the word 'Attention' has once been given, may easily become a trying exertion for those who are being drilled.

In complete contrast to the stiff Military Carriage is *Standing at Ease, the attitude of rest or muscular relaxation.* If this attitude becomes habitual in walking or standing, then the whole figure looks weary, weak, indolent, and limp.

While the stiff Military Carriage expresses restrained masculine energy, readiness for immediate vigorous action, Standing at Ease rather expresses feminine softness, submissive weakness, and sleepy inattention. In the one, the rigid limbs are held erect by great muscular tension; in the other, all the lines are of melting softness, the limbs are held together and kept in balance merely by the Joints and bands or Ligaments, and with the least possible muscular effort. Thus, the body is held up on the Pelvis mainly by the supporting-Ligament of the hip-joint, (the powerful Ligament of Bertin, as it is called). While from the stiff position we can pass immediately into the advancing stride of the march, the body shooting forward like a tense spring suddenly released, the slack attitude requires that the body should be raised erect and pulled together before we can pass from contemplative rest to movement and action.

The soft flow of the limbs in the latter position has made it a favourite for statues of beautiful women, in which, moreover, the body generally rests on one foot. But although the feminine form *may thus gain in beauty of line*, it is none the more suitable for girls on that account. For the beauty of 'Art,' intended to give pleasure, and Athletic beauty as the result of well-directed Physical Culture, are very different things. The confusion of the two has already worked mischief enough in the training of girls.

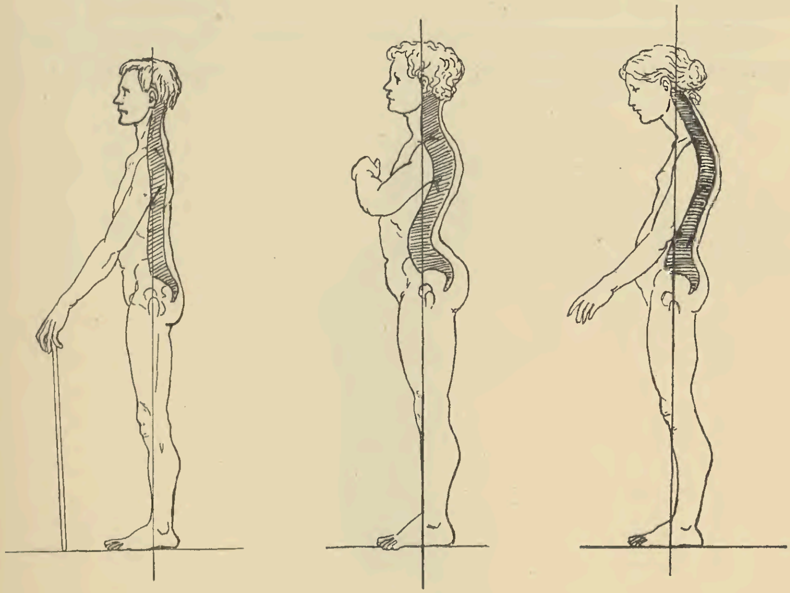
Thus we see that the rigid Military 'Attention' and the relaxed 'Standing at Ease' are two extremes; the graceful proper carriage is midway between. Exercises help us to attain this last, but a stiff Carriage is a help towards its attainment, and is therefore to be freely used in Exercises as well as on the parade-ground.

### COMMON FAULTS IN THE CARRIAGE OF THE BODY, AND SOME REMEDIES.

1. *Flat Back.* Here the natural Curves of the Spinal Column are scarcely to be seen. The back is level, 'flat as a board'; the indentation above the seat is almost lacking. The whole Column has hardly altered since the first year of life. The Chest is flat, and the Shoulder-blades hang back to such an extent that a finger can be put underneath them.

It may be the result of an inherited tendency, of illness, of bad habits, of bad Food, and so on. Among other cures, plenty of Exercise in the open air should be insisted on.

The best Gymnastic Exercises here are a systematic course of Running and Walking, of Hanging by the Hands as in the 'Giant's Stride', Wrestling, and the Horizontal Bar. As shall presently be shown, the Exercise of Hanging by the Hands



Figs. 32—34.

affects the Pelvis and so increases the Curve of the Spinal Column near the Loins.

2. *Hollow Back* is the exact opposite of Flat Back: here the Spine has the wrong wavy line instead of having little or no line at all. Near the Loins the Column is depressed, while the seat is firm and prominent: the upper part of the Back is rounded. It will be hard to bend the body forwards.

*The Round Back, which is common in youth* (see 34, 35), *is usually the most important as far as health is concerned.* It occurs most frequently in both boys and girls, at the School-going age, from 7 to 16. It is said to be commoner among girls.

The Back forms a simple Curve, convex behind; the Head is bent forward, the Chest is sunken (and especially the upper part of it); the Shoulder-blades hang outwards, the inner edges standing out like wings; the lower part of the body sticks out. The whole bearing gives an impression of flaccidity and weakness. Actual Muscle-weakness is by no means always to be found in such cases, for many schoolboys who hold themselves thus are fairly good athletes; it is rather the result of a lack of will-power and energy, of indolence, or of self-indulgence.

Children with Round-Back are a source of anxiety to their parents, and with reason; for the stooping Carriage checks the

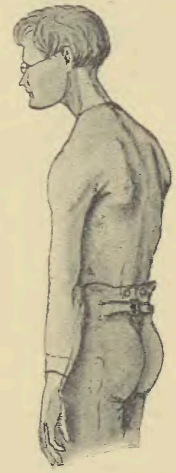


Fig. 35. Round Back.

freedom of Breathing, and thus stops the development of the upper part of the Chest, and thus favours the beginning of the fatal curse—Lung-Disease.

Very much may depend on Diet. If Parents and others would study Diet, instead of nagging at the boy or girl, they would do far more good and arouse far less disgust.

This habit is often also a family or racial peculiarity. Or, again, it may come from the boy or girl sitting constantly in a stooping position, a position going naturally with the low and ill-proportioned tables at School or at home, with forms having no backs (or having backs of the wrong kind), with school-books of which the print is too small, with bad lighting or with reading and writing in the dusk, with long hours of Piano-practice, and so on. To these causes may be added short-sight.

So spectacles or glasses may help to cure a Round Back. See below.

Suitable Exercises can do much to correct a Round Back and stooping Carriage, and they should be practised in youth, if they are to be of due value.

Above all things it is necessary that the Exercises should be effective in another way: the child must be taught to enjoy the feeling of power, to take pleasure in bracing the Muscles; it must be convinced that an upright carriage alone is graceful and right, and it must learn to be perpetually on its guard in this respect, and to pull itself together constantly.

Of special Exercises the first of all is a systematic training in *Walking and Marching*. Very effective is the stiff Military March, in which the whole sole of the foot is put down firmly

Fig 36.

and at once, as is also the 'Goose-Step' (p. 90), which should be practised at first by itself, and with the hips steady, and then together with suitable Exercises with sticks and dumb-bells.

Certain Exercises with weights are useful in strengthening the Muscles of the shoulders. In these a graceful bearing should be insisted on throughout.

The same applies to Exercises with Gymnastic appliances, of which exercises the most highly to be recommended is Hanging by the Hands.

Apart from Gymnastics in the strict sense of the term, Swimming will be found of great value.

Exercises in Balance strengthen the Muscles of the Back, and the carrying and Balancing of a weight upon the head is especially valuable if the object to be carried (e.g. a high cushion or small squat vessel) is set well forward rather than on the crown of the head.

The mechanical supports, which have found much favour, are

Fig. 37. Rest for the Forehead during work.

almost useless without vigorous Exercise too. For not the very best instrument can remove the cause of evil, the slackness of the Muscles of the Back and Shoulders in consequence of a defect of will. Such instruments as the Chinrest of Soennecken,

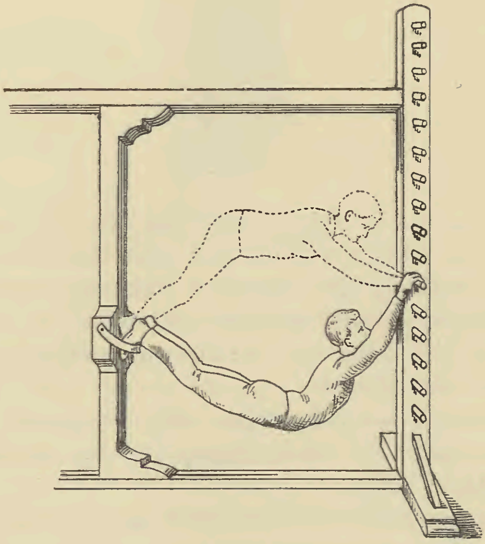


Fig. 38.

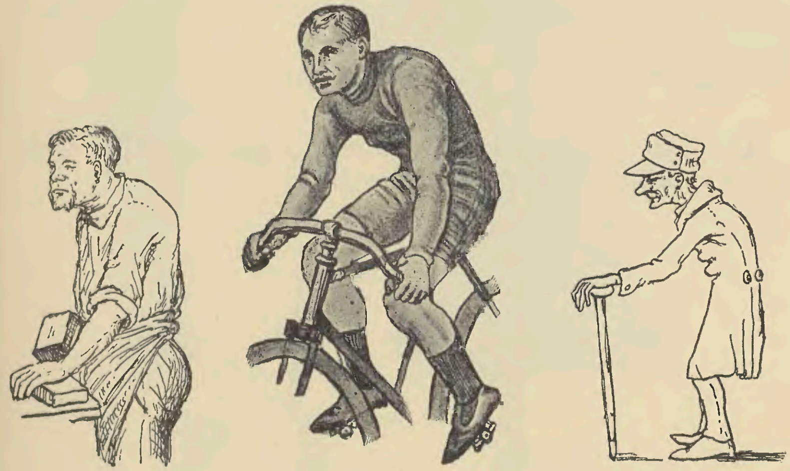
or the Forehead-rest of Staffel or Kollmann (37) may help to prevent a stooping posture in reading or writing.

We may add the Special Exercises of the Swedish System of Educational Gymnastics, on the Stretching-frame, or on the apparatus in fig. 38, or on the Horizontal Bars, Perpendicular and Vertical Ladders, etc.

Massage of the Back may also be of great use.

Some *Types of perverted Developments* may be mentioned here.

(a) *Round back from hard labour.* Severe manual labour (if carried on in a stooping posture), the using of heavy tools, and the constant straining of the Muscles of the Shoulders and Arms, may bring with them a permanent rounding of the upper part of the Spinal Column. This is the form of humped back



Figs. 39, 40, 41. Round Backs from hard work, bicycling, old age.

common among workmen. It does not affect the capability for work.

The objectionable attitude often seen in the case of 'scorching' and rapid cycling seems very likely to be injurious in this way.

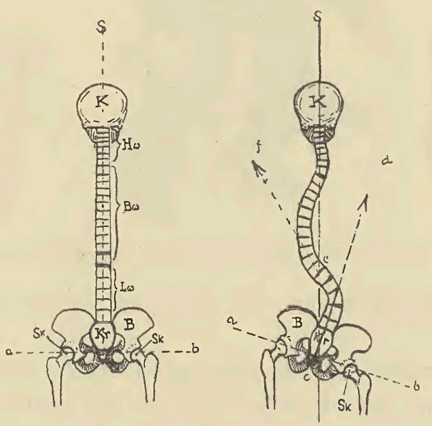
The Cyclist can keep a correct Carriage only when going at a moderate pace, and when saddle, handle-bar, and pedals, are all rightly adjusted to his figure. But too often this is not the case, and the bearing of the Cyclist is bad, even when he is going slowly. In Rapid Cycling, however, every Cyclist is wont to bend his head, since it is hard to breathe against the pressure of the air on the face. Here, as in cycling against the wind, the head is often quite horizontal, and the rider instinctively bends forwards (40), so as to oppose as small a surface as possible to the wind.

Even if this should have little or no permanent effect on the Spinal Column (and consequently on the whole bearing) in strong grown-up people, the danger is certainly a real one in the case of growing boys and girls.

There still remains the Round Back of old age, owing to Muscular weakness and the wasting of the bones, which (see 41) makes the Vertebræ sink together. The support which the Corset (for which, in this one case, we must say a good word) gives to the Spinal Column, helps to counteract the bad tendency in old women. Hence old women more commonly retain a more graceful bearing than old men.

### CURVED SPINE.

(35) Figures 42 and 43 show how the Spine naturally curves sideways when the Pelvis is at an angle.

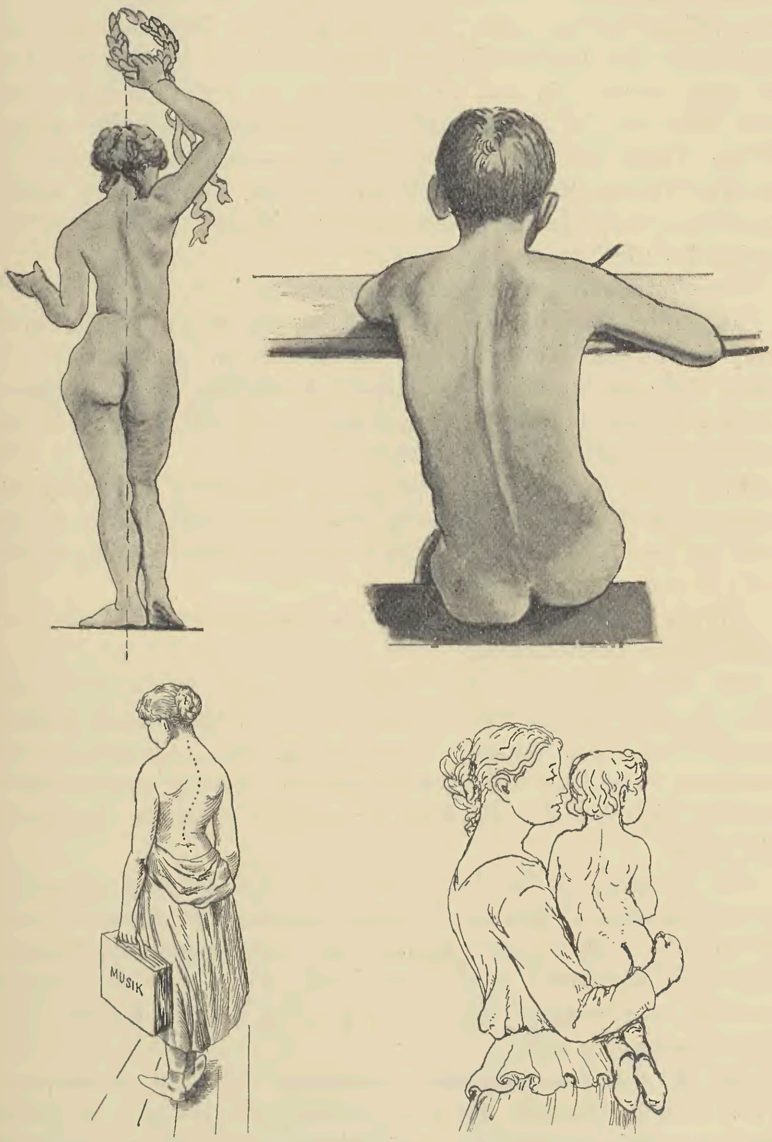



Figs. 42, 43. The Spine curves sideways when the Pelvis is at an angle.

This position of the Pelvis is very frequent when *the weight of the body rests upon one Leg*, as when one stands in an 'easy' position; the other Leg is slightly bent and placed either in front, behind, beside, or across the standing Leg, as in 44.

In none of these positions is the weight entirely shifted to the supporting Leg, as it is when the free Leg is lifted or moved independently; a small part of the weight falls upon the free leg.

Although it is really more tiring to stand on one Leg than




Figs. 44—47. Curves of the Column owing to (44) resting on one leg, (45, 47) sitting on one side, (46) carrying a weight on one side.

on both, yet in repose most people are wont to stand on one Leg. At the word of command, 'Stand at ease!', one Leg is usually relieved of the weight and placed easily in front or beside the other. If one Leg gets tired, we change and shift the weight to the other, so that the free Leg can rest idle. But, since the supporting Leg is stretched out, and the free Leg is bent at the hip and the knee and so is the shorter of the two, the foot of this shorter Leg can only reach the ground if the Pelvis and the Hip-joint are lowered on this side, as in 43. Hence to stand with the weight of the body almost upon one Leg needs a sideways or Lateral Curvature of the Spine for the time being.

Constant habit may make it permanent.

The Pelvis may be also tilted at an angle, and so the Spine may be curved (see 44—47) if we do not sit straight. This is often the case with girls at school. In slipping into their places on the narrow benches they pull their petticoats to one side and so form a one-sided pad on the seat.

But, apart from this, the weight of the sitting body may rest chiefly on one side of the seat (usually the left), just as it may rest on one Leg. Here also the Pelvis is tilted and the Spine (47) is curved.

Of other influences in making the Spine curve sideways, we may notice the following:

(a) *Weight on one side*. Where a burden is carried on one side, balance is generally kept, as has already been pointed out (p. 91), by a sideways Curve of the Spine towards the unburdened side. It makes no difference whether the weight is carried high on the shoulders or whether it hangs down from the arms.

(b) *Bending of the Head sideways*. This position, especially when the head is turned as well, also brings a sideways Curve of the top part of the Column, and a corresponding Counter-Curve of the lower part. Hence *the position of the head in reading and writing* may help to bring on this Curvature in the school-going age.

(c) If you *lean sideways*, supported by your shoulder or your arm, a Curve of the Spine follows; for instance, in sitting you may lean to one side and steady yourself by resting your shoulder against a pillar.

Fig. 47 would show how careful mothers ought to be in carrying children.

If one arm is lifted, and leans against some fixed object, the lower part of the Column curves in the opposite direction. In writing, people often let the elbow of the left arm rest on the table, while the right hand lies upon the surface of the table; this may also be bad.

(d) By far the commonest forms are due to unequal burdening of the Column. In some cases (which should be carefully attended to during school-life) an habitually bad carriage, especially when the boy or girl is seated, gives an unequal pressure on the spine and so gradually leads to permanent crookedness (or Scoliosis, as it is called). In other cases Disease of the bones makes the Column too pliant in response to any strain.

This is the commonest of all *acquired* defects in the body, except the distortion of the feet by boots and shoes. Most cases originate in the school-going age, between the seventh and twelfth years. It is five or six times as common among girls as among boys. In Germany it occurs with appalling frequency, as a few quotations of figures will prove.

Of 336 girls examined, W. Mayer found only 147 free from this defect. The number of faults in the Carriage and structure of the Column was 43.65 per cent among girls of seven years old, and at thirteen years the proportion rose to 70.9 per cent. Guillaume found that among 350 boys 18 per cent had curved Spines; among 381 girls, 41 per cent. In Stockholm, on the other hand, Axel Key found the cases averaged 10.8 per cent (about one in every nine). At seven none of the girls had Curvature, but at 18 the figures had risen to 17.10 per cent (about one in every six). Schenk examined 200 Berlin School-children by a peculiarly exact method. In only 40 was there no fault in these respects.

In a quarter of the whole number of cases the tendency seems to have been inherited. The Flat Back and the Round Back of youth tend most readily to this curvature. As we have seen, both these are the result of weakness of the muscles and the will.

(e) Or again, the Legs may be of unequal length.

This inequality need not be enough to cause a perceptible limp. According to Staffel and others the curvature due to this is commoner than has been generally supposed; out of 230 cases examined he found the left leg a little the shorter in 62.

By putting very thin slips of wood or cardboard under the foot of the shortened Leg we can gradually raise that side of the Pelvis till it is no longer tilted. The height of these slips will show how short the Leg is and how much the sole of the shoe should be thickened. Special stretching-appliances can also be used.

We have seen, then, that an habitually incorrect position in writing (both at school and at home) is generally regarded as the exciting cause. To this may be added an incorrect position in reading and drawing, and also over-fine needlework. Scoliosis has consequently been called 'School-disease' or 'Sedentary disease'.

This is so commonly neglected, and it affects so many millions to-day, and so many millions of millions yet unborn, and its effect on Athletic as well as on Health and Beauty is so important, that we may well consider it in more detail.

1. One incorrect position in writing is when the head is turned to one side, e.g., because the paper slants or is laid too far to the right. This naturally causes the upper part of the body to move round, i.e. the Column is twisted, while a slight Curve is formed in the lower (Dorsal) part, and a corresponding Counter-Curve near the Loins.

2. Curving of the Spine, as well as twisting, is even more easily started, in Writing, by letting one arm (generally the right) rest higher up than the other. The body usually rests at the same time on the left side of the seat, so as to give more freedom to the right arm.

3. We have already seen the way in which girls also thrust the petticoats under one hip or thigh.

4. These evils are often aggravated by long sitting, which wearies the Muscles of the Back, and so makes the Spinal Column more liable to sink together.

This is chiefly the case where the forms have no backs or have backs of the wrong kind.

Briefly, then, prolonged sitting in an incorrect position on bad forms brings on, at first for the time being, then permanently, the sideways or Lateral Curving of the Spine, even when the child seems to a casual observer to be sitting tolerably straight.

If this faulty position is persisted in for several hours daily, definite changes gradually take place in pieces or vertebræ of the Spine and their bands or Ligaments; these changes are favoured by a certain softness of the bones, common not only in sickly and delicate, but also in quickly-growing children.

The Muscles are slack to begin with, and are able to correct the Curve by themselves only in the earliest stages; only then can they restore the Column to its proper straightness. Later on, the effort soon exhausts the children, who sink back into the objectionable position, till at last they cease to be aware of it. The Curve has then become permanent.

Thus at least two causes act together to produce the faults, viz., one-sided pressure on the bones of the Spine, and fatigue of the Muscles of the Back.

### TREATMENT OF CURVED SPINE.

1. *Preventive measures* are of the highest importance. First and foremost comes the general strengthening of the body, and of the Muscles and Bones in particular, by plenty of Exercise in the open air. The Exercise is best taken in the form of Games, which should be encouraged in the earliest school years; for *the bad effects of sitting at work in school are most strongly felt at the sensitive age from six to nine.* Swimming and Skating should be added later.

The aims of special Gymnastic Exercises should be to strengthen the Muscles of the Back and ensure a graceful, upright Carriage.

Gymnastic Exercises for girls should not be merely of a soft and graceful kind, but should demand a fair amount of strength and endurance. Feminine charm and Feminine character will not suffer thereby. Even in girls, the body cannot be healthily developed without *vigorous* movement and exertion, such as quick Walking and Running; set figures and dances with special steps are not enough.

During school hours a proper position in Reading and Writing should be constantly insisted upon. *The desk and seat must therefore be of the right kind.*

We need the following characteristics:—

1. *Correct height.* The seat should be made so that the whole sole of the foot naturally rests upon the floor. The proper measure has been given as three-elevenths of the height of the whole body. Since children of the same age vary very greatly, *every Class should be given*

*seats of different sizes.* The children should be arranged on the seats according to size: the habit of placing them in Classes with uniform desks must be abandoned.

2. The form must be of the right *width;* the thigh should rest on it almost to the bend of the knee. The form is easier to sit on if it is not quite straight, but slightly *inclined* backwards or hollowed out behind.

3. The desk should be slightly inclined towards the pupil. This brings print or writing more comfortably within the range of the Eye, and there is then less temptation to bend the head forwards.

4. The *relative positions* of desk and seat are of importance.

A uniform distance is often preferred, both for reading and for writing.

The height of the slanting Desk above the seat is to be noticed. The shoulders should not need to be lifted up, nor the head or arms lowered.

5. So as to relieve the Back Muscles at intervals, the bench should have a properly shaped back.

6. No less important than the arrangement of form and desk is *the position of the paper* and, perhaps, the direction of the writing.

The paper should certainly lie in front of the middle of the body, not towards the right side. If the writing slants, the paper should slant too; if the writing is upright the paper should be upright too.

An upright hand, such as was universal at the beginning of the 18th century, and is still practised by some people, has found many advocates of late, because it helps an upright position, and, more especially, because it is less trying to the eyes. It has been introduced as an experiment into a number of German Schools. Whether it is better than slanting hand is at present an open question.

7. A number of special appliances are in use to help the right position of the head, especially when children are preparing lessons at home. The simplest is the movable writing-prop of Soennecken, which gives support to the chin; Kollmann's arrangement of an iron ring which is covered with indiarubber, and the Forehead-rest of Staffel, also deserve mention. The spectacles invented by Müller of Basle in which the bending of the head averages itself by the falling of a shutter over the eyes, can only be regarded as an instrument of torture.

The best desks and seats of any type, however, are nearly worthless if the child is kept sitting in them too long; for then the Back Muscles become overfatigued and cannot hold the Column upright.

8. Jäger holds that *young people should be accustomed to work standing,* that is, a standing desk should be substituted for the ordinary desks in Schools. This goes much too far: it might result in flat foot, in bandy legs, in much 'slow' blood in the legs, and hence Varicose Veins, and so on, among our young.

The Sitting and Standing Desk (introduced by Turninspektor Herrman of Brunswick in 1882, and since improved), makes it possible to sit or stand at work alternately.

In writing sometimes as much as 12 hours a day, this standing position is often a great help. It encourages one to walk and kick about at intervals, whereas constantly sitting down one would be less liable to go in for this variety.

Under no circumstances should the teacher fail to let the children change frequently from a Sitting to a Standing position during Lessons. (Hence one of the merits of 'taking places' in School-time.) This should be done both because of the relief to the Muscles of the Back, and so as to keep up a bright and alert attention. It is good, too, to let the children do some Exercises while they are standing, in order to quicken the Circulation of the blood; they might swing their arms upwards and forwards and round and round, flap with their arms, twist and bend their body, and so on. We shall speak later on of the injury to Breathing and the Circulation, caused by prolonged sitting. But the Exercises in Breathing should be avoided if the air of the schoolroom is bad.

In any good English School, where the master is usually athletic and has no difficulty in keeping the boys in order, such Exercises ought certainly to be tried. The master who could not keep his form in order during such Exercises would be an exception. The Foundation-positions and Foundation-movements of Games might well be practised at intervals during school-hours. The Head-Master who tries it will turn out better Scholars, better Athletes, and better boys all round.

9. On the way to School, boys and girls should not be made to carry heavy satchels, or piles of books strapped together. The weight of the Portfolios often carried by High-school girls, especially when they go both for Music and for ordinary Lessons, is iniquitous.

So far we have treated of Prevention. Now we come to Cure, where the Fault already exists.

The earlier the treatment, the better the result. Hence it is necessary that the Faults should be observed at their very beginning. Schoolmasters (and mistresses), and the teachers of Gymnastics, should watch with keen and practised eye for any sign of Curvature so as to be able to tell the Parents at the earliest possible moment.

The Parents and Nurses themselves should also watch. They have better chances of seeing the children naked.

1. First notice the high shoulder.

The Shoulder-blade of the side towards which the Column curves stands further out than the other, and its apex and inner edge are particularly well-marked. In very thin children this can be seen without difficulty: in others it can easily be shown by drawing a finger-tip along the Spinal Column: this will leave a faint red mark on the skin for a few minutes.

2. In addition, supposing the Curve in the Column is towards the right (a curvature lower down and towards the left would of course soon follow), then the depression in the hollow of the waist will be deeper on the right side, and the right hip will project more than the left.

3. Later on, the whole trunk will be shifted to the right of the Pelvis, so that when the right arm hangs loosely down it will no longer touch the upper part of the thigh, but will swing free.

But before the Curving has reached this stage, it must be obvious either to the sight or to the touch. This is not always so at first; at first the high shoulder and the unequal Waist-triangles give the surest warning; at that time the Column may still seem straight to the eye or to the finger.

In mild incipient cases should come a regular course of Gymnastics, to strengthen the Muscles of the Back; and with it should come suitable Diet to nourish the body, and as much open-air and out-door Exercise as possible; these may often effect a cure. Meanwhile, of course, every effort must be made

Fig. 48. How to correct the Curved Spine.

to correct bad habits and, as far as can be, to remove the cause of them; and, at the beginning of such Gymnastics, the child must be kept for a long time from all sedentary work at School or at home.

The best Exercises are those for the cure of Round Back in youth, viz. Marching, Goose-Step, Exercises with free hands, then with dumb-bells and sticks; Exercises in Balance, Hanging by the Hands, carrying weights on the head, and so on.

Furthermore, special Exercises may help to restore the strength of the Back and Muscles, which will be in danger of failing for want of use (Atrophy). Certain Obstacle-Exercises (Swedish

Gymnastics) are good, and so are Exercises for one side of the trunk, deep-breathing with one side of the Lungs, etc.

These one-sided Exercises can be supplemented by the use of a slanting seat: a book or cushion may be thrust under the side opposite to the Curve, or a seat raised on one side (48) may be tried.

To these helps may be added certain appliances for drawing or stretching. But medical advice should generally be sought.

### 3.—THE CHEST OR THORAX.

Figure 49 gives a better idea of the Bones of the Chest, or Thorax, than any description in words. The Bones are very flexible and elastic.

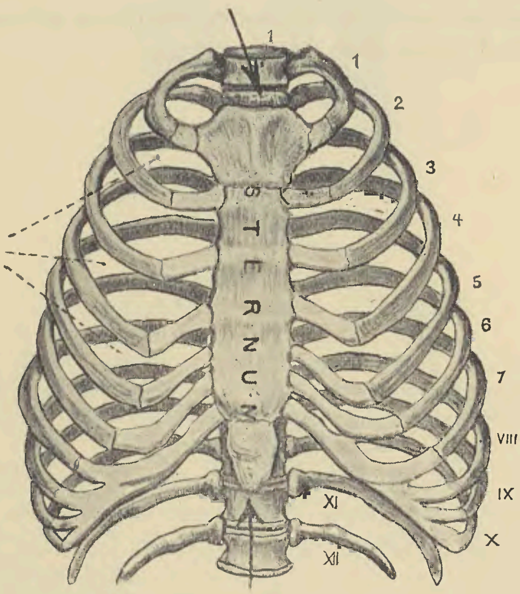



Fig. 49. The Chest (Thorax).

If they are not stretched enough, however, or if they are kept too much at a stretch (as in the case of certain Weight-lifters) they are apt to lose their elasticity and to become 'fixed.' Hence the right Exercises, and the right amount of Exercise, is very essential, especially for the young.

Hold your Chest, and breathe in a very deep breath, and you will see that the Chest or Thorax is *extraordinarily elastic.* If it is pressed in, it springs back to its original position the moment the pressure is removed; this fact is taken advantage of in 'Artificial' Breathing. The elasticity goes with a great power of resistance; the wheels of fairly heavy carts may pass over a powerful Thorax without breaking it in. This makes it possible for an Athlete to catch Cannon-balls on his Chest, or to set on it an anvil upon which a smith may work.

It is especially because the Thorax has a wide back-wall that man, in contrast with other animals, can sleep on his back.

The shape of the chest alters as we breathe: we have to distinguish between the two positions, when we breathe in and when we breathe out.

In a deep Breath the Ribs are *lifted.* This position

1. makes the Cavity of the Thorax wider from side to side; and
2. makes it wider from back to front.

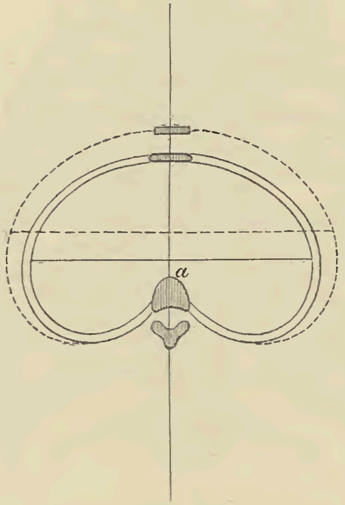



Fig. 50. The shape of the Chest or Thorax when we breathe in and out. (*a.* the Spinal Column.)

Thus, when we breathe in, we move the front part (the Sternum) further from the Spinal Column, and also lift it up.

The deep breath also

3. makes the Cavity longer (from above downwards), because the Diaphragm moves.

We may distinguish between Broad Chest, Narrow Chest, Stretched Chest, etc.

In Broad Chest we have a prominent, full, and arched shape. This is regarded as a sign of consummate strength. The ancient statues of gods and heroes show magnificently developed 'Torsos'.

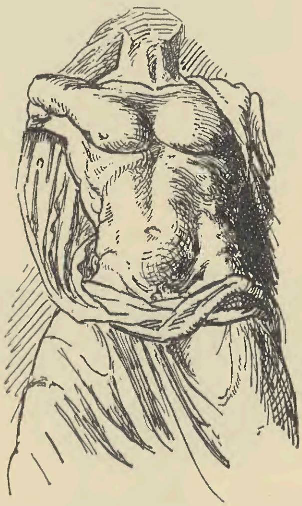


Fig. 51. Torso of Zeus (from Pergamus).

In Narrow Chest (52) the side-walls are long and flat and steep, and there are other signs as well. The Breathing may be still quite deep, and such a Chest may be able to expand very considerably.

If the Chest regularly keeps in the position which it has after a full deep Breath, we have a stretched or Extended Chest. A mistake is often made here: it is often supposed that this Chest is a good sign.

People measure their Chests, and are pleased if the number of inches is great, or if it has increased since the last measurement: whereas the difference between the number of inches of the Full Chest and Empty Chest is really more important.

If we closely watch the broad and powerful chest of some Athletes as they breathe in and out, while they play with dumb-bells of enormous weight, we see that the great walls and massive Muscles of the Chest hardly alter at all with the Breath. And, as a matter of fact, measurements with a tape sometimes prove that the Chests of many of these 'strong men' will hardly expand at all.

Thus, with Lutz the Athlete, Dr. Reimers of Hamburg found that after the deepest possible breath the circumference of the chest increased by only, 1.75 centimetre, and in the case of Abs (now dead) the increase was only 2.5 centimetres; both figures are far below the average. This stiff preserving of the In-Breathing position makes the breathing capacity far smaller. It is usually the result of a Disease of the Lungs (called Emphysema).

A Crippled Chest, on the other hand, keeps the extreme Out-Breathing position, the position when the Chest is nearly empty; the muscles of the Chest are too weak to lift the Ribs, as in fig. 52.

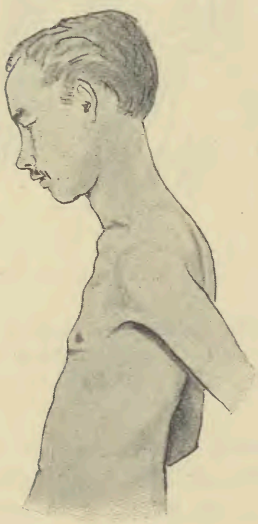
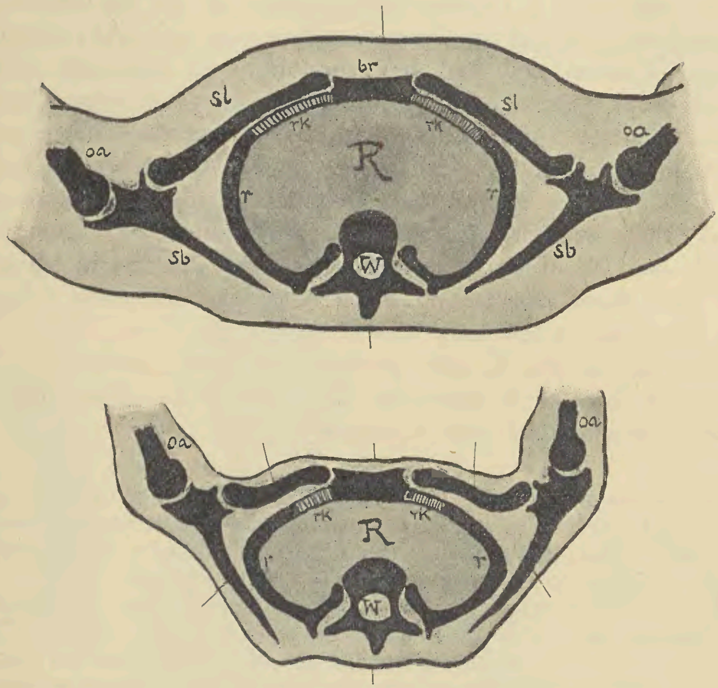


Fig. 52. Flat Chest (Thorax) in Consumption.

The ribs can easily be seen and counted under the thin and and disused ('atrophied') Muscles of the Chest; the victims are almost always thin and have been badly nourished.

This type of Chest occurs most frequently in *Consumptive* people: it is closely related, not only to Diet, but also to the incorrect Carriage during early youth, called Round Back.

Figs. 53 and 54 will give a good idea of a Consumptive Chest.




Figs. 53—54. A section (horizontal) of the Chest (Thorax) in Health and in Consumption (W. Joint or Vertebra of the Spinal Column).

Here a proper course of Exercises is particularly valuable, so as to increase muscular power and the energy of the will. It is also one of the best means of preserving health, and even life, against the attacks of Consumption (Tubercular Disease of the Lungs). It is only by Exercises of the Muscles of the Chest, Shoulders, and Back, that the Chest or Thorax can be lifted and thus made able to breathe properly.

### THE CORSET.

It might be thought that this subject should be omitted from a book of this kind: this is quite wrong. We are the children of both of our parents, and of all our ancestors, male and

8

female. On the woman depends a great deal of the shape and of the Health of the Children. It is therefore right that they should know what such a Fashion really means—if not for the sake of females only, at least for the sake of boys and men. Any rebellion against Custom will find few supporters at first: and such a rebellion as this will be slowest of all, partly because Custom is the greatest Tyrant in the world, partly because women are—by training as well as, perhaps, by nature—the slaves of Custom to a far greater extent than men, and partly because women think that without Corsets they will not attract men so much—and for the present they may be justified in thinking so. But there can be no harm in telling the truth here, in the hope that a few may have Ears to hear.

The use of the Corset, ancient and widely spread as it is, is yet a sign of a depraved taste, and is an offence against nature especially because it injures Health. [1]

At various periods of History, especially in times of morbid refinement and affectation, there is a tendency to distort and disguise, in this way or that, the natural form and proportions of a well-developed body, according to a false and perverted idea of beauty.

Thus, in Court circles at the end of the Middle Ages, not only did the women lace in as tightly as possible the soft parts between Chest and Hips, so as to produce a small wasp-like waist; but men of fashion, knights and courtiers, did so to an even greater extent, as the miniatures and woodcuts of the 15th century will show. The Corset was revived and brought into more general use among women later, with a view to preventing the growth of the Breasts.

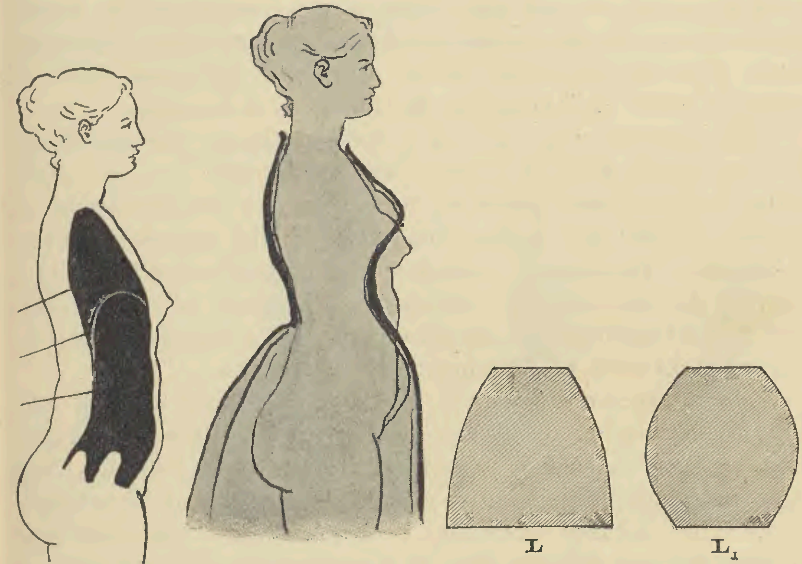
In the national dress of some districts on the northern border of the Alps (Upper Bavaria and the Tyrol especially) stiff bodices have remained in use; these tend to kill the Breasts and to make the women unable to nurse their own children. Hence in the Bavarian Alps artificial feeding of infants takes the place of the natural nourishment at the mother's breast. This also partly accounts for the many deaths of infants in the whole of Western Europe.

The Corset of the 18th century, which has become practically universal among the women of the 19th, goes in the other direction; it strives to emphasize and exaggerate the special characteristics of the Female figure.

[1] I am bound to say, however, that I do not altogether agree with this view. When one implies that lower or Abdominal Breathing is the best, one is treading on very dangerous ground. The absence of the Corset during the hours of sleep, the fact that many Corsets *have* elastic already, the effect of the Corset on the uprightness of the body, all this, and much besides, must be set over against the objections to the Corset. (E. H. M.)

Figures 55, 56 and 57 will show some of *the effects* of a Corset on the figure of a woman.

1. The Chest or Thorax is forced into the shape of a cone. The Organs in it are pressed upwards: the lower opening is narrowed and its walls are brought too near together (57). The Lower Ribs become too short, and (if the Corset is worn early in life)




Figs. 55—56. Female figure without a Corset (55), and with a Corset (56).
Figs. 57. Lung-Diameter without a Corset (L), and with one ($L_1$).

the Upper Ribs become too long. The Thorax as a whole becomes too long.

2. As the lower part of the Thorax is narrowed and made rigid by the firm Corset round it, the Diaphragm, the most important Muscle for Breathing, the Muscle which goes right across this region, is slackened and almost put out of action. Thus *only the Upper part of the Lungs is able to breathe*, and the Breathing, which should be to a great extent carried on in the broader region at the bottom (the Abdomen), is confined by the Corset to the Upper part (the Chest).

It is the Chest which shows a marked rise and fall in Breathing, while the movement of the lower region is small.

If, however, the same test is applied to a white woman who has never worn a corset, or to an Indian woman to whom it is unknown, the record is very much the same as in man. And, on the contrary, a man laced into a corset shows the same type of Breathing as the tight-laced woman.

This goes far to prove that the way in which most women breathe is merely due to the Corset and its narrowing effects, and is not a sex peculiarity. For a woman who has never worn a corset or had her waist tightly compressed by a stiff girdle to support the petticoats, for this comes to very much the same thing in the end, shows in repose the same kind of powerful lower or Abdominal Breathing as a man does.

As a general rule, and in a state of repose, the Breathing both of men, and of women without corsets is done especially by the lower parts of the Lungs, i.e. by the action of the Diaphragm; this action shows itself in the movement of the Abdomen. But directly great demands are made upon the Lungs, so that the volume of Breath has to be largely increased, then the Chest-Breathing comes into play. This therefore acts to some extent as a reserve for special occasions.

Such a reserve is wanting to the tightly-laced woman, and thus the wearer of the Corset soon gets out of breath with any unusual exertion such as running, dancing, or going upstairs; she does not readily regain an easy and quiet method of breathing. [1]

3. The ordinary Breathing is deficient also: the lower half of the Thorax is narrowed, and thus the Lungs are reduced in size and surface-extent (p. 105). The result is that Gases are less freely exchanged, *and the blood does not get enough Oxygen*; it becomes poor in its most important element, the red Corpuscles; in a word, Anæmia is a result.

4. The direct pressure of the Corset on the side-walls of the Chest forces the Ribs against the Abdomen. The *Liver* suffers most severely from this, and the surface of it actually shows a furrow, as a sign that it is narrowed.

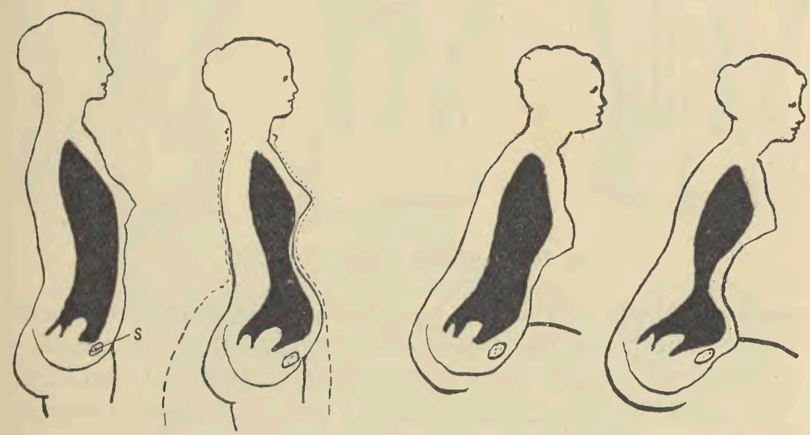
5. The effects of this narrowing (of the middle of the trunk) upon the position of *the Stomach* are yet more disastrous.

It is not so much that the waist is always made *smaller* by

[1] However, the powerful upper-Chest Breathing of women is no small point in favour of the Corset. (E. H. M.)

the Corset, as that it is made rounder and less flat. Often the shape is altered rather than the size.

Figures 58—61 will show that the Cavity of the body is narrowed in the middle and gets the shape of a kind of hour-glass. Now, exactly at the narrow point lies the Stomach; not having room in the smaller circle, *it is forced downwards*. Ordinarily this membranous 'sac' lies across the body. The effect of the tight corset or girdle is to press it more and more into an upright position, the lower end sinking right down into the Pelvic parts.




Figs. 58—61. I. The Cavity inside the Body, when the body is standing up without a Corset: II. standing up with one: III. sitting without one: IV. sitting with one.

A host of *digestive troubles* and nervous disorders follow: the Health in general is lowered, and the blood becomes poor by losing many of the red Corpuscles.

It may further be noticed that, even when no Corset is worn, the attaching of petticoats to a tight waist-band, or *the wearing of a tight strap or belt or sash round the body*, may lead to similar results both in men and women.

6. These Diagrams also show the following result: the narrowing of the middle of the trunk is increased by a sitting and stooping position (60 and 61), such as is usual with those who do much fine needle-work, with the poor woman or child who sits all day long at her sewing-machine, or with others who take their regular spin on their Bicycle, in an incorrect

attitude. The wearing of tight belts in Gymnastics, Games, Rowing, Bicycling, etc., should be forbidden quite as much as the Corset for girls; the riding-belt has already been forbidden by Jahn.[1]

*α*. In the case of growing girls, it is better to substitute for the Corset a Bodice (such as has been recommended by Meynert

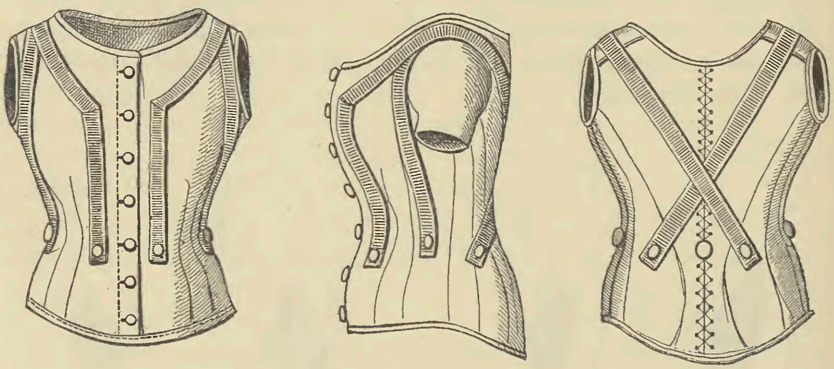


Fig. 62. A Bodice instead of a Corset.

among others), with strong bands to which to fasten the petticoats. The bands (see 62) are so arranged that the weight is distributed as much as possible over the Back and Shoulders.

*β*. For little girls (school-children) Braces to which to button the petticoats (63) will answer the same purpose.

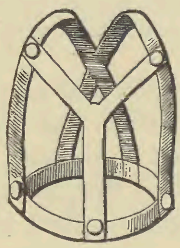


Fig. 63. For little girls—Braces and Belt to which the Petticoat may be buttoned.

*γ*. A certain amount of play is allowed to the Breathing in the lower part of the Lungs by the use of a Corset with broad strips of elastic at either side.

[1] There are other aspects of the question besides the above, if the Belt is broad and is not worn too tight. (E. H. M.).

It may be questioned whether within a measurable distance of time our women will make up their minds to a complete reform of dress on principles of health, and will deliver themselves from the sway of the all-powerful Dame Fashion. The most forcible exhortations to, and the most enthusiastic attempts at, reform have hitherto been productive of very small result.

From the Gymnasium, the Playground, the Field, and the Track, at all events, such unhealthy clothing should be banished; for it would undo much of the good that might be hoped for from Exercise, and might even turn it into harm.

## 4.—THE BONES OF THE SHOULDERS, ARM AND HAND.

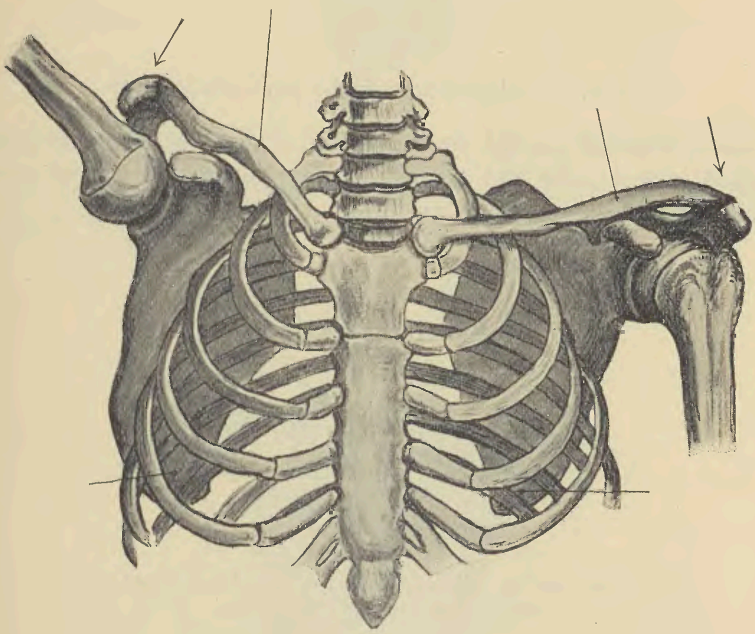


Fig. 64. Shoulder-bones when the Right Arm is raised.

### BONES OF THE SHOULDERS.

Fig. 64 shows the Bones of the Shoulders, and fig. 65 shows the Shoulder-Blades, when the Right Arm is lifted up.

The Shoulder-joint is the most movable in the whole body, and it lets the arm move freely in various directions.

It is a common fault, in playing Games, not to use this joint nearly enough. For example, in Ball-Games thousands of

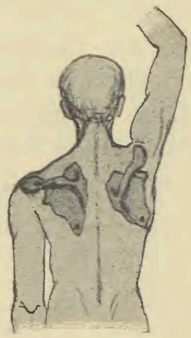
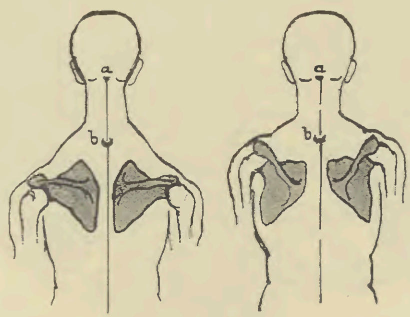


Fig. 65. Shoulder-blade when the Right Arm is raised.

players use their wrists far too much, where the Shoulder-Joint would give a safer and surer movement, and would be not only better Exercise, but also less tiring.




Figs. 66—67. Sloping Shoulders and 'Long Neck', High Shoulders and 'Short Neck'.

## THE BONES OF THE ARM.

The ordinary position of the Shoulders varies greatly with different people. In delicate people, with weak Muscles and little energy, the weakness of the Muscles, which should hold up and raise the shoulders, lets them hang down (66), and thus we see 'Sloping Shoulders'.

In vigorous people, on the contrary, the strong Muscles of the neck,

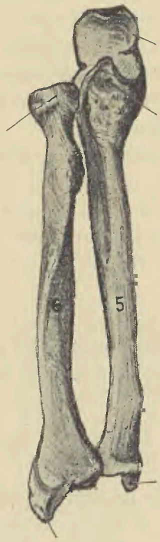



Fig. 68. The Fore-Arm, showing the Ulna (5) and the Radius (6).

powerfully stretched, draw the Shoulders up, and we have the 'High-Shouldered' type. When this is very pronounced (67), it is known as 'Bull-necked'.

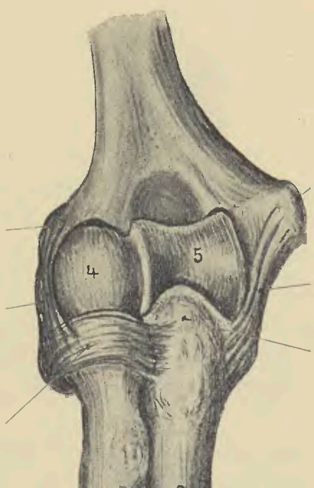



Fig. 69. Elbow-joint, opened.

In the first case, when the Shoulders slope, the Neck looks long, in the second, it looks short, although the Spinal Column here may be of the same length in both cases. The great apparent difference between 'Long-necked' and 'Short-necked' people does not depend upon a difference in the actual length of the Column, but upon the way in which the Shoulders are carried.

We find that the Neck looks short when the muscles of the Neck and Shoulders are powerful, as well as when the Chest is prominent. In cases of stretched or distended Chest, a short Neck is often associated with shortness of breath. In long-necked (swan-necked) people the Muscles of the Neck and Shoulders are generally feeble and slack.

(44). Figure 68 gives us the two bones of the Lower Arm or Fore-arm: they are called the Ulna and the Radius. The Ulna is on the same side as the Little Finger, while the Radius is on the Thumb-side.

The movements of the Fore-arm and Hand are very free.

### THE ELBOW JOINT.

At the Elbow-joint three Bones meet, viz. these two and the Humerus. Unlike the Knee-Joint, the Elbow-joint consists of three separate Connections (fig. 69).

### BONES OF THE ARM.

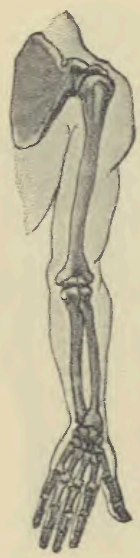


Fig. 70. Bones of the Shoulder-blade, Arm, Fore-Arm, and Hand.

By stretching out and bending the Arm can pass through an angle of some 150 degrees.

Figure 70 shows what the Bones are like.

If to various other movements we add the movement at the Shoulder-Joint, which is about 180 degrees, the hand has a movement of 360 degrees, that is to say of four right angles: so that when the hand is hanging down we can turn it almost completely round and bring the palm outwards. In Figure 71 the the Wrist-Bones are given.

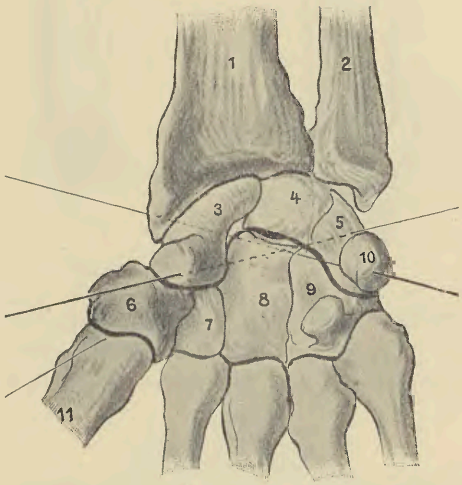



Fig. 71. The Wrist-Bones, when the Palm of the Hand faces you.

## NOTES ON THE BONES OF THE HAND.

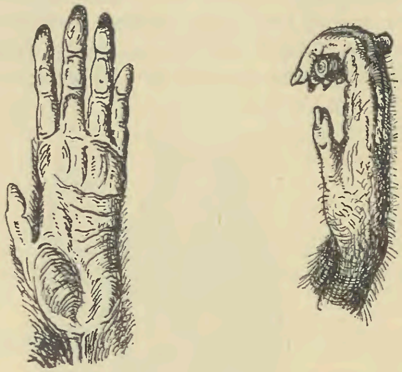
The Bone of the Thumb is shorter than that of the other Fingers, and is separately connected with the Wrist by a strong flexible Joint, called a Saddle Joint. Contrast the Gorilla's Hand (Figs. 72—73). It is this Joint that gives the Thumb its special character as compared with the Big Toe, and helps to give the Hand its special character as compared with the Foot.

This would be clear if you tried in how many ways you could move your Thumb about, and then tried to move your Big Toe in the same way.

For instance, the Thumb can move across the Palm towards the Little Finger and can touch the tips of all the Fingers. It is also large.

A long narrow hand is not altogether the most useful type of hand.

The Hand has the power of varied movement by means of its many Muscles (for the skeleton of the hand has 27 bones, which are moved by 40 Muscles), it is richly provided (especially



Figs. 72—73. A Gorilla's Hand.

at the finger-ends) with Nerves of Touch that can appreciate the smallest details (of position, surface, form, texture, temperature, etc.) in other objects; it has Muscle-nerves which carry news of

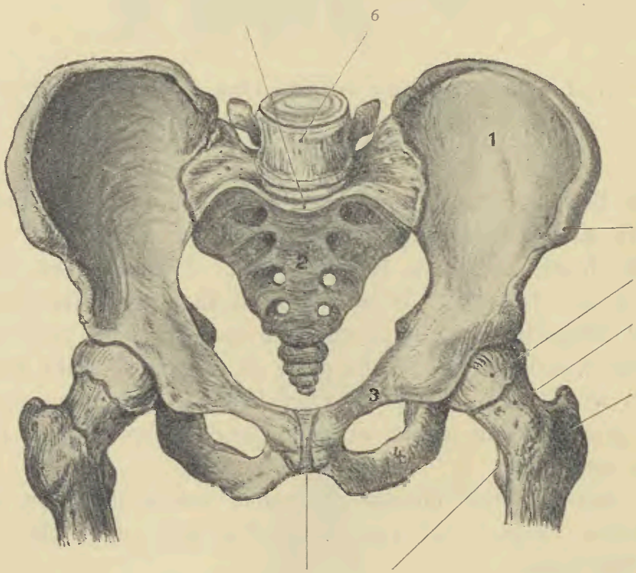



Fig. 74. The Pelvis.
1. Bone of the Flanks (Iliac), 4. Bone of the Seat (Ischium),
6. Joint or Vertebra of the Spinal Column.

the slightest Muscular feeling and thus give an amazingly accurate estimate of force and weight; thus the human hand, Sense-Organ and Instrument in one, is perhaps most consummate tool that Nature has ever devised.

Nevertheless, most kinds of special Gymnastic training of the Hand are repugnant to large numbers of people, though the Hand serves so many practical uses in real life, and though there is no part of us that cannot be improved by training of the right kind. The skilfulness of the Hand is chiefly developed by certain practical employments, such as writing. Philanthropists have already made a study of this, and Gutsmuths wrote instructions for learning how to turn, to work in metals, and to grind, as an Appendix to his admirable system of Gymnastics for the young.

Others have introduced special finger Exercises, such as weight-lifting.

In Gymnastics proper, with or without gymnastic appliances, the hand gains but little advantage.

## 5.—THE LOWER LIMBS, AND THE CARE OF THE FEET. THE PELVIS, THIGH, AND HIP.

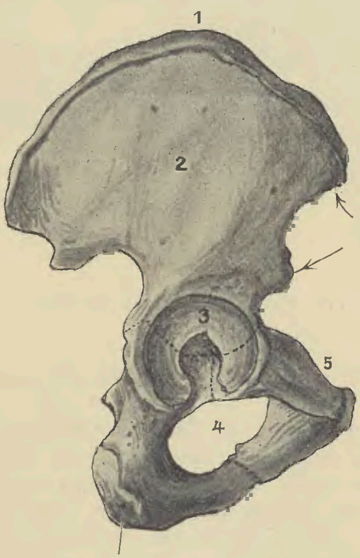



Fig. 75. Side-view of the Pelvis. 2. Bone of the Flanks (Iliac).

(49) In 74 we see that the Pelvis holds up the Spinal Column, and is itself held up by the Hip-Joints, on the heads of

the Thigh-Bones. In 75 we have a side-view, and in 76 the bands or Ligaments.

The Pelvis in the human skeleton shows differences of sex, and gives rise to an outward difference hardly to be concealed. Actresses in masculine attire, for instance, can easily be recognised as

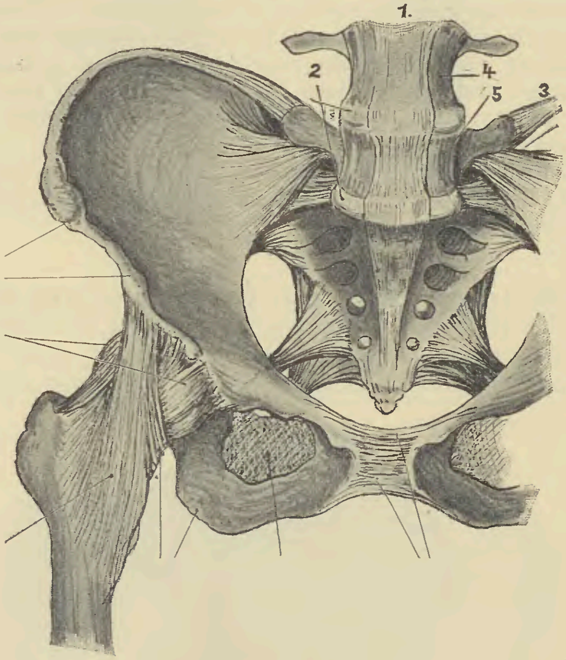



Fig. 76. Ligaments of the Pelvis.

women by the width of the Pelvis and the distance between the Hip-Bones.

The distinctions of sex in the Pelvis are not equally pronounced in all races. Generally speaking, they are least marked in those which stand lowest in the scale. Among the tribes of Central Africa, and among the Arabs, the figure of a woman, seen from behind, differs little from that of a man, if, of course, we leave out the differences in the hair. The rounded fulness of the hips is most pronounced in European women, even apart from the fact that modern dress (by the Corset) tends to exaggerate their natural breadth.

It is a remarkable fact, also, that the female figures in ancient sculpture generally have a somewhat narrow Pelvis.

Whether we may infer from this that the modern European woman has wider Hips than the Greek women of the time of Phidias and Praxiteles, must remain an open question.

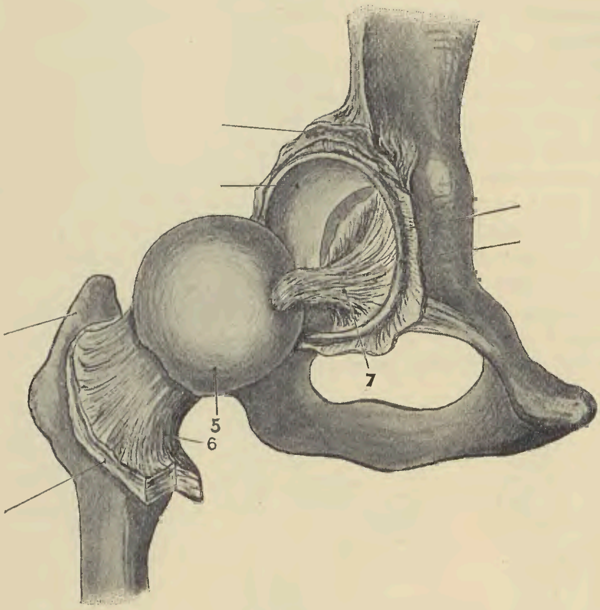



Fig. 77. The Hip-joint, opened.

The Thigh is the largest and heaviest bone in the body.

The Joints of the Hip and Knee are the firmest and strongest points in the whole body. In construction the Hip-joint

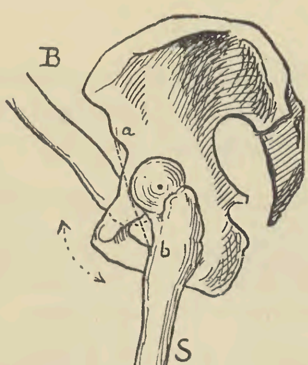



Fig. 78. The Hip-joint: the very powerful Ligament (of Bertin) goes from *a* to *b*.

resembles the Cup-and-Ball Joint. The Hip-Joint is to be seen, opened, in fig. 77.

When we 'stand at ease', the weight of the trunk is then balanced by the powerful Ligament of Bertin, and special muscular exertion is not needed.

But how does it come to pass that, in spite of the weight of the trunk, the Hip-Joint is not only firm and supple, but does not wear out soon or break away from its Socket? To compare the Cup and Ball, why does not the ball drop out of the cup? There is a ring of Cartilage, but it is too weak to keep the head permanently in the socket. The weight of the Leg would soon wear it away. Neither is it the Ligaments that hold the head fast; they may be cut through all round, and yet the head will not drop out of the Joint. There must therefore be some other force. This force is the pressure of the Air.

'The hanging Leg'—to quote the Classic work of the brothers Weber—'is supported and held in place merely by the pressure of the air; it can only fall away if this pressure is removed...'

I II III

Figs. 79—81. Bending of (I) the Thigh towards the Trunk, (II) the Trunk towards the Thigh, (III) the Thigh and the Trunk together.

The thigh in motion swings like a pendulum, without friction.

There is no need to say anything more about the Hip-Joint if figs. 79—81 be studied, and then 82.

THE LOWER LEG AND KNEE.

The Knee-Joint will be seen in 82, and the Ligament which keeps it from bending forwards is marked by the dotted line in 83. The Ligaments of the Knee-Joint are very complicated.

Figs. 84 and 85 show how the Knee-Joint changes when it is stretched out straight and when it is bent.

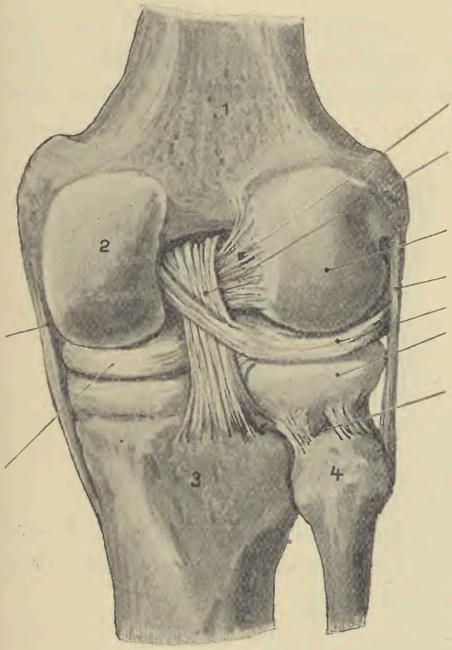



Fig. 82. The Back of the Knee-Joint; the Ligament, called Capsular, has been removed.

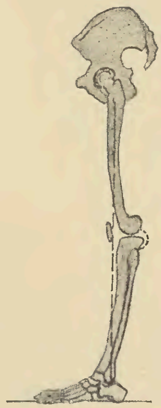


Fig. 83.

When the Leg is fully extended, the lower Leg and the tip of the foot invariably and involuntarily turn out a little; when

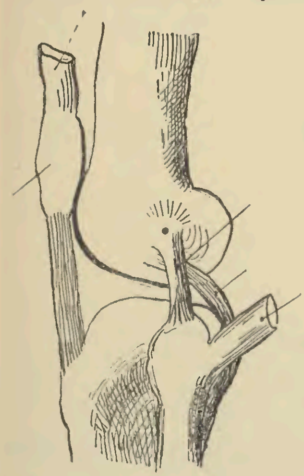


Fig. 84. The Knee-Joint when extended and straight.

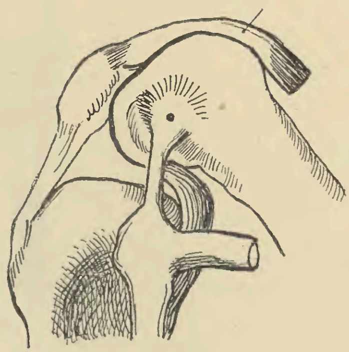
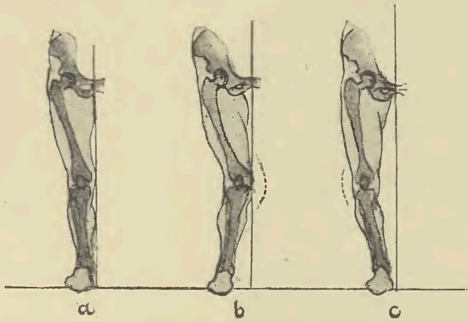


Fig. 85. The Knee-Joint when bent.

the Leg is bent, the Shin-bone turns itself in again Thus when the Legs are stretched out, the Feet are naturally turned out a little. To walk with the feet pointing straight forwards, as



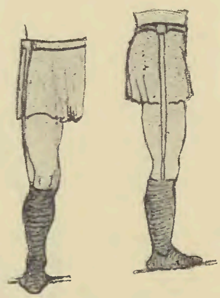

Figs. 86—88. (a) Ordinary leg, (b) Bandy-leg, (c) Bow-leg.

the Indians do, and as has been lately advised by a French Army-surgeon, requires that the Knees be bent. Otherwise the gait will be constrained and tiring.

Of the turning-in of the toes, however, we shall speak elsewhere.

Figs. 86—88 illustrate different kinds of Legs, e.g., Bandy-legs.

Experience shows that Bandy-Legs are to be found especially among people who, in youth, have to stand up constantly and for hours together; in youth the Ligaments are more yielding than in later life.



Figs. 89—90.

Figures 89—90 represent a special method of fastening stockings, as opposed to the way of fastening them with garters just below the knee (or even just above it).

The former way not only leaves a deep furrow round the Leg, but it also hinders the Circulation of the blood in the lower limbs. Varicose veins and cold feet may result from this.

## THE FOOT AND ANKLE.

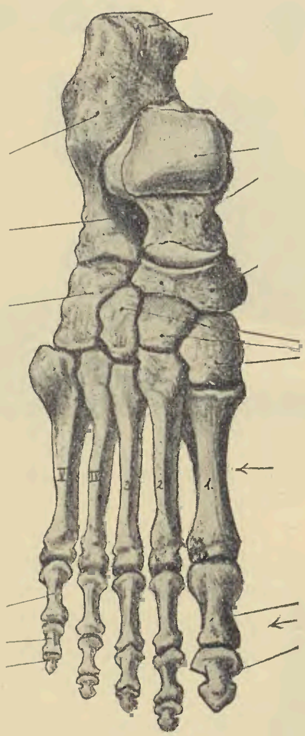


Fig. 91. Skeleton of the Foot, seen from above.

The Foot differs from the Hand partly, as we have seen, because the Thumb differs from the Big Toe; but besides this, the Bones of the Ankle are far stronger than those of the Wrist.

Again, the human Foot properly only touches the ground at three points—viz., the balls of the Big and Little Toes, and the Heel.

Mammals like the bear, which puts the whole sole of the Foot to the ground, have no Arch, but set the Foot down quite flat. Most Mammals only touch the ground with their toes.

In mankind, the Arch protects the Nerves and Veins of the sole, which thus are not pressed at every step. When the weight of the body falls on the Foot, the Arch is rather flattened, and the Foot becomes a little longer.

This should be remembered in the trying on of Boots.

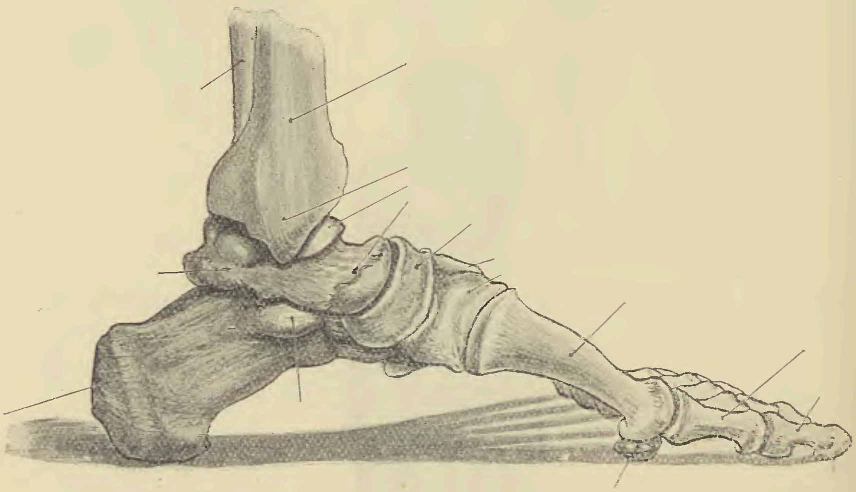


Fig. 92. Skeleton of the Foot seen from the inner side.

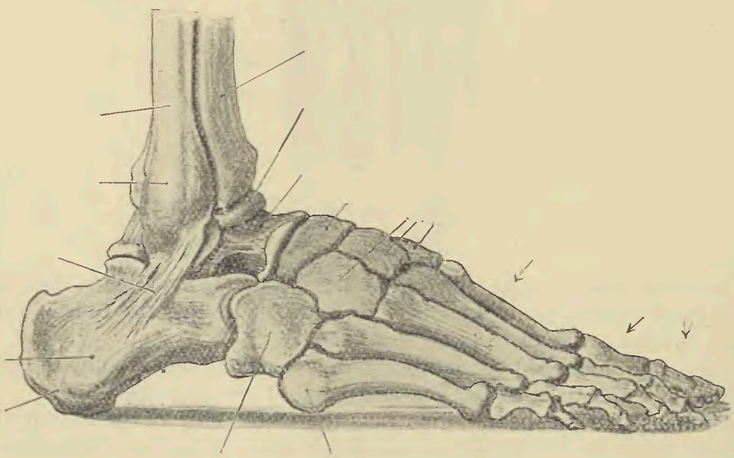
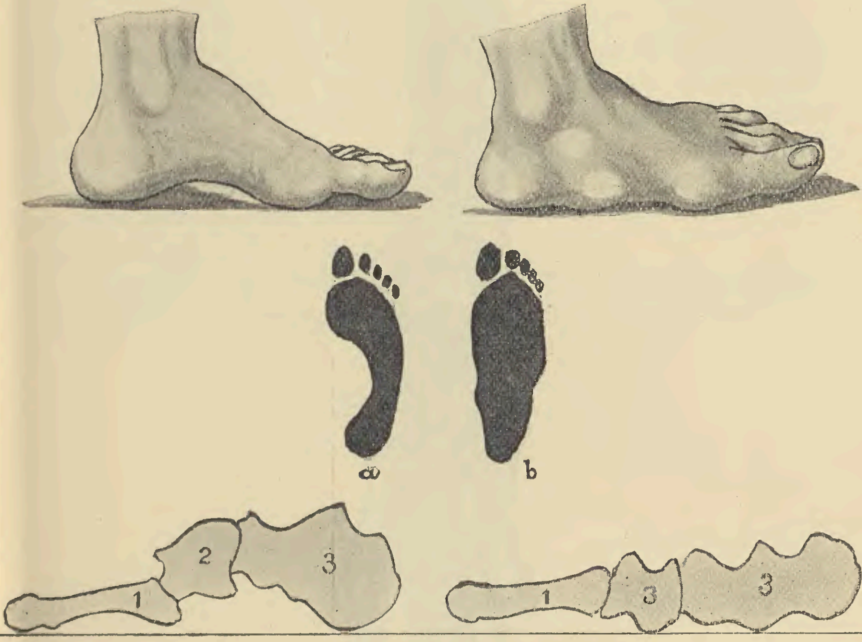


Fig. 93. Skeleton of the Foot, seen from the outer side.

Figs. 94—99 shew the ordinary Arched Foot as opposed to the Flat Foot.




Figs. 94—99. Ordinary Arched Foot and Flat Foot.

In fully developed Flat Foot the Foot looks broader and longer, and the inner Arch rests on the ground altogether. The gait is clumsy and unelastic. Generally, Flat-footed people are easily tired, and cannot endure long walks or Marches; they are also very liable to perspiration of the Feet.

This should be remembered when Exercises for children and boys are being considered. Jews are often Flat-footed, and so are Negroes.

Acquired Flat Foot can come from excessive and long-continued strain on the Arch of the Foot, especially among those who have to stand much in early life. *Children*, above all, whose Bones and Ligaments as yet are tender, *cannot stand for long* without serious risk and without the Arch of the foot sinking. This is another argument against the practice of standing too much at Lessons in School.

In fig. 100 we have the Foot-Bones: for some lessons to be drawn from a study of them see below.

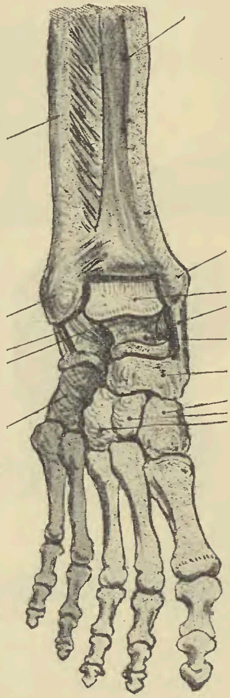


Fig. 100. Skeleton of the Foot and Ankle-Joint.

Fig. 101 shews that *Tip*-toe is a misnomer.

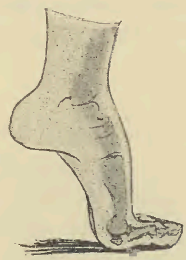


Fig. 101. Tip-toe.

## THE CARE OF THE FEET.

No member of the body is so much distorted and spoilt by unscientific clothing as the Foot. And yet it is the member on which we are continually making heavy demands, and which has to bear and move the weight of the whole body. *Our ordinary foot-gear is in most cases unsuited to its purpose.*

In our Schools of Agriculture and Veterinary Science, Lectures are given on the right way of shoeing horses; the shoeing of the human Foot is handed over to the custom of the trade, and, worse still, it is subject to Fashion: just as if the natural shape of the Foot changed with the Fashion! Although the right and left feet are quite different, the right and left shoes of girls and women used to be shaped exactly alike in Germany till quite recent times. [1]

Yet anyone who wishes to go in for Exercise such as Walking, Running, Jumping, etc., or Games involving these Exer-

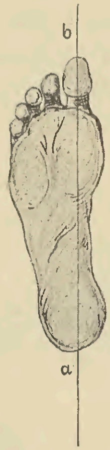



Fig. 102. A Sole of the Foot with Meyer's line.

cises, must have proper Shoes or Boots if he is to do himself justice. The wrong Foot-gear must lessen the power for such Exercises.

In Walking naturally, we first set down the Heel, and then the rest of the Foot follows, the movement going from the Heel to the Big Toe. The Foot then pushes off from the ground with the Big Toe.

The line along which the movement goes, the line from the middle of the Heel to the Big Toe and along it, is called

[1] It is strange that this should have been tolerated in the German Army. [E. H. M.]

'Meyer's Line' (102). *The Big Toe should do its work along this line*, if it is to do its best.

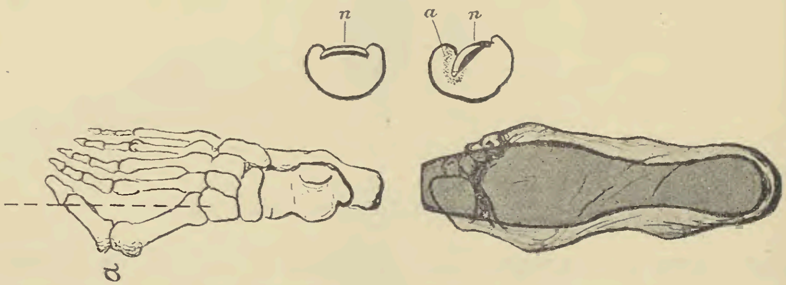
Otherwise, how can it get its proper leverage? It is partly because of the turning-out of the Big Toe by Boots and Shoes that, in quick Running, we so often see the Toes turned in. By this means the Toe *does* get its leverage.

Figures 103—105 should be very carefully studied.

The following rules will not all be followed by many. They are suggested in spite of this.

The front part of the sole of the Shoe or Boot must be so designed that the Big Toe resting on it can keep its natural position. This rule is put first because it is most commonly sinned against. In many Shoes the tip, instead of lying on the inner edge, is almost or quite in the middle of the sole. So the Big Toe is forced out of its natural position, and towards the middle, and the tip of it, instead of pointing straight forwards, thrusts itself towards the line of the sole, as in 103 and 104.

This not only lessens the force of the backward-thrust of the Big-Toe as it leaves the ground in walking, but also turns the Big Toe, so that it lies all wrong; hence may come the 'in-grown Toe-Nail' (105).




Figs. 103—105. A Woman's Foot deformed by fashionable Shoes, and a section of the Big-Toe Nail and its Bed.

2. The front part of the upper leather must let the Big Toe keep its proper position or come back to it easily; and it must give room for the free movement of *all* the Toes in treading and springing. When the upper leather is not raised enough corns are apt to come—the Little Toe being generally the chief sufferer. The leather should be raised most above the Big Toe, and not above the middle of the Foot.

If the upper leather does not give the Toes room to spread outwards and forwards, they are obliged to curl up. *This makes jumping down*, deep bending, etc., in Exercises and Games, a very painful process, to say nothing of the descent of hills. In wet and cold weather, tight upper leather over the Toes is very apt to produce chilblains.

In Games most people do not bend enough or do not bend easily enough: this is especially noticeable in Lawn Tennis. It is *partly* due to want of practice, but partly also to bad habits owing to badly shaped Boots and Shoes.

3. *The tip of the Shoe should curve upwards*, and should be above the level of the ground. This upward curve helps the Toes to bend easily, as they ought to do, in walking, at the moment when the back Foot leaves the ground, and even more decidedly in Standing and Running on tip-toe.

4. The shoe must *leave room* for the greater stretching of the Foot when one treads, but, on the other hand, it must fit close enough to keep the Foot from slipping forwards. Here we must distinguish between the different kinds of leather, according to their elasticity.

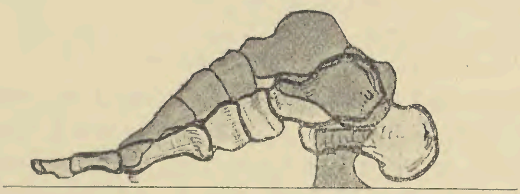


Fig. 106. The Skeleton of the Foot, on a high heel.

5. *The heel of the Shoe should be low.* Our girls and women are very ready to express their horror at the distorted feet of Chinese women. But the amount of hideous distortion and deformity (106) concealed by high-heeled Shoes and Dress Shoes (which many consider so dainty) is known only to the initiated.

High heels force the Foot to keep perpetually and unnaturally on the stretch: if they are worn from early youth, they may bring about permanent deformity of the Skeleton of the Foot.

Moreover, the High Heel interferes with the natural Walk, in which *the pressure of the Foot on the ground passes from the Heel to the Toes*. The High Heel requires that the tip of the Foot should be set down first, instead of the Heel. The result is an awkward tripping gait, short-stepped, and very fatiguing. This is one cause of women's frequent dislike for (and incapacity for) good Exercise in the open air, such as Walking, Mountaineering, Running, and Games—and thus the General Health is affected.

It is a survival of a perverted and mischievous conception of beauty that walking on the tip of the foot should be taught to girls by Gymnastic Lessons, and held up to admiration as beautiful.

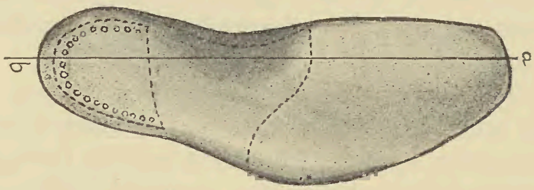


Fig. 107. The Sole of a Last made in a Natural shape.

When the Foot is put on an inclined plane, the High Heel also makes it slip forward. The Toes press against the upper leather of the Shoe, and are strongly curved or even laid one upon the other, and so may become distorted and unfit for work.

6. The Heel should be broad, and should come well forwards. If the Heel is too narrow (as often in Ladies' Shoes) the Foot is very apt to twist and to get sprained; the walk

Figs. 108—109. Right and Left Toes in properly-made Socks or Stockings (1), and in the 'Conical' shape (2).

becomes unsteady and unsafe on uneven and stony ground, on bad pavements, on hard trodden snow, or on frost-bound roads. Thus also bad Shoes may hinder good Exercise in the open air.

7. It is not possible to make properly fitting Shoes by

average measurements. Ready-made Shoes, and Shoes modelled on the lines of the shoemaker's 'average' last, fit only in exceptional cases. Shoes in the Nature-shape, or better still, in the case of grown-up people, a last in the Nature-shape (107), carefully designed once for all, should be made by exact measurement in each individual case.

In the measurement for shoes the following points should be observed:—

8. The measurements should not be taken over the stocking, but on the bare foot. This is the only method which makes allowance for deformity, corns, etc. Moreover, the pointed stockings generally worn (108, 109) disguise the shape of the Toes.

9. The measurements of the *right and left* Foot are not always alike; each Foot should therefore be measured separately.

10. The Length and Breadth of the Foot should not be taken when it is raised, but when it is set down on the ground. The best guide for the sole is the impression of the footstep. You can take it by laying on a sheet of white paper, another sheet of which the under side has been coated with charcoal, blue, or some such material.

11. For the outline, a thin or flat pencil should be set straight up against the border of the foot and drawn right round it.

12. The instep (the height of the Arch of the Foot from the ground) should not be measured when the foot is set down, but when it is lifted and unburdened, since then the Arch is highest.

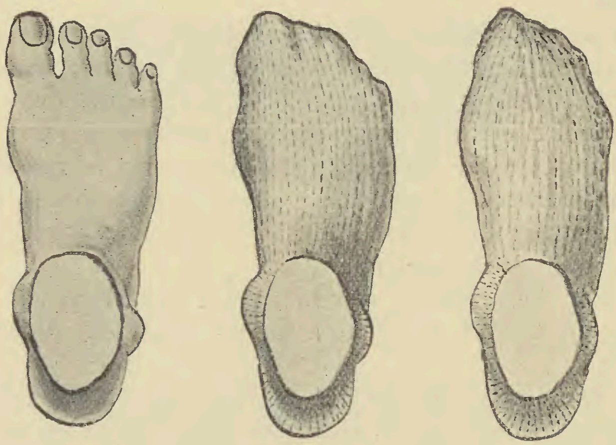
13. The advantage of *high-laced Boots* (or really good Buttoned Boots), is that they can be securely fastened over the instep. In Walking they may not be a sufficient protection against the wet, but in other respects they are beyond a doubt the best for Tours. For Mountaineering, the thick soles and broad heels should of course be studded with iron points.

Top-Boots are usually badly ventilated, and Elastic-Side Boots may be too tight when new, too loose when old.

Low shoes are light, which is an advantage; but they sometimes let the foot slip forward so that the Toes press against the upper leather. They are useless for Walking-tours, unless they cover the ankle.

For the Gymnasium, Lawn Tennis, etc. light shoes of leather or canvas, laced, and reaching *above the ankle*, are perhaps the best. [1]

14. Another important point is the shape of the Stocking (110—112). In children of under a year old, the Toes spread apart. The child can move the separate Toes daintily, and can 'play with them'. Soon comes a change, however. The elastic pressure of the tapering Stocking, with its cone-like point, gradually draws the Toes together, and narrows the middle



Figs. 110—112. Normal Foot undistorted (110), in a Natural-shape Sock or Stocking (111). Distortion due to a Conical-shaped Sock or Stocking (112).

part of the Foot and the sole. 'Nature,' says Starcke, 'has given us seven strong Muscles for the Big Toe alone; they are all partially paralysed by the careful hand of the knitting mother.' If the Stockings are not to produce such evil effects

[1] I do not quite understand what Dr. Schmidt means by the so-called Foot-ball or Tennis Shoes with leather soles, which have become popular of late. But it may be mentioned that, for many Ball-Games, e.g., Lawn Tennis, Boots are coming in a good deal, and in Cricket Boots are, I think, the rule rather than the exception. Dr. Schmidt is very wide of the mark when he says that Shoes with India-rubber soles have entirely failed to hold their own for Games.

(E. H. M.)

they must be made *distinct for the right and left Foot respectively, since the tip of the foot is not in the middle*, but on the side where the Big Toe is. Stockings of this sort are not more troublesome to make than the kind generally worn, and *they last longer,* because the Big Toe does not go through the end so quickly. All teachers of needlework should show girls how to make Stockings of the natural shape, and should see that the girls make them thus.

The need of Foot-covering of a correct and natural shape where speed or endurance are required, has been recognised by great Generals in all ages. Julius Cæsar, Gustavus Aldolphus, and Frederick the Great may be cited as examples.

In the campaigns of 1870 and 1871 it happened not seldom that in a long march as many as five per cent. of the troops (as many, that is, as are disabled in a fiercely contested battle) had to be left behind on account of sore feet. The fate of the great army of Bourbaki was certainly hastened by the wretched condition of the French soldiers' boots. More than a hundred years ago the Dutch Anatomist, Petrus Camper, tried to bring about a change by his work on the best shape for shoes *(Von der besten Form der Schuhe).* It was published in 1782 and translated into most European Languages, but without much permanent result. Fashion and the trade custom were too strong for him.

15. *Open-work Shoes* (or Lattice-work Shoes, or Sandals) are also sadly needed, so that the Feet may be ventilated and may get an Air-Bath; and so that they may get an occasional wetting by walking in grass (cf. Kneipp's Bare-foot System); and so that they may get hardened against cold and damp. Probably, when once the Feet get used to the Air, a cold hardly *can* be caught by wet Feet. The effect of these Sandals, on Health and the Nerves, at the German Nature-Cure Establishments is said to be remarkable.

16. With respect to the care of the Feet, in other ways, *scrupulous cleanliness* is essential. For 'Hot Feet' it is a good thing to powder the Feet and Stockings with Salicylic Powder (a mixture of three parts of Salicylic Acid to ten parts of Flour and 87 parts of Powdered Magnesian Earth). The idea that nothing should be done to cure Hot feet is wrong. If the feet are red after long Exercise, or if they are blistered and sore, Salicylic Powder should be applied. A Salicylic

Ointment has lately been introduced in the German Army in the place of the Powder. One or the other should always be taken on Walking-Tours which last more than two days.

Besides Boracic Powder, we may mention that the alternate Hot and Cold (or Warm and Cool) Foot-Baths are used with great success in the German Nature-Cure Establishments. These latter have the Extra advantage of helping to cure Cold Feet.

As to *Corns*, they may be softened by pads of wet material being put round the toe and then covered with oiled silk. In the morning the Corn covering may be picked off. If the Foot is wrapped all over with several layers of wet material, and then covered up with Flannel, the whole Foot will have a kind of Wet-Sheet-Pack as well.

## 6.—THE MUSCLES AND FATIGUE OF THE MUSCLES IN GENERAL.

The Muscles form the greater part of the body, of which about half the weight is in Muscles and thin tissue.

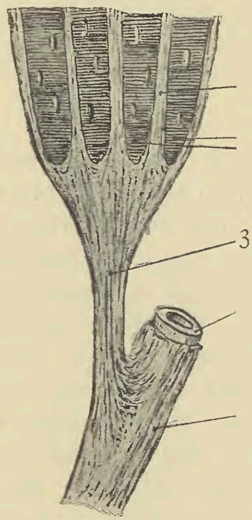



Fig. 113. How the end of a Muscle passes into its Tendon (3) and how the Tendon is inserted into a Bone.

The bones are the Passive Organs of Motion, the parts that are moved; the Muscles are the active Organs of Motion, the parts by means of which the Bones are moved. A stimulus given by the will makes the Muscles contract; *they become shorter, and so draw closer together the points to which they are fastened.* Of course at least one of these points must be movable.

We divide the Muscles into two classes, which differ in their minute structure. Those of the first class, the *Striped* Muscles, are almost without exception subject to the will, and are therefore called Intentional or Voluntary Muscles; those of the second class, the *Smooth* Muscles, are not directly affected by the will, and are called Involuntary (and sometimes Automatic) Muscles.

The Muscle-Bunches are made up of many Muscle-Fibres, and each of these Fibres is made up of smaller Fibres (Fibrillæ), and these again are made up of Disks (light Disks and dark Disks alternately.)

A Section of the Muscle-Bunch is seen passing into a Bone in fig. 113.

There are exceptions. Thus the Fibres of the Heart-Muscles are striped. But they are not Striped in quite the same way as those of the Arm, for example.

Figures 114 and 115 show a Smooth Muscle-Fibre, and a Bundle of such Fibres.

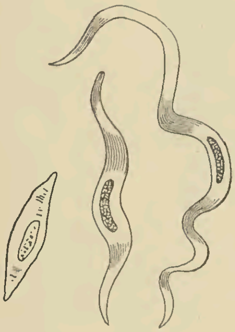


Fig. 114. Smooth Muscle Fibre.
Fig. 115. Bundle of Smooth Muscle-Fibres.

Round each Fibre is a fine sheath of Membrane, and round each Bunch of Fibres is yet another Membrane, which holds the Blood-Vessels (these give nourishment to the Muscles, and help to carry off its Waste-products), and also holds the Nerves and Fat.

Fig. 116. Shows a Nerve ending in a Fibre of a Muscle.

The Muscle enlarges itself from Cells within the Membrane: these lie scattered about, and help to form fresh Fibres.

The Muscle-Nerves enter the Muscle-Fibres from the side. They have two duties. In the first place they are Motor-Nerves, that is, they carry the commands of the will to the Muscle from the Central Nervous System (the Brain or Spinal Cord), and set the Muscle to work.

But, besides the Motor-Nerves, the Muscle has Sensory Nerves, that is, Nerves which take news (esp. of the outside world) from the Muscle to the Central Nervous System. This feeling we call Muscle Sense. It is like the sense of touch; it tells how much the Muscle is being resisted in the discharge of its work; it tells how much exertion is needed to do the work; it tells of the weight of bodies which are to be lifted, of the firmness of bodies which are to be moved; and it gives some idea of the qualities of these objects, whether hard or soft, stiff or elastic. In the same way it tells whether the Muscle is fresh or tired.

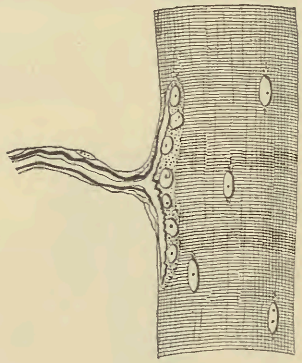


Fig. 116. How a Nerve ends in a Muscle.

The Nerve and Muscle together thus make up a unity, the Muscle being an Organ at the end of the Nervous System.

All striped Muscle (as we have seen) is not Intentional or Voluntary. The exceptions are (1) the Muscles at the top of the gullet, which take part in the act of swallowing, apart from the will; (2) the Breathing Muscles, which *can* be brought into subjection to the will, but usually work Automatically, without effort of the will; and finally (3) the Heart, which is said to be quite impervious to direct suggestion from the will. But knowledge is not yet complete.

THE ACTIVITY AND THE ROUSING OF THE MUSCLES.

The power of the Muscles to act, i.e. to contract at a given impulse, is called 'Excitability'.

When the Muscle receives a Stimulus (e.g., when you give it an electric shock) there come from the Muscle force and heat. The Stimulus helps to free and let out this force and heat, like the spark which frees the force that slumbers in gunpowder, and makes it explode, so as to give out force and heat.

We notice the following 'Stimulations' which make the Muscle contract:

1. Natural Stimulation, when the Nerves, e.g., from the Brain or Spinal Cord, 'command' the Muscles to contract;

2. Artificial 'Stimulation', when the Muscle contracts because it has touched strong corrosive Acids, or something very hot or very cold, or when it is suddenly and sharply pinched or pulled.

But the most important kind for our purpose is that which is given by an Electric Current, because it is the easiest to regulate and to measure. It is this kind which is chiefly used in Scientific experiments on the action of the Nerves and Muscles.

## ACTION OF THE MUSCLES.

(67) When a resting Muscle is made to act by 'Stimulation', the process is this:

1. The Muscle in action becomes shorter and at the same time thicker; the greater the Stimulus is, the shorter and thicker the Muscles become (as a general rule);

2. the shortened Muscle loses a little in size, but gains a little in weight;

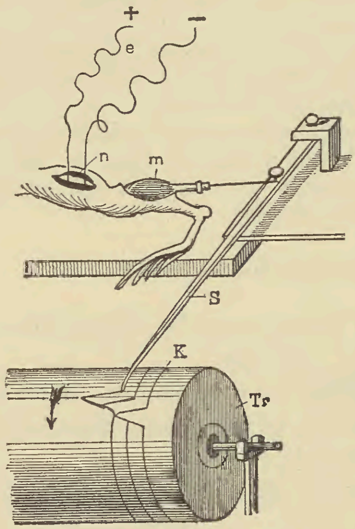
3. in action the blood-vessels of the shortened Muscle are somewhat dilated, and contain more blood. The Changes in the body go on quicker than before.

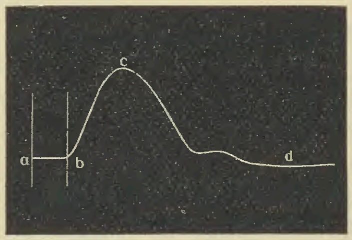
If a single Muscle (with its Nerves) is cut out, and if the Nerve is then 'Stimulated' by a single Electric shock, there is one single and short convulsion of the Muscle; the hitherto inactive Muscle *shortens* quickly in answer to the Stimulus and quickly returns to its former slack condition. But if a series of such shocks is given in quick succession to the Muscle of the Nerve, by an Electric Current constantly interrupted and then re-applied, the Muscle remains continuously contracted, i.e. continuously active.

A series of single convulsions in quick succession keeps the Muscle constantly shortened.

The will produces continuous contraction (and most movements are of this kind) in just the same way, viz., by sending many impulses in quick succession to the contracted Muscles, as long as the movement is to last. The single and short convulsion is the unit or element, as it were, and all the longer contractions are made up of a quick succession of these single and short colvulsions.

Appliances have been invented by which the Muscle itself can accurately register how violent and long the convulsion has been.




Figs. 117—118. Muscle-Register (Myographion), and a Curve registered by it.

Figure 117 shows such an appliance, by which the freshly exposed muscle, e.g., of a frog, will show the Convulsions (118).

Notice that

1. The convulsion is very quick;

2. the Muscle takes less time to reach the highest point of contraction (at *c)* than to return to the condition of rest (at *d)*.

3. *The convulsion does not begin at the moment when the Stimulus is applied* (represented by *a)*, but rather later (viz. *b)*.

The course of Contraction is divided into stages.

(a.) The Muscle, being Stimulated, begins to get ready; the length of time is 0.01 second; it is longer when there is fatigue, lowering of the temperature, or extra weight upon the muscle; it is shorter when the 'Stimulation' is more violent, or when the temperature is higher: cp. the expression 'feverish activity'.

(b.) The energy rises with fresh Muscle: this lasts from 0.03 to 0.04 seconds. If the contraction is slight, the weight to be lifted light, or the Muscle very fresh, the time is shorter, and the curve steeper.

(c.) The energy decreases, sinking back into rest. This process is slower, and takes longer than the period of rising energy.

(d.) The period of elastic after-vibration, in which the slackened Muscle contracts again very slightly. It calls for no further notice here.

If the 'Stimulation' is applied to the Muscle through the Nerve (and generally the will can reach the Muscle by no other route), the convulsion is more violent and prolonged if the Muscle is far off and if the Central Nervous Organ is near to the point at which it is applied. In the Nerves, therefore, the 'Stimulation' increases in volume like an avalanche.

Stimulation is sent by the Nerve not as quickly as a wire sends the Electric Current, but much more slowly. In the Muscle itself the wave of 'Stimulation' spreads even more slowly.

## FATIGUE OF THE MUSCLES.

If a Muscle has made many contractions quickly following one another, the curves do not remain the same as in the beginning; they show a gradually increasing change.

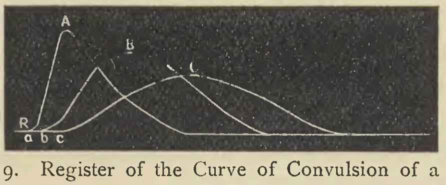



Fig. 119. Register of the Curve of Convulsion of a Muscle when (A) fresh, (B) half tired, (C) very tired.

1. The time of preparation grows longer, i.e. the Muscles take longer in beginning to contract;

2. the rising energy becomes smaller by degrees, and in two ways; the Muscle contracts more slowly, and so reaches its greatest contraction later; and the Curve does not reach

so high, but becomes flatter and flatter. In other words, the force of contraction becomes smaller and smaller.

*At last the Curve (see 119) becomes a straight line:* the Muscle can no longer be forced into action. It is exhausted.

The more heavily weighted the Muscle is, the more quickly does it get weaker and more tired. *A stronger 'Stimulus' is needed each time* to make the weighted muscle reach the same height several times in succession, or, in other words, to make it do the same work. Finally, even the strongest 'Stimulus' cannot rouse it to its original activity; the power of the Muscle has failed.

The cause of this we call *Fatigue*, and we must notice that

1. when the Muscle is fatigued it requires a stronger impulse or 'Stimulus' than when it is fresh, if it is to do the same work;
2. its actual muscular power is smaller;
3. the process of contraction becomes slower.

Fatigue, therefore, means not only greater effort, but it also means weaker work, worse work, and slower work.

## CONTINUOUS CONTRACTION OF THE MUSCLE.

Most of the movements which we make in daily life, or during Exercise, are continuous; they do not consist of one single and short convulsion of the Muscle, but of a greater or smaller number of convulsions, following close one upon the other and practically blending together.

If these shocks follow one another so quickly and for so long that the Muscle has not time to relax, but remains on the stretch, then we have Tetanus.

Convulsions which rapidly follow one another not only blend together so that the Muscle is almost kept shortened, but they have a 'cumulative' effect: *they produce a far more violent contraction than any single shock, however strong, could possibly produce.* The only condition is that the second shock must follow upon the first and act upon the Muscle during and not after the first period of contraction.

Thus we see that the Muscle reaches the highest possible degree of contraction only by the total effect of a number of distinct but successive shocks.

## CHANGES IN THE MUSCLES.

The tissues of the Muscles give the force for the actions of the body. As the action of a Steam-engine depends upon coals being consumed, and as this needs Oxygen; so in living Muscle certain Chemical changes take place, especially the consumption of Materials by the help of Oxygen, which changes them into heat and vital power or work.

Thus *the Muscle needs Oxygen to enable it to work, and it yields,* as its chief Waste-product, the Oxygen mixed with the Carbon of these Materials. These Materials are in the Muscular tissue or in the blood which is supplied to it. Part of the product is *Carbonic Acid.*

In its power of changing Materials into energy and work, the body is superior to the very best steam-engine.

The Muscle while apparently at rest, is really continually making Changes, which may be called 'Internal Breathing'. It has to keep the temperature of the body just right. *It absorbs Oxygen from the blood which streams through it, and gives off Carbonic Acid to the blood in return. This is one of the most important processes in life.* But the amount of Oxygen it absorbs is greater than the amount of Carbonic Acid which it gives off; the Muscle stores up an excess of Oxygen. This is a reserve-fund.

When the Muscle is in action, the blood-vessels are always dilated, because great Changes are going on. When the Muscle contracts and hardens it does not squeeze out the contents of the blood-vessel like a sponge, as some used to think.

When the Muscle is in action, we find that—

1. it gives off very much more Carbonic Acid; and
2. it uses up very much more Oxygen.

This using of Oxygen is made up for in the following ways:

(a) By the free exchange of gases in the Lungs, the body absorbs more Oxygen when it is in action than when it is in repose: indeed it absorbs 4 or 5 times as much;

(b) the Oxygen already present, stored up in the blood and Muscular-tissue, is used more satisfactorily.

3. All the parts of the Muscle are more active in the changing the Materials. In action the Muscle is acid, in 'rest' it is neutral.

## CAUSES OF MUSCULAR FATIGUE.

While the Muscle is active it is making certain Chemical Changes within itself. These are as follow:

1. There is more Carbonic Acid. Some of this is sent off from the body by the Breathing Organs. The more severe the exertion is, the more Carbonic Acid there is; the Lungs have to work hard to get rid of this and to breathe it out. For Carbonic Acid is a poisonous gas, when much of it is collected in the blood.

If many large Muscles take part in the action, and if they continuously keep up violent exertion, *the amount of Carbonic Acid* produced and absorbed by the blood may *become so vast that the deepest possible Breathing of the Lungs cannot expel it.* Hence the Lungs get tired for the time, and this we call *Breathlessness*; and an instinct tells us to stop the effort, or at least to interrupt it or to slacken it. It can only be resumed after an interval of repose, during which the Lungs have mastered the extra amount of Carbonic Acid, and so the Breathing has become regular again. We shall return to this subject later.

2. Besides this, *a number of Chemical substances, Waste-products, including Uric Acid, are formed in the body by Muscular exertion.* Like the Carbonic Acid in smoke, they are to some extent the results of the processes of 'combustion' in the Muscle.

Like the Carbonic Acid, the Waste-products are poisonous when large quantities of them are accumulated in the body (i.e. *in the blood). Unlike the Carbonic Acid, however, they are not expelled immediately*, but often many hours after the violent exertion, and, indeed, sometimes many days, weeks, or even years after it.

*How are they expelled?*

(a) They are expelled by the Skin, in the Sweat.

It is not clearly seen how poisonous are the *Waste-products* expelled by the Skin in the Sweat, till a large part of the Skin's surface is put out of action. These Waste-products cannot then be expelled from the body, but gather together in the blood and cause signs of serious disease, and may even result in death. This is the case, for example, when a great part of the surface of the body is burned or scalded. If a large part of the skin of a dog is covered with varnish, the animal dies miserably; children whose naked bodies have been gilded (so that they may represent angels) in Festivals of the Romish Church, have died because of this.

(b) They are especially expelled by *the Kidneys, in the Urine.*

Stoppage of the action of the Kidneys by sudden disease ends in signs of deadly poisoning (Uremia), on account of the presence in the blood of poisonous matter (urea), which cannot be expelled.

(c) They are expelled by the *Intestines,* in the fæces.

Too great a quantity of Waste-products in the tissues and in the blood may bring two kinds of Fatigue, which may be called Local and General Muscular Fatigue.

## LOCAL FATIGUE.

After a short Muscle-movement, the Waste-products produced in the muscle are rapidly carried away by the blood-stream and the Muscle is soon able to repeat the movement. It is otherwise when the Muscle remains continuously contracted, as in a long effort, or when a brief and violent Muscular effort is frequently repeated at short intervals.

In either case so many Waste-products gather together in the tissues of the Muscle that they cannot be completely carried off and washed away by the blood which circulates through it. The first effect of these Fatigue-products on the overstrained Muscle is to reduce its alertness and its excitability, so that a further exertion of the Muscle needs a greater effort of will.

At last, however, the Muscle becomes completely paralysed; it cannot respond even to the most energetic impulse of the will.

Only after a certain interval of rest does it recover and again become capable of more or less exertion.

Hold out your arm straight, with a heavy weight in your hand, and you will see what is meant here.

If, after such exertion, the arm is given complete rest for a while, the pain and the feeling of weight disappear. The Waste-products accumulated in the Muscle and in the Muscle-nerve are carried off by the blood-stream, and the muscle can now work once more. But it is not quite restored to its former freshness.

Sometimes, after Fatigue, Tea will for the time being bring back the Muscle to something that seems fresher than freshness. But this is only for the time being, and the result of repeating this soon begins to tell. The renewed freshness becomes shorter and shorter.

Constant and regular Practice makes the Muscle more capable of exertion, so that it can keep up its Exercise for a longer time or a greater number of times; and, besides this, the lingering signs of Fatigue, the 'gymnasium-fever', seldom or never reappears. The Muscle is thoroughly practised and is 'in training'.

In the example of the Arm holding out the weight the full amount of exertion of the (Deltoid) Muscle, in lifting and holding up the Arm, was in itself very small; in some Exercises the effort is many times as great, and yet is made with ease. Now vary this Exercise by turning round the Arm, which is thus held out, as far as you possibly can.

In the simple act of holding the arm straight out with the back of the hand upwards, all the Bundles of the Deltoid combined to hold up the weight of it; but now the new movement is

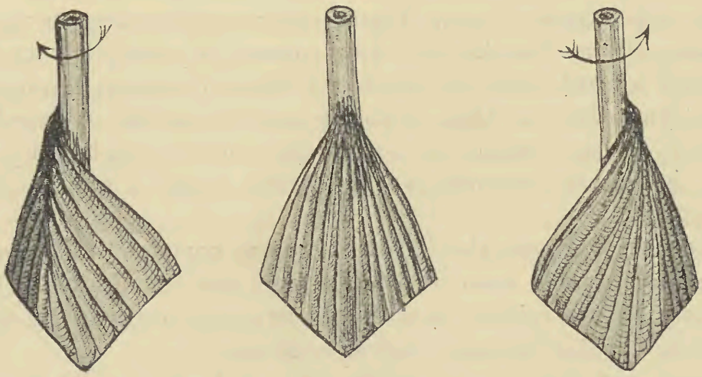


Fig. 120. The Deltoid Muscle, as the Arm moves round.

continually putting some of the Bundles of the Deltoid Muscle out of play, and the weight of the Arm is borne by only a few Muscle-bundles (viz., by those which are shaded dark in 120); these are therefore strained to the uttermost. The help given by small Muscles of the Shoulders may be left out of account here.

Although this movement would seem to add very little to the amount of exertion needed by the original Exercise, yet the Arm becomes very much sooner Fatigued. Sharp pain is felt much sooner in the Shoulder, and not only does the Deltoid Muscle lose its power of action much more quickly, but *other movements of the Arm are hindered or made difficult, although the rest of the Muscles of the Arm have hardly been brought into play at all,* and ought to be—at least so one would think—fully capable of exertion.

The tired Muscles, by their painfulness, check any attempt at movement, however slight, and the whole shoulder is as if paralysed.

Thus we see that Local Fatigue, i.e. overstrain of single Bundles in a Muscle of the Shoulder, may hamper and paralyse the muscles of the whole Arm and Shoulder.

If similar Fatigue is produced by Exercises of small Muscle-areas, e.g., of the Hips and Knees, the action of the whole of the human body may be impeded by Local over-fatigue in these single and scattered Muscle-Bundles, and a feeling of tiredness and over-strain may be imparted to the Muscles in general.

The conclusion is that Muscular Fatigue may be severe, not only because heavy work has been performed by the Muscles, but because the work has been distributed in a certain way.

Really severe exertion, on the other hand, may be distributed over many Muscles so that no one of them is strained to the utmost limit of endurance, and so that each of them has intervals for rest: during these intervals, the circulating blood will carry off the Fatigue-products. [1] Such severe exertion can be undergone without any sign of Fatigue, whereas a very slight mechanical exertion, if confined chiefly to small Muscle-areas, or even to single Bundles of Muscles, may there produce symptoms of extreme Local exhaustion, and thus incapacitate almost every Muscle in the body.

## GENERAL FATIGUE OF THE MUSCLES, AND EXHAUSTION.

To repeat this most interesting point, overstrain of even a small Muscle or Muscle-Bundle may be able to bring great Local fatigue, although the actual force used may be very small, and the Muscles can do a very great deal of labour if only

[1] In the above pages little account has been taken of the very great value of Dr. Haig's researches, which are verified by my own experiences. Dr. Haig shows how Waste-products can be introduced directly into the blood by certain Foods: different Foods have different effects on the same person, and the same Foods have different effects on different persons, but it has been found that certain Foods

too many Fatigue-products do not accumulate in those Muscles which are in action. Fatigue may be prevented, even in prolonged exertion, by short intervals of rest; and these intervals, like the Exercises themselves, are best when they are regular and follow a certain Rhythm.

It is in this way that the Muscle of the Heart can work without interruption, and can exert a mechanical force of an astounding magnitude.

Like the Heart-Muscles, the Breathing-Muscles, with their ceaseless rhythmic activity, put forth an immense amount of force, and, like the Heart-Muscles, show signs of Fatigue only when taxed far beyond their *ordinary* limits.

In the work of the Heart and Breathing Muscles we have Involuntary or Automatic action.

If we turn to the 'Intentional' or Voluntary Muscles, *they also give the highest total of exertion if rhythmic action is distributed over a large number of Muscles.*

However, the first Organs to yield to Fatigue in Exercises of Speed are those which are made very active by Exercises of Speed, viz., the Heart and Lungs.

Exercise and rest follow each other in rhythmical interchange, and so *give a total of exertion which our Muscles could reach in no other manner, as found in the movements of Walking, Climbing, Running, Swimming, Rowing, Bicycling, etc.*

If these movements are continued for a very long time, they may also cause Local Fatigue in some of the Muscles which are used, and in their Motor-Nerves (of which we shall speak later on).

It must be remembered also that Waste-products exist in the blood of the whole body. They are already to be found in it. The Skin, Kidneys, and Intestines, can only expel them slowly. If more Waste-products are formed in the Muscles in action, by continuous and strenuous exertion, and if more are passed on, into the Circulation, than can possibly be expelled, then it must be in the blood that they will accumulate.

and Drinks seem to introduce Waste-products (the very essence of *Fatigue*, as it were, *ready-made)*, and produce tiredness in the Muscles which are being used, quite apart from any great physical effort. It has been found that they will bring Fatigue after a quarter or even an eighth part of the work—and the work may be bad work, and slow work. (E. H. M.)

And this poisonous matter, circulating with the blood throughout the body, is the chief cause of the signs of General Fatigue and exhaustion. It first effects the Nerves. We feel disinclined for movement, depressed, and irritable; and the movements themselves become heavy and sluggish. In rest after action there comes a feeling of slackness, of prostration, over the whole body; the Pulse is feeble and frequent; the temperature rises to fever height; the appetite for food, which might be expected to be great after all this exertion and using up of materials, is lacking; in spite of the feeling of exhaustion and weakness, in spite of the need of repose, sleep will not come; the night passes restlessly. Next day the limbs are still heavy and have a bruised feeling; thick 'precipitates' (Uric Acid Salts for the most part) appear in the urine. By the third day perhaps the former freshness is restored.

General Fatigue is then a kind of self-poisoning of the body. If the blood of a hunted and exhausted animal is injected into the Veins of a fresh animal, it produces the signs of Fatigue; and the flesh of hunted game after a 'knightly' chase is notoriously unwholesome, or even poisonous, because of these Waste-products.

## EXERCISES OF STRENGTH, ENDURANCE, SPEED, SKILL, AND PROMPTITUDE (DEFINED).

To some extent we must distinguish between Exercises of Strength, Endurance, Speed, Skill, etc. Though Promptitude is rather a Nerve-Exercise, yet for the sake of giving a general view I shall include it here.

I take a Dumb-bell in my right hand: I grip it with all my might and lift up my arm very slowly, and, using my whole force, I may strain tremendously. Here there is no long Endurance, and there is no Speed, and there need be no Skill. It is an exercise of hand effort and of *Strength.*

Now I take it again, but I do not hold it tightly. I move my Arm up and down two hundred and fifty times, not very fast. It required no great strain, at any rate at first, but by degrees I begin to feel tired. I must put forth actually more Strength. But at first it is merely a matter of keeping on—it is *Endurance*, not Strength or Speed or Skill. As I go on, I may get used to the movement and so move quicker. The Exercise of Repetition or Endurance may become also more and more an Exercise of Speed.

After a rest, I again take up the Dumb-bell and move my Arm very quickly up and down, for ten seconds. Here there is no Strength, no Endurance, no Skill, but only Rapidity or *Speed.* If I go on for many minutes, even if I keep up the pace, it will soon become a question of 'lasting', i.e. an Exercise of Endurance. In time it may (like the Exercise of Endurance) become an Exercise of Strength.

Now I have had enough of this, and, with the Dumb-bell still in my hand, I do some Exercises in order to practise certain Lawn Tennis Strokes. These are very complicated, and one may consist of ten parts. This is an Exercise of Skill. I need not have to use Strength, I need not keep up the Exercise and so use Endurance, I need not use Speed; I may be using only Skill, i.e. I may be trying to do the thing in the best possible way—which involves many many different requisites, such as perfect time, perfect action, and so on.

Yet another change—I say to a friend 'Shout out some instructions sharply, as Backhand Volley, Forehand Half-Volley, Backhand Lob, etc.' Directly he shouts out, or directly a Phonograph shouts it out, I at once try to imagine the ball coming, and to get into position to return the Stroke. This needs not (necessarily) Strength, or Endurance, or Speed (for I may make the Stroke itself quite slowly), or Skill (for I may make it badly, i.e. worse than I should have done if I had had time to calculate). No: I only want to practise being ready and alert—to practise Promptitude and rapid Adaptation.

If I only have five minutes to spare, I may simply use all my force and Strength, and tax my Endurance to the uttermost, by rushing through, with tremendous Speed, various Exercises that need Skill; I may, as it were, jump from Exercise to Exercise, turning on the Phonograph at lightning pace. Here each class of Exercise may appear.

Each class of Exercise has its special use and its special bearing on all the other kinds: thus we have seen how Repetition or *Endurance* and *Skill* (including Accuracy), may help to increase the Speed more than any Exercise in speed could possibly do. For example, the way to learn to play a piece fast (with Speed) on the Piano would not only be to practise playing it fast, but, e.g., to practise playing it in the right way (with Skill), and to practise this again and again (with perseverance and Endurance).

Every single one of these Exercises may develop a small Muscle or a large Muscle, a small Muscle-Group or a large Muscle-Group, or many small or many large Muscle-Groups.

### RECOVERY OF THE MUSCLES.

The Muscle which has been strained till it is tired, or even till it is too tired to work, will, after a rest, regain its power. As we have seen, it used a larger quantity of Oxygen during

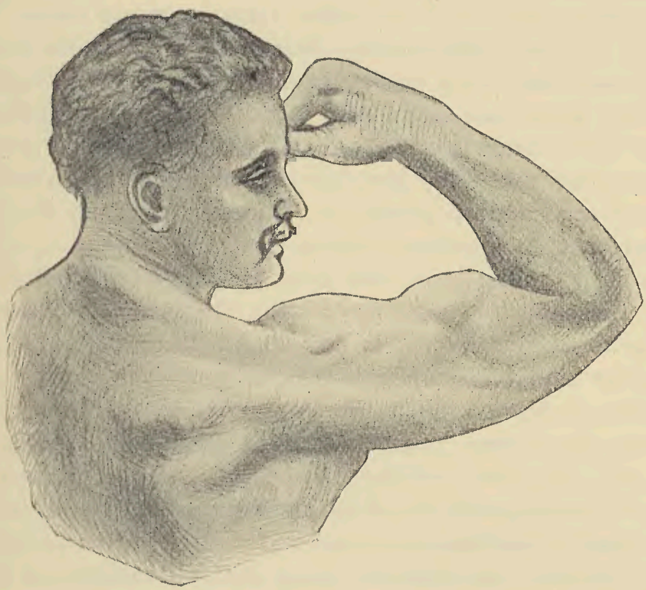


Fig. 121. Sandow's arm.

exertion, and it got this extra Oxygen not only by taking much more Oxygen from the blood, but also by using up the Oxygen stored up in the Muscle itself. The Muscle now takes advantage of the rest; it tries to make up for the loss and to lay in a fresh store of Oxygen. In rest the Waste-products of the Muscle are likewise being carried off; the Muscle was made acid by the exertion, but now it tends to become neutral once again. Soon we may feel fresh again—the Muscle is telling the Central Nerve System that it has recovered now.

### GROWTH OF THE MUSCLES.

When the Muscle is in action its blood-vessels are always dilated; a stronger stream of blood courses to the working Muscle. And, even during rest after work, the stronger blood-stream persists for some time. This more active Circulation gives the Muscle more nourishment and power, besides trying to carry off the Waste-products.

As more blood pours in, and with it more nourishment, the Muscles grow.

And thus we get a fundamental Law for every kind of Exercise. It is that (unlike many lifeless machines made by man, which wear out more or less quickly by use) the Organs of the living body can only have perfect life and full power by natural and regular activity; that their power is increased by vigorous use; that they become incapable and 'atrophied' by too long repose and inactivity. Labour keeps up the power and increases it; idleness devours it.

This Law holds good, not only for the Intentional or Voluntary Muscles, but also for all the Organs of the body. It goes far to decide success in any kind of Exercise, and it shows how every kind of Exercise is necessary.

We can take too much Exercise, or we can take wrong Exercise (e.g., when young we can do straining Exercises, or, when old, Exercises of Speed): but the words 'natural and regular' Exercise will cover this apparent exception to the Law.

As regards the Muscles in particular, they become noticeably weaker, thinner, and limper, even in the inaction of a few weeks. An Arm, made immovable by being put in a splint or cased in plaster of Paris, will in a few weeks be thin and powerless compared with its uninjured fellow. Nothing but proper Exercise and activity and massage, after it is well again, will restore to the Arm its former thickness and to the Muscles their former size.

And this is not all: it is not merely development and improvement of the Muscles, and improvement of the appearance, that come with 'natural and regular Exercise': such Exercise quickens the Changes that go on in the body, and thus increases Health in general.

As nearly half of the body is made of Muscles, these Changes are very considerable.

### ATHLETES' MUSCLES AND THEIR APPEARANCE.

Ancient Writers remark upon the feeble Health of their professional Athletes, and Modern Writers remark upon the Same thing. This is especially the case with some of the so-called 'Strong' men. Sandow is a noticeable exception. But then *he* studies Health as well as Strength.

Great masses of Muscle, especially about the Shoulders and Arms, have nothing to do with a real Training of the body. There can be no talk of harmonious proportions when the Neck is of bull-like thickness, the shoulders of excessive width, the upper Arms shapelessly huge. Nay, these masses of Muscle are wont to hinder free movement sadly: and Free Movement is one of the proper objects of Training, no less than power and strength. The heavy masses of flesh about the Shoulder-Joint must impede the free and quick movement of the Arm. Of Lutz, the Athlete, it is reported that he could not put his arms far enough behind him to button his braces at the back, and the masses of flesh prevented him from crossing his Legs when seated; he could only stoop when his knees were wide apart. It is self-evident that such an unwieldy body is far from the ideal of Gymnastic Training, and may render the 'Strong' man incapable of even easy feats of skill.

Abs, the Hamburg Athlete, was considered the 'strongest' man in Germany, and Lutz was also very strong. Maul's naked figure had quite a comic look, as if the trunk of a statue of Hercules had been set on the legs of a slim statue of Bacchus.

### SIGNS OF WELL-EXERCISED MUSCLES.

We have already seen that there are many different kinds of Exercises; the Muscles formed by these different kinds will not necessarily be the same.

Strength Exercises will increase the hardness and girth: for these exercises the utmost force may be exerted for a brief space, and this process can be repeated at intervals.

Such Exercises increase Strength and sometimes Endurance, but not necessarily Speed or Skill or Promptitude. They may even diminish Speed very considerably. It is as well for the players of Games to bear this in mind, for *Games*—at least those that are usually played in England and America—*depend far less on Strength than on any other quality*.

Moreover, Strength is apt to be lost very quickly—it is not a lasting quality.

Nevertheless Strength is a great thing, and, if only for the sake of the Training it should demand, and especially the Simple Diet and abstinence from Stimulants, it is well worth the trouble of getting.

But it is not without its dangers, as we have seen, and it is not the best form of Exercise.

We have already seen that in Exercises of Speed and Endurance each exertion of each muscle is by itself slight: it is only the sum of many small efforts that far exceeds, in force employed, what can be reached even by great feats of Strength.

The Exercises of Speed and Endurance do not always add to the girth of the Muscles; neither do Exercises in Skill always do so. They may rather be found to make the Muscle small and hard: they need not multiply its Fibres.

Hence to be able to perform great feats of Speed or Endurance does not necessarily prove an extraordinary growth of the Muscle.

We observe that many famous Mountaineers, good Runners, splendid Cyclists, show no great development of the Leg-muscles; their Legs are often slender and sinewy.

Such Exercises, moreover, tend to give the body a more uniform appearance, in contrast with the instance of Maul.

Now, though there is no doubt that a Gymnastic System of short Exercises in strength and skill, so as merely to produce strong Muscles, is one-sided, still it is possible to go too far in the opposite direction: it is possible to end by trying to develop each part of the body equally by a large number of extraordinarily varied Exercises on no particular plan.

Varied Exercises may produce general skill and versatility, and are well worth considering and trying; but for the harmonious development of the Muscles they do not do so much as one would expect. For training in Endurance is apt to fall into more or less complete neglect. In the same way many of the important Organs of the body, which in *you* may need special Exercise, would not be benefited so much by a countless variety of Exercises. You should of course try to develop your body in every direction, both the left hand and arm as well as the right. But with this should go your speciality or specialities, viz., those Exercises or Games that you like most or can do best of all. *Go in for a special Game, and let special Exercises prepare for it and also supplement it.*

It has been shown by various experiments that *a practised or trained Muscle gives off far less Carbonic Acid and Waste-products*, in any given exertion, than an unpractised Muscle would. In the latter, *Fat* and other substances are probably to be found. In exertion, these are the first to be used up, and thus yield large quantities of Carbonic Acid etc. *Moreover, the untrained Muscle contains more Water.*

Hence a person who seldom takes Exercise generally requires far more Breaths during severe exertion; he has a bad wind for Mountaineering, for instance, or for even a short Run. The regularly-exercised or trained Muscle, on the contrary, has used up its stock of Fat and other extra-substances. 'Changes' still go on in it, but they are of a different character; for, after its extra-substances have been used up, its true force serves merely to keep up the exertion. Above all things, it works much more economically. The Breath is less heavily taxed, for there is far less Carbonic Acid to be expelled: therefore Breathlessness and direct Fatigue do not set in so readily.

But here again, if the Simpler Foods be taken very carefully, even a week with no Exercise often finds one in practically the same Training as before, and this applies even to the Muscles.

And, as we have seen, proper Exercise effects more than this mere Training and Economy of Force: regular and strenuous Exercise improves the Muscles' power of contracting. It becomes more 'susceptible' to 'Stimulation', and a slighter effort of will is enough to set it to work and make it contract.

Again, the Motor-Nerves become less liable to Fatigue. *The better an (intentional) Movement is known, that is, the longer it has been performed, the more frequently has the will-*

*power passed along the same nerve-tracts, and the more familiar to it has the way become.*

If the movement is Rhythmic, and, to a smaller extent, if it is not Rhythmic, it tends to become quicker and more Automatic. Finally the will scarcely has to exert itself at all.

Thus the Muscle not only becomes stronger by Exercise, but, when practised, works with less 'Change' of matter and therefore more easily.

## THE MUSCLE AND ITS WORK.

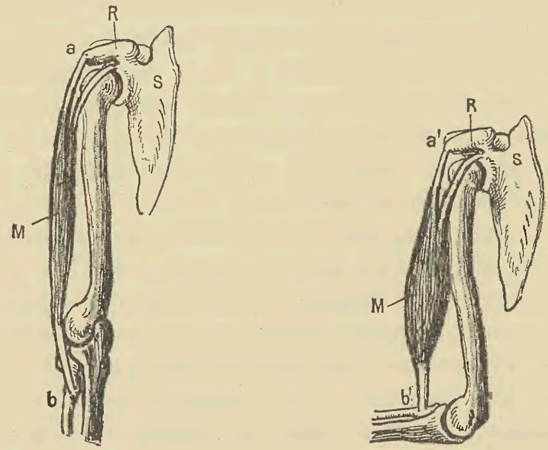



Fig. 122. The Biceps-Muscle when it is (I) relaxed, (II) contracted.

Figures 122—123 give some idea of how a Muscle works.

Muscles are splendid workers, for they not only put force to better use than machines made by man, but they also, instead of wearing out, become stronger and more hardened to exertion by practice.

One or two features are of interest here.

1. *A Muscle can lift most weight at the beginning of a contraction*, but steadily less and less as the contraction goes on.

The Muscle can therefore master the heaviest task if it is not already contracted at the moment when it should set to work. The action of the elastic Muscle is like that of a long elastic coiled spring. This also jumps back most strongly from its greatest tension.

2. So before violent movements the Muscle should first be stretched, as when a jumper bends backwards and downwards before his jump, or a spear-thrower before his throw.

The necessity of first stretching any Muscle which is to go through any great exertion, and of preparing for the effort by special movements, is important throughout all Exercises and Games.

3. The Golf-swing is well-known, but few realise the value of the Lawn-Tennis swing. The average player here, as in

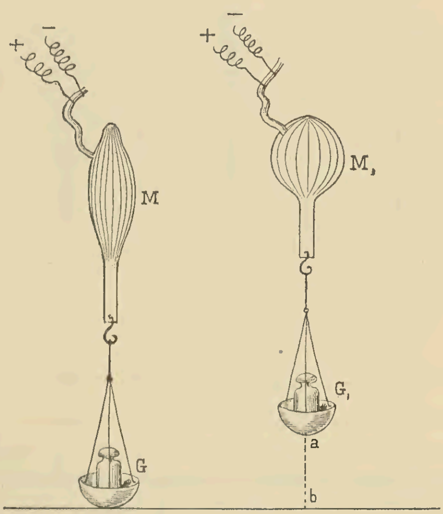


Fig. 123.

Rackets, is wont to keep the face of his Racket near the ground: hence his Stroke starts with a jerk. If he brought the head of the Racket up before the Stroke (or, better still, if he had brought it up directly after the previous stroke) he would have had a good swing. In these and other instances the weight of the arm etc. is another factor besides the spring of the Muscle.

As to the lifting-strength of Muscles, Quetelet calculated the average strength of the Loins: he found the heaviest weight that could be lifted from the ground with both hands, and worked out these figures. They show the growth and falling-off of muscular strength at different times of life.

| Years of age. | Men. kg. | Women. kg. | Difference. | Relative strength of the male and female sex, the latter being taken as 1. |
|---|---|---|---|---|
| 5 | 21 | .. | .. | |
| 6 | 24 | .. | .. | |
| 7 | 29 | .. | .. | |
| 8 | 35 | 25 | 10 | 1,4 |
| 9 | 41 | 28 | 13 | 1,4 |
| 10 | 45 | 31 | 14 | 1,4 |
| 11 | 48 | 35 | 13 | 1,4 |
| 12 | 52 | 39 | 13 | 1,4 |
| 13 | 63 | 43 | 20 | 1,5 |
| 14 | 71 | 47 | 24 | 1,5 |
| 15 | 80 | 51 | 29 | 1,6 |
| 16 | 95 | 57 | 29 | 1,6 |
| 17 | 110 | 63 | 47 | 1,7 |
| 18 | 118 | 67 | 51 | 1,8 |
| 19 | 125 | 71 | 54 | 1,8 |
| 21 | 138 | 76 | 62 | 1,8 |
| 23 | 147 | 80 | 67 | 1,9 |
| 25 | 153 | 82 | 70 | 1,9 |
| 27 | 154 | 83 | 71 | 1,9 |
| 30 | 154 | .. | .. | ... |
| 35 | 154 | 83 | 71 | 1,9 |
| 40 | 122 | .. | .. | ... |
| 50 | 101 | 59 | 42 | 1,71 |
| 60 | 93 | .. | .. | ... |

According to this, a man's strength most exceeds that of a woman during the most vigorous period, between 25 and 35.

Kotelman determined the following measurements of the strength of boys in pushing and pulling by means of Collin's Dynamometer.

| Age. | Pressure of both hands. kg. | Pull of both arms. kg. | Pressure of the thighs. kg. |
|---|---|---|---|
| 9 | 20.88 | 11.10 | 25.84 |
| 10 | 21.39 | 13.00 | 26.29 |
| 11 | 23.33 | 14.22 | 27.09 |
| 12 | 25.51 | 16.13 | 27.51 |
| 13 | 26.74 | 18.05 | 29.54 |
| 14 | 31.10 | 19.73 | 34.36 |

Dr. Kellogg, of Battle Creek, Michigan, one of the greatest living authorities on health, has constructed a special Dynamometer, for measuring the strength of any Muscle-Groups in the Arms, Trunk, Legs, etc. His statistics are likely to be wonderfully valuable.

But, as we have said already, the Education and Training of the Body is by no means finished when the Muscles of the Body have been merely strengthened.

For the Muscles themselves need increased power of endurance, rapidity in receiving and working out commands from the will, and so on, and not only increased vigour for single feats of strength.

To this must be added the effect, of Exercises, on the Nerves (e.g., for skill, readiness, etc.), on the Circulation and action of of the Heart, on Breathing, on Digestion, and on all the 'Changes' in the body.

The results obtained by such a 'Universal Dynamometer' should therefore be received with caution; they are evidence, but not enough, in themselves, to decide as to the greater or smaller value of the various systems of Physical Culture.

Statistics show that *Exercises of Endurance* (not of strength or speed) give the greatest sum-total of Exertion.

Climbing comes high on the list.

*Bicycling* can well stand comparison with Climbing. It has been called 'a seated Walking-upstairs'. In this Exercise we can put forth exertion such as could hardly be put forth in any other. According to Rankine's reckoning—with which that of Zuntz agrees—the force exerted in Bicycling on level ground would lift the weight of the body straight upwards through one-fortieth of the distance covered.

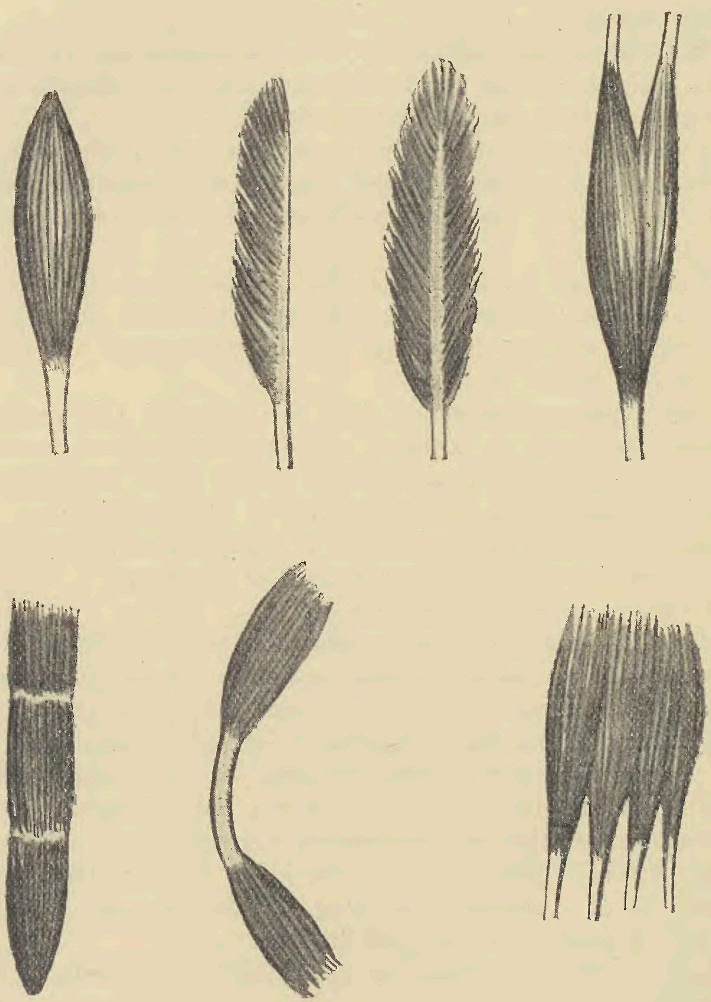
A Racing Cyclist can, in one hour, exert a force which would lift a dumb-bell, weighing 100 lbs., through a distance of over 2 yards, 900 times in an hour.

Large totals of exertion can be reached by Walking on level ground.

The sum-totals of exertion that can be reached in quick Running are smaller.

We may, therefore, take it as proved that no kind of continous effort gives so great a total of exerted force as Mountaineering, Cycling, and Walking.

It is the fleshy part ('belly') of the Muscles which really does the work. Figures 124—130 give the shapes of some Muscles. We ought to know what queer-looking beings our faithful servants are.

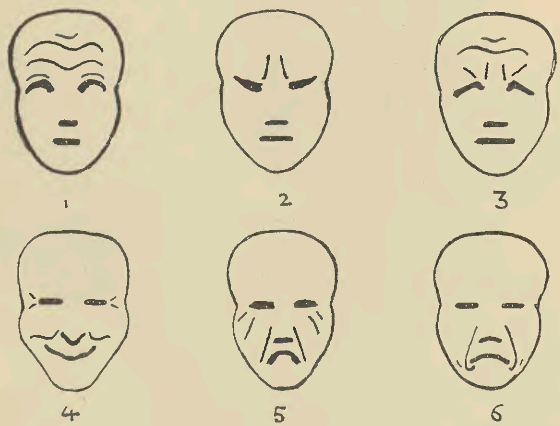


Figs. 124—130. Muscles of various shapes.

We hardly realise, perhaps, that, when we show astonishment, we show it by means of Muscles. Yet Figs. 131—136 actually give the chief Muscles.

As we can get our Leg-Muscles into training by practising them in certain ways, so we can get our Face-Muscles into training. These may produce lines and wrinkles, which may even become permanent, or practically so.

It is well known that Emotions etc. tend to move the Muscles, and that these movements, if repeated, may leave traces on the Face, and this ought to make us very careful indeed. And it is also well known that something like most of these movements, like the Society Smile, can be produced without, or in




Figs. 131—136. Face-Muscles to express Emotion, viz., (1) Astonishment, (2) Reflection, (3) Pain, (4) Laughter, (5) Weeping, (6) Contempt.

opposition to, the Emotion which naturally causes them. But it is not yet known to what extent the *true* movements can *help* to produce the Emotion themselves. A certain Mrs. Archer has worked out some Exercises which tend to produce certain Emotions etc., and the idea ought to yield most valuable fruits. Quite apart from the smoothing-out of Face-Wrinkles by stroking and rubbing [1] and pressing, it is quite possible that some Exercises for the features may help to produce Emotions. At least the checking of the Muscle (e.g. of contempt) may help to check the very feeling of contempt itself, and there is no reason why the Muscle of a *true* smile should not *help* to give a feeling of contentment.

[1] The Health-Culture Company, Fifth Avenue, New-York, sells a special Roller for massage and for the removal of wrinkles.

## MUSCLES CLASSIFIED BY THE WAYS IN WHICH THEY ACT.

All Muscles are divided into groups according to the ways in which they usually act. These movements and their opposites are usually expressed by technical terms. The following are quoted as a sample of some of the clearest medical technical terms.

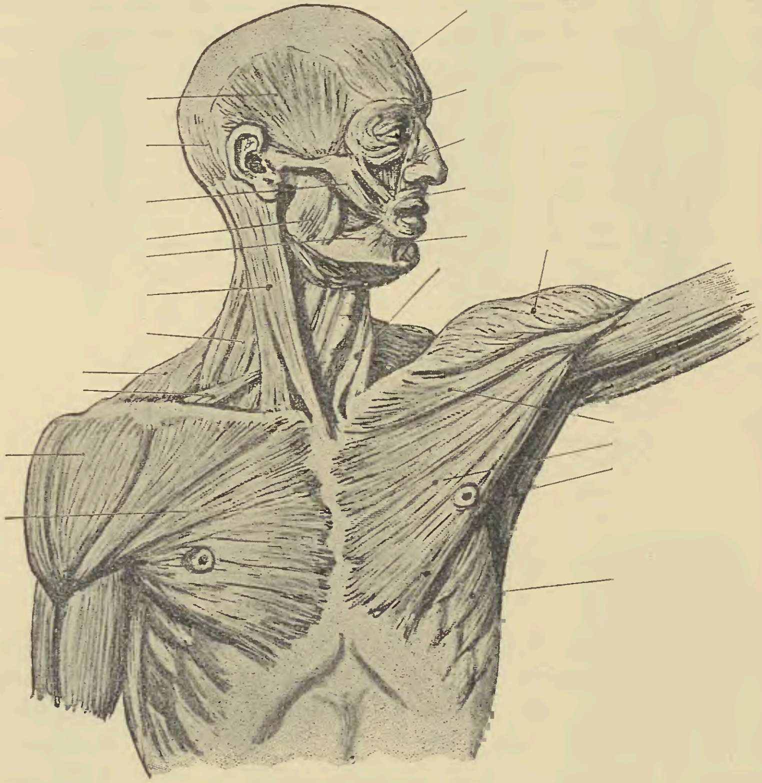


Fig. 137. Muscles of the Head, Neck, and Chest.

Flexion——Extension.
Adduction of the trunk——Abduction from the trunk.
Rotation inwards——Rotation outwards.
Elevation——Depression.
Closing——Dilatation.
Inspiration——Expiration.

The Muscles which serve for the same kind of action are called synergetic; those which oppose the action of other Muscles are called antagonistic.

To combine difficult movements of various kinds with Accuracy and Certainty and Speed, is one of the chief aims of Exercise and Training. We shall return to this subject at a later stage.

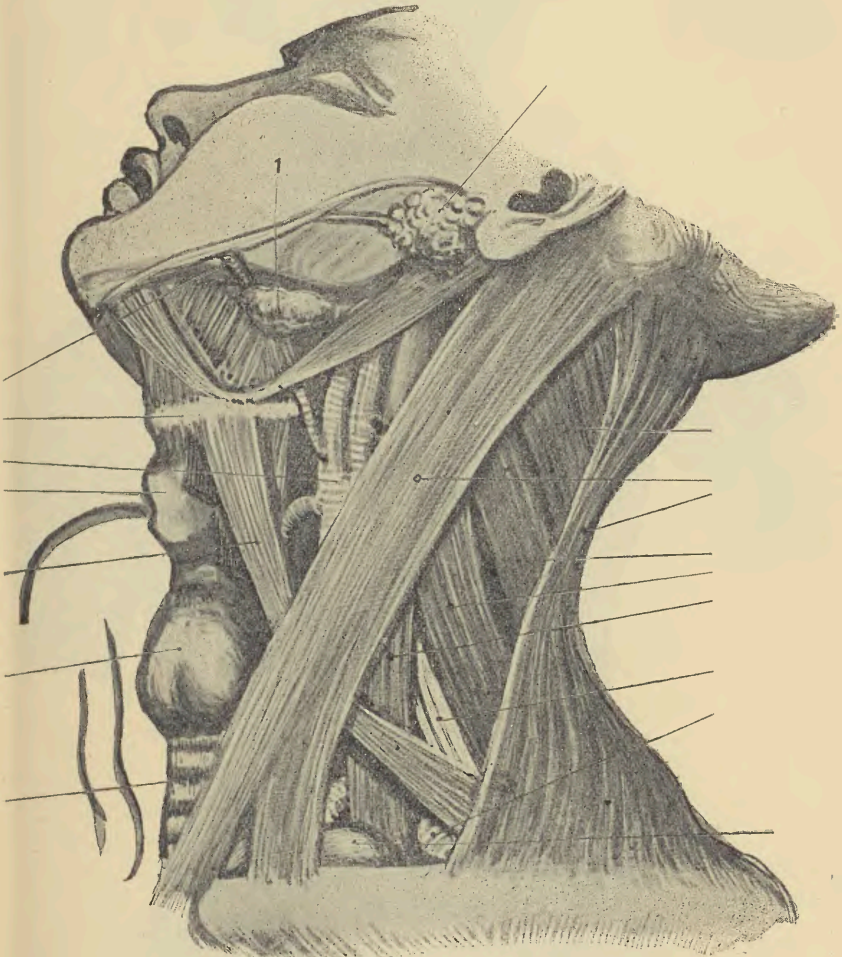



Fig. 138. The Organs within the Neck.

NOTES ON SPECIAL MUSCLES.

Here, as a general rule, it will be sufficient to refer the reader to the figures. If he studies them carefully, he may learn for himself how best to use various Muscles in his body.

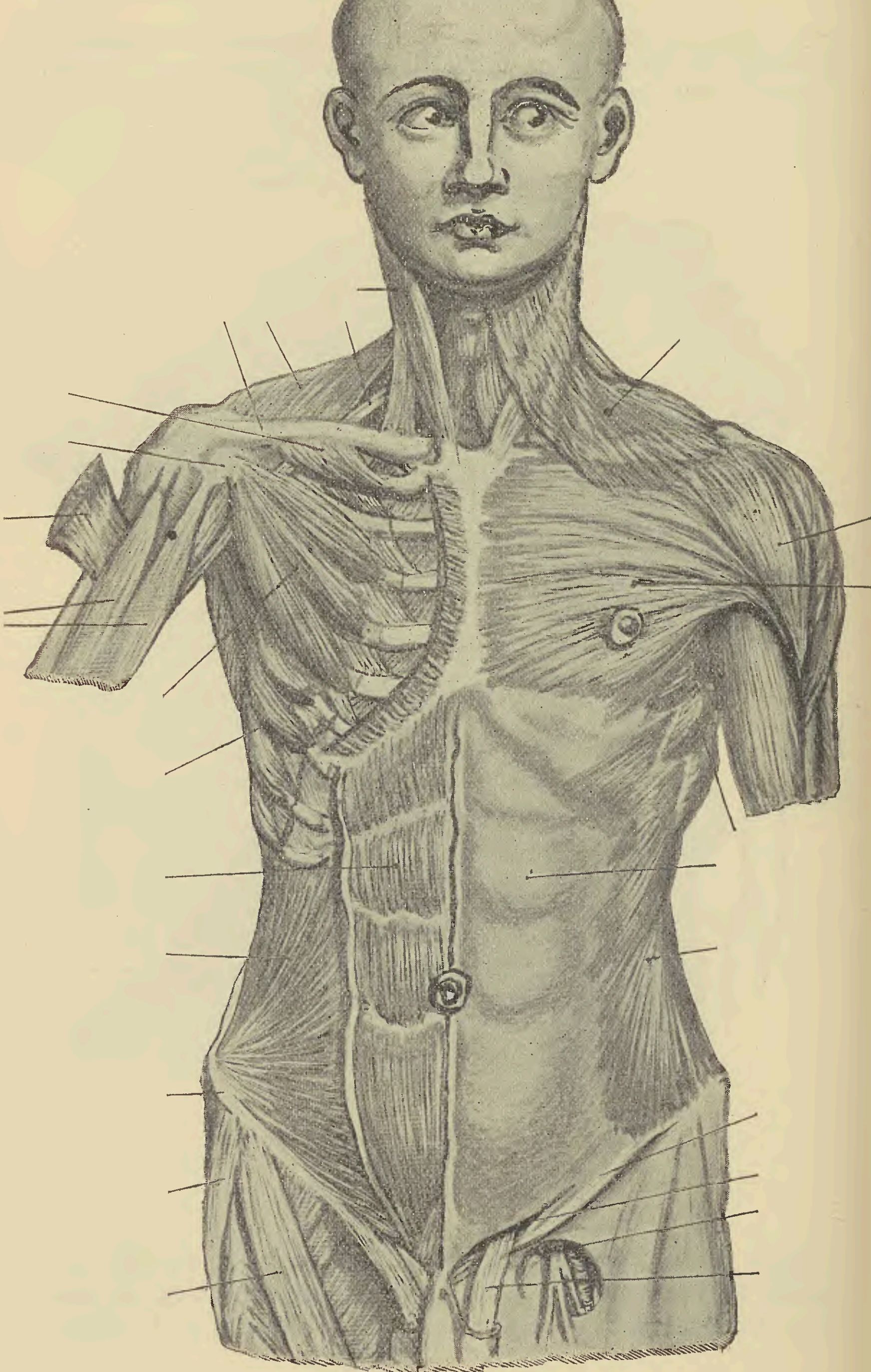


Fig. 139. Muscles of the Chest and Abdomen, after many Muscles have been removed from one half.

Fig. 137 shows the Muscles of the Head, and 138 the Organs within the Neck.

Neck Exercises form an important part of Training, and help to a graceful and dignified Carriage. They are also good

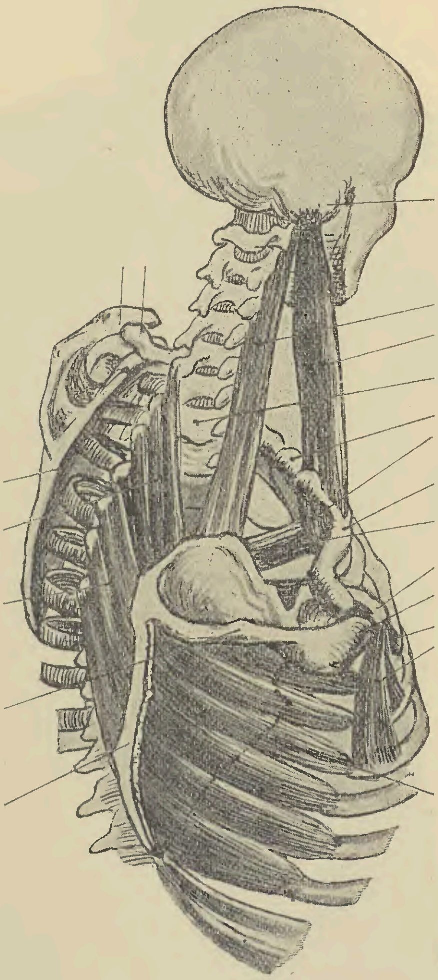


Fig. 140. The Neck and Shoulder-blade, after a large part of the latter has been removed.

for many games, in fact for most games. By means of a lithe Neck, the player can keep his eye on the ball while

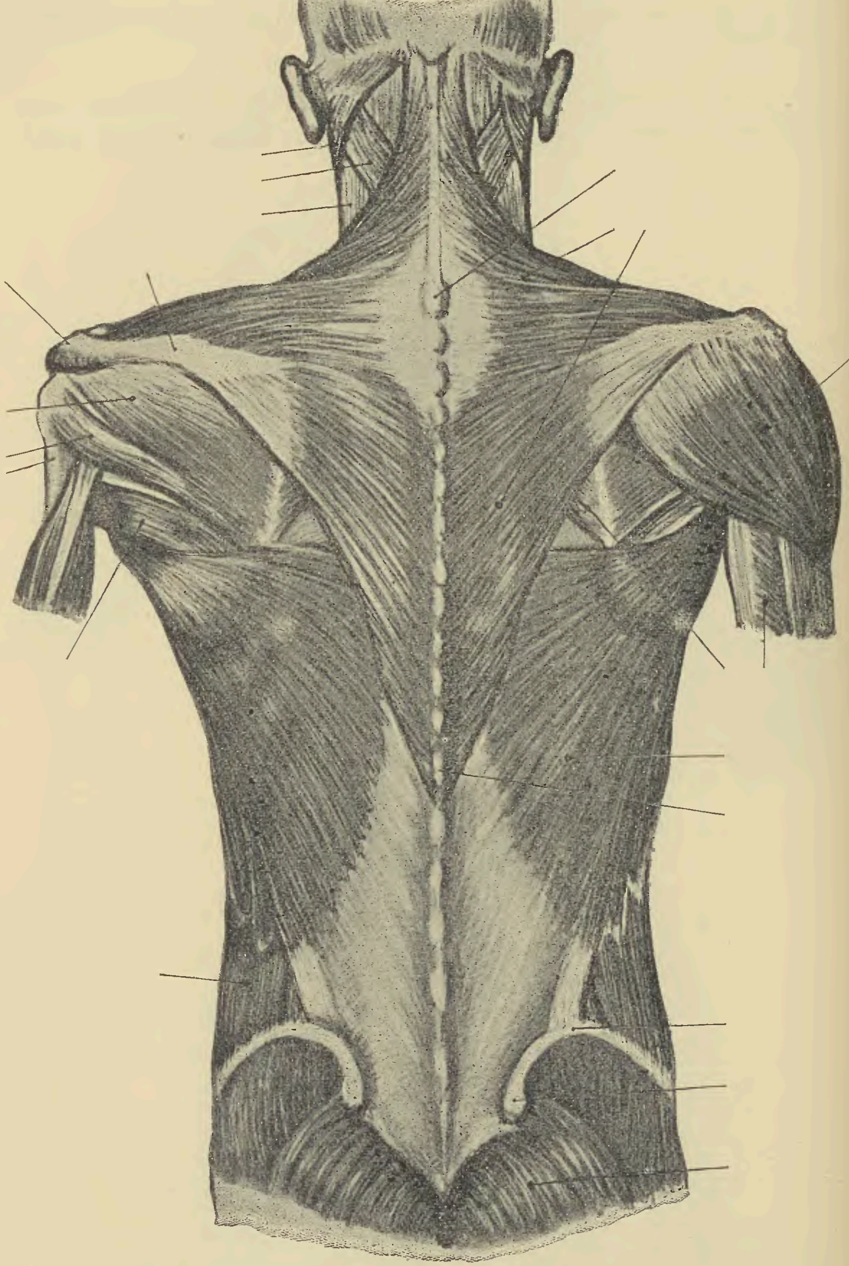


Fig. 141. Muscles of the Back: Surface-Muscles.

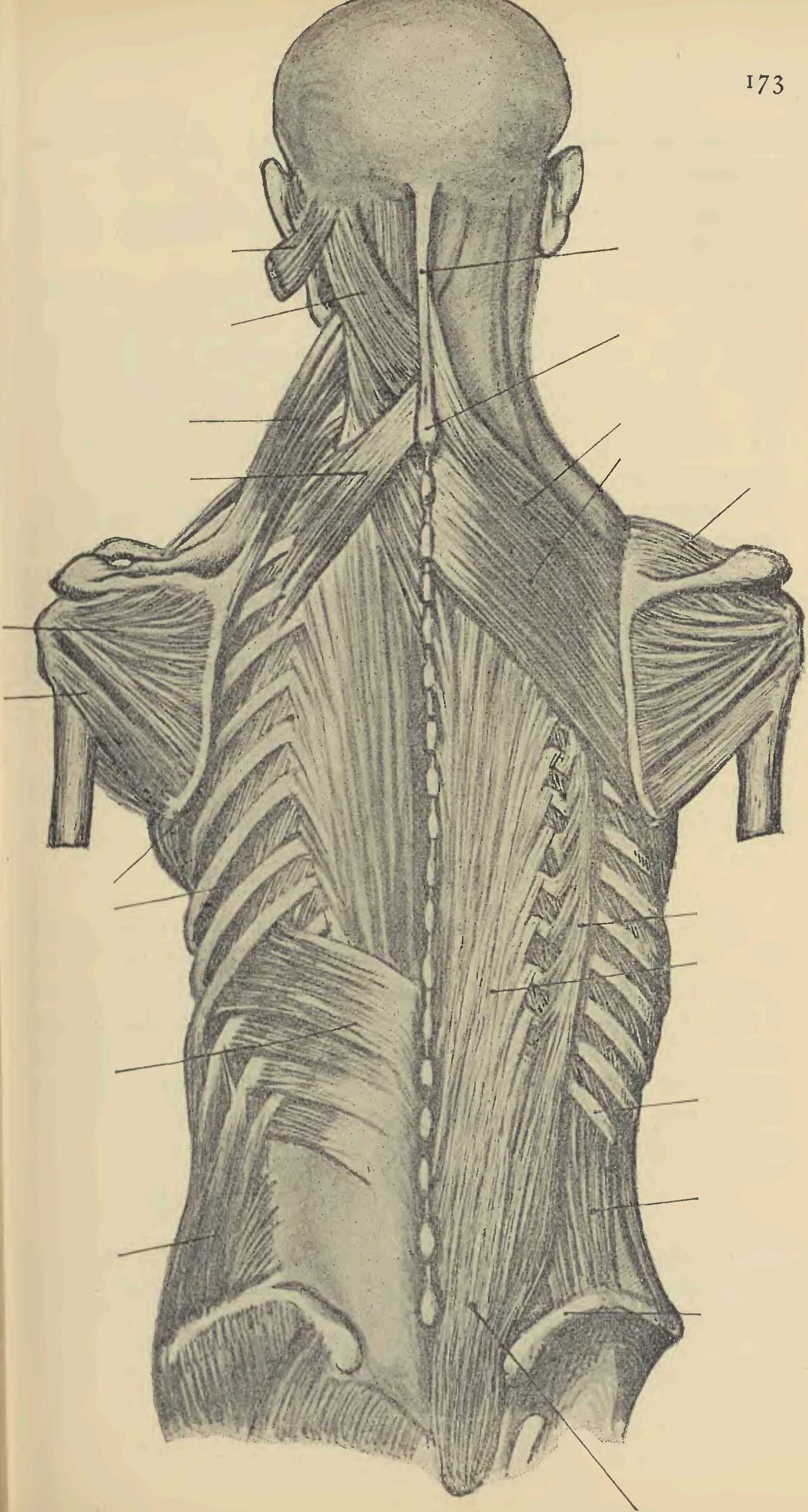


Fig. 142. Muscles of the Back: Deep-Lying Muscle.

moving his body freely about.[1] 'Dodging' at Football may depend a good deal on this.

In fig. 139 we have the Muscles of the Chest and Abdomen: for the Chest or Thorax, see below.

The Swedish Gymnastics exercise Chest-Muscles in various ways: e.g., the hands can be stretched out straight on both sides (right and left) and then drawn together with conscious effort. The arms can be made rigid, and the Chest can be moved. The Chest-Wall is raised by the pull of the Muscle, and the Chest-Cavity is enlarged. The great Pectoral muscle can also occasionally help the Breathing.

A person struggling for breath (after quick Rowing, for example, or after violent Running) instinctively grasps at some firm support with his hands (e.g., the rower at part of the boat): he holds his arms rigidly extended so as to give the Muscles which go from the Arm and Shoulder to the Chest, a firm base from which they may pull the Chest, and so help out the deep and laboured movements of the Lungs.

Fig. 140 gives some Muscles of the Chest and Shoulder-Blade.

141—142 give the Muscles of the Back; 141 gives the Surface-Muscles, and 142 the deeper lying Muscles.

### ABDOMINAL MUSCLES.

Figure 143 marks the Abdominal Breathing: it must be noticed that the Abdomen has more space in it than one might naturally suppose, though it varies much in fat and thin people. It arches outwards when we breathe in, because the Diaphragm comes down and presses the inside of the Abdomen out against its front-wall. When we breathe out, up goes the Diaphragm, and in goes the Abdomen, as you will feel if you put your hand there.

### 7. — MUSCLES OF THE ABDOMEN, AND EXERCISES.

The Muscles of the Abdomen help you to Breathe out, and, whenever your Breathing out is laboured they come into action as special muscles for this purpose.

[1] See *Lessons in Lawn-Tennis* by E. H. Miles.

But the Abdominal Muscles press hard against the Thorax, in the act of straining. *The full force of a muscle can be used only when the Muscle acts from an absolutely firm point and upon a movable point.* Now the Bones of the Shoulders, to which the Arms are attached, are connected with the Skeleton only by a movable joint, and it is from the Thorax that the chief Muscles come which hold the Shoulder-Blades fast (as well as the best Muscles of the upper Arm). *Hence, in every great exertion of the upper limbs, the Thorax must be fixed immovably. Only from a rigid Thorax can the full power of the Muscles of Arm and Shoulder be exerted.*

This is the case even when we strain or press hard with our Hand, which seems far away from the Shoulder-Blades. To

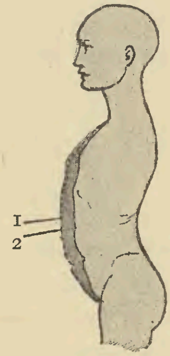



Fig. 143. Abdominal Breathing.
1 Breathing in, 2 Breathing out.

keep the hand firm, we must keep the Lower Arm firm, to keep that firm we must keep the Upper Arm firm also; to keep that firm we must keep the Shoulder-Blade firm; and so we come to the necessity for keeping the Thorax firm also, i.e. for the necessity for pressing with the Abdomen. The Muscles which hold the Shoulder-Blade fast can only do so forcibly when their origin is fixed, that is, when the Thorax is held rigid and does not Breathe.

Thus a movement in one part of the body, a small movement, but one which needs the utmost exertion of the Muscles immediately concerned—briefly, therefore, a movement of Strain—makes ever widening circles and draws more or less the whole Muscular system into a kind of Co-operation.

In straining or exerting pressure we must take a deep preliminary In-Breathing; the Thorax *must* be brought into the position in which it is full of breath: otherwise it will not be firm and rigid.

Now, of the Muscles which help you to Breathe out and so tend to narrow the Thorax, the Abdominal Muscles are the most powerful and effective; therefore they *must* be used in straining.

As to *Straining*, see below: here we may point out that the unskilled beginner, unable to calculate exactly how much force is needed, is especially inclined to go too far and to make use of every possible advantage so as to avoid failure. *The teacher should find fault with and forbid unnecessary and excessive holding of the breath in the easier Exercises*, which call for no great exertion of power. For Straining, if frequent and continuous, has a serious effect upon the Lungs and Circulation.

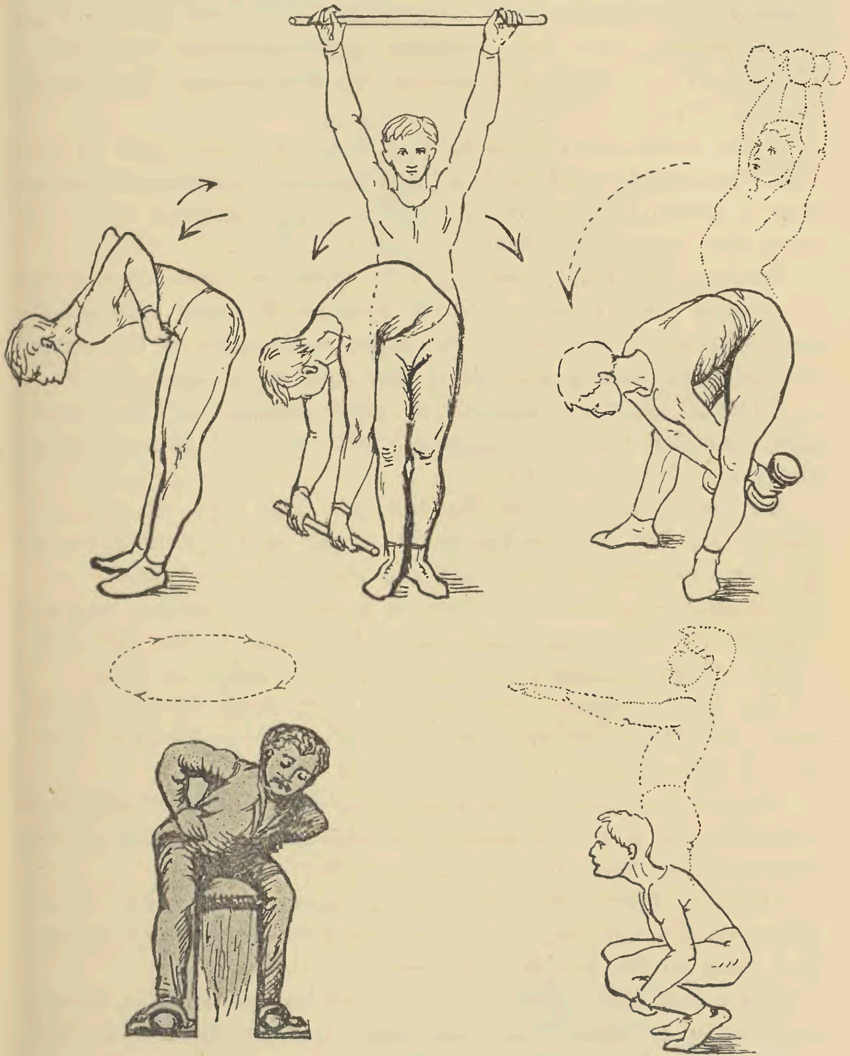
## EXERCISES FOR MUSCLES OF THE ABDOMEN.

These Muscles are most important for Breathing and therefore for Health. Pressure of the Abdomen will force onwards the contents of the Intestine, and so help to prevent Constipation. Massage of the Abdomen is even useful.

*Sluggish Digestion and Habitual Constipation are* among the commonest evils in life: in many cases these are connected with slackness of the wall of the Abdomen. Where this is so, they can be remedied by certain Exercises to strengthen the Abdominal Muscles. This will apply especially to people of sedentary habits. *When Sluggish Digestion can be remedied by Exercises of the Muscles of the Abdomen, this is better than any other method.* It can have no bad results on the Organs of the Abdomen, such as are often produced by purging pills etc., and, on the other hand, it gives regular Exercise, which is in itself a blessing. In what are called Digestive and Health Exercises, therefore, i.e. in Home-Gymnastics, the strengthening of the Abdomen Muscles plays a great part.

Various appliances can be used, e.g., the Horizontal Bar, which may be made to press on the Abdomen. And there is no doubt that Vaulting-Exercises on the Horse, and most of the Exercises on Parallel Bars, set these Muscles in brisk action and therefore strengthen them.

Among other forms of Exercise, rowing on Sliding seats



Figs. 144—148. Exercises for the Abdominal Muscles.

gives capital play to these Muscles. And most Exercises of Strength that involve a Strain are also useful, but they are not without their danger, especially for the young.

A number of *Exercises without apparatus* stand in the front rank.

First, forward and backward bending of the trunk. When the trunk is bent forward the hands may at the same time be clasped and pressed hard against the Abdomen (144). Forward bending may be combined with rotation to both sides; if is then an effective Exercise for the sloping Abdominal Muscles (145).

If the hands, with dumb-bells in them, are lifted high as you bend backwards, and as you bend forwards are brought down with a sweep between the Legs, which are set wide apart, we have the Exercise of Hewing (146).

Bending the trunk over to the right and then to the left is another good Exercise for the slanting Muscles; it should be made to right and left, with proper movements of the Arms.

The same applies to moving the trunk in a circle.

Another effective Exercise is deep bending of the knees, down to the squatting position (147), with the Arms clasping the lower part of the Leg.

Another is transplacing Dumb-bells. The Legs are set wide apart, the feet turn on the heels; a pair of Dumb-bells is put on the outer side of the right and left Foot alternately.

All these Exercises are done in a standing position, and are repeated in quick succession about 10 times at first, but afterwards oftener, as the pupil becomes more skilful in them.

The best teachers will insist on their being done very correctly and slowly and with conscious effort: the pace and the number of times should only be increased by degrees.

Moving the trunk in a circle can be done not only in a standing, but also in a sitting, position, the pupil sitting astride of a narrow bench or stool (148).

There is more than one special apparatus for this, but a Music-stool would do. The heels are kept close to one another and close to the foot of the stool.

Again, excellent Exercises for the Abdominal Muscles, though not easily practised by everybody, can be done with little dumb-bells, or (better still), with the implements invented by the Italian, Atrezzi (149). Of these, the bending of one Leg so that the knee approaches the Chest, and the bending of both legs to the lowest possible Squatting position, are of chief importance for our purpose.

Certain Leg-Exercises are good for sluggish Digestion, e.g., raising and lowering the knee in front or to the side, swinging the Legs, moving them in a circle, etc. But these are not so good as the trunk-Exercises.

Fig. 149.

Here also come movements of the trunk in a lying position. The simplest is the act of *rising to a sitting position*, at first with, and then without, the help of the hands, and then a slow and gradual return to the straight position (150). This can easily be done in bed.

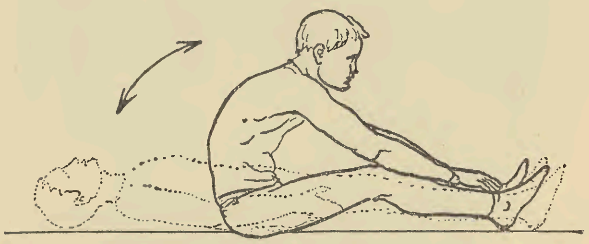


Fig. 150.

Fig. 151 suggests another.

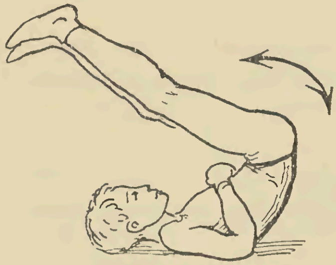


Fig. 151.

Or the body may be held fast by the Feet being thrust under a cross-pole: the pupil thus needs no second person. Or it can be done on the Parallel Bars in the exercise of 'hanging over to the side' (152).

Other methods of strengthening the Abdominal Muscles are Massage of Abdomen, Exercise with Swedish Obstacle-apparatus, and Zander's Mechanical Gymnastic Apparatus (see above).

As to Massage, the word 'UPRIGHT' should be remembered. Massage *up the right* side of your body, then across (above the Navel) and then *down the left* side. Then massage round the Navel itself in the same direction, and complete the circle.

But strains should be avoided for they may cause Hernia.

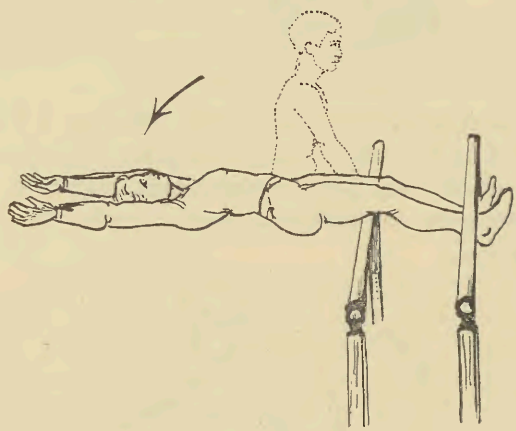


Fig. 152.

Among Germans engaged in hard manual labour, mechanics, porters, etc., the number who suffer from Hernia is far greater than among other classes.

*As further helps against Constipation etc.*, these should most certainly be noticed:

(a) *Diet:* the avoidance of Tea and many of the Flesh-Foods, together with the eating of certain Fruits (e.g., Prunes, Figs, Gooseberries, etc.), and of certain Green Vegetables, but not all.

(b) *Water:* alternate Warm and Cool Sitting-Baths (Hip-Baths), Cold Douche or Sponging down the Spine, etc.

THE DIAPHRAGM.

With the exception of the Heart, the Diaphragm is the most important Muscle in the body.

Figs. 154—155 show how the Breathing alters its position. As the Diaphragm comes down upon the Abdomen, it helps along the contents of the intestine, and makes the intestine-Glands active.

See also below, where it is shown that the Diaphragm and the Breathing keep the Viscera moving about.

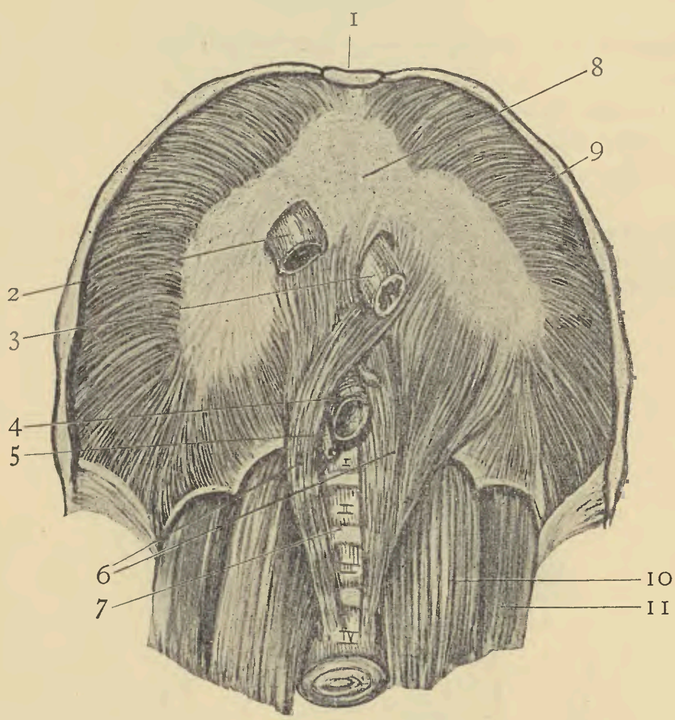



Fig. 153. The Diaphragm seen from below.
1. Ensiform Appendix of Sternum.
2. Square opening with the Lower Vena Cava.
3. Passage for the Gullet.
4. Passage for the Aorta.
5. Thora Channel.
6. Muscular Loin portion of Diaphragm.
7. Loin portion of the Spinal Column.

The Diaphragm is the strongest and most active Muscle of *ordinary* Breathing. As it contracts, the Chest-Cavity is expanded, and the Lung follows the movement (attracted by Air-Pressure), and has *its* lower part expanded.

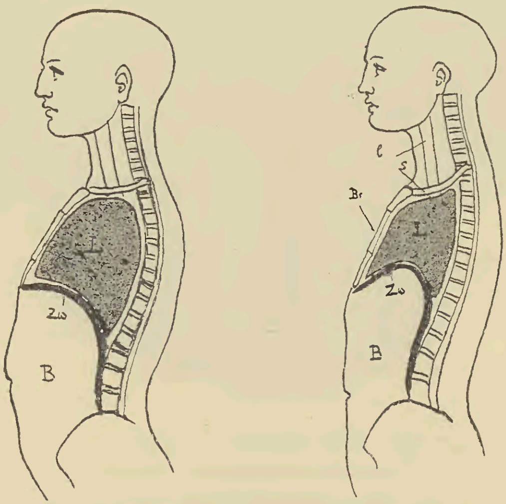
As a rule the Diaphragm works Automatically, and as we require it to act (e.g., when we run fast, it of itself moves faster). But when it is not powerful enough to do all the Breathing then extra Muscles of Breathing come into play.

### 8.—MUSCLES OF BREATHING. GENERAL FORCES USED IN BREATHING.

Amongst the various forces of ordinary Breathing, we must reckon

(a) Some Muscles,
(b) The weight, e.g., of the Chest, and
(c) The elasticity of the Ribs etc.

When the Breathing is easy, the In-Breathing alone needs Muscular power, for the Breathing-out follows passively, without the action of Striped Muscles.




Figs. 154—155. The Diaphragm while one is (I) breathing-in, (II) breathing-out. (L. Lung-space, B. Abdominal Cavity, Zw. Diaphragm.)

### 9.—OTHER MUSCLES. ARM- AND SHOULDER-MUSCLES.

Figures 156—159 explain themselves.

It will be seen that the bending of the Hand and the bending of the Fingers limit each other. The Hand can only be fully bent towards the Palm if the Fingers are stretched (as when we slap downwards from the Wrist with the flat Hand). The

*Fist* can be most strongly clenched when the Hand is bent towards its back.

It is important to remember this in many Ball-Games. For

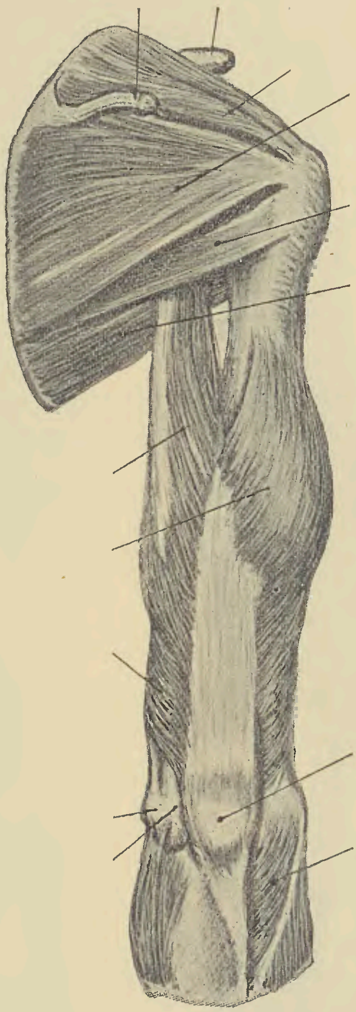


Fig. 156. Upper Arm and Shoulder-blade, back-view. (Some parts have been removed.)

example, in Lawn Tennis and in most strokes at Cricket, it is important to grip the handle tight. This can best be done by the bending of the Hand backwards. When, on the contrary,

Fig. 157. Muscles of the Arm.

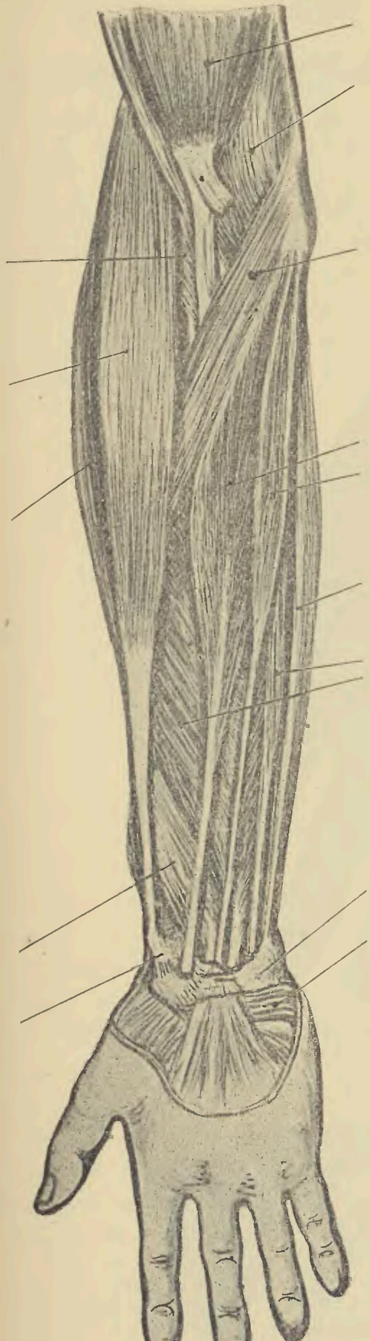


Fig. 158. Muscles of the Lower Arm (inner side).

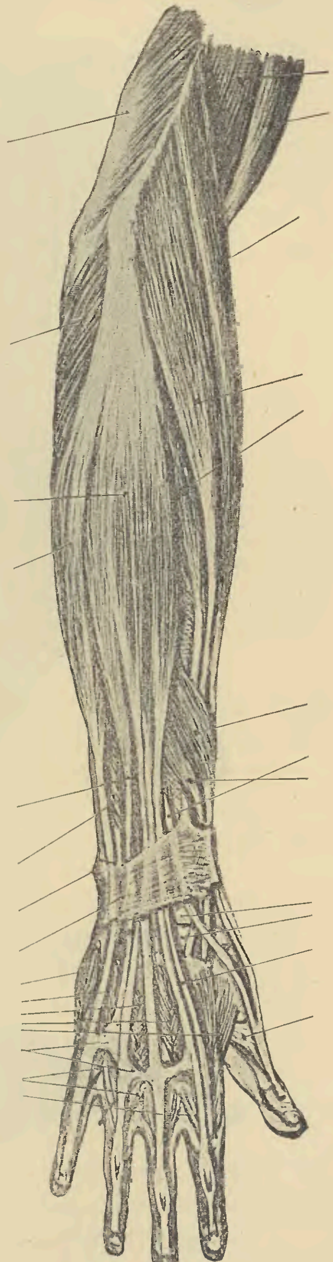


Fig. 159. Muscles of the Lower Arm (outer side).

In fig. 160 we have the Palm of the Hand, in 161 the Tendons of a Finger.

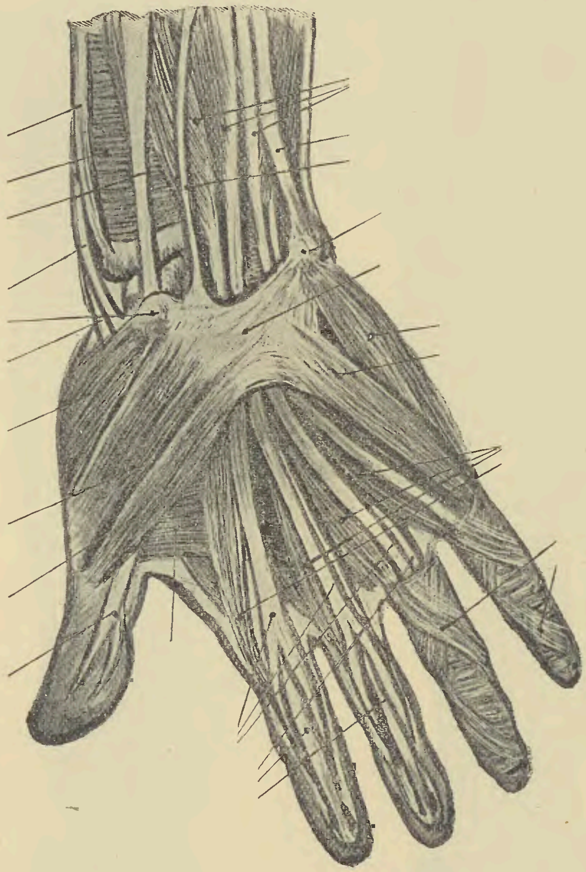


Fig. 160. Muscles and Tendons of the Palm (the Ligaments of the first and middle fingers have been removed).

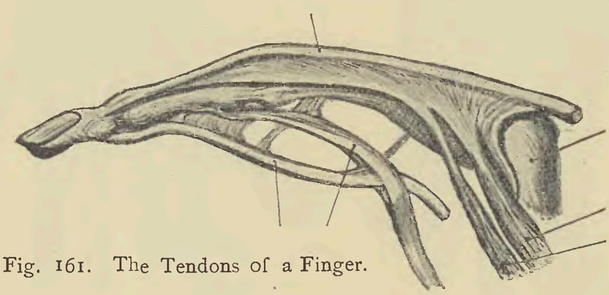


Fig. 161. The Tendons of a Finger.

you want a delicate light stroke, you can do the reverse: you can bend the hand forwards.

A Pianist plays *piano* with his Hand slanting downwards, but plays *forte* with it bent upwards from the Wrist.

When, on the other hand, a stretching movement is to be powerfully made (e.g., a parrying movement of the Hand) the Hand is made ready by being bent towards the palm, which is the position of the Hand of the Borghese Gladiator); this is because, in the position of stretching towards the back, the stretching Muscles of the Fingers are useless.

## PELVIS-, THIGH- AND LEG-MUSCLES.

Observe the powerful Thigh-Muscles in figures 162 and 163.

The form of the Muscles of Pelvis and Leg in Man is due to his erect carriage. It is not merely the Movements which need such powerful Muscles as those of the Thigh and Hips: they are needed to balance and carry the Pelvis, and with it the trunk, on the heads of the Thigh Bones. In Man alone, more especially, do we find the strong development of the buttocks ('les fesses n'appartiennent qu'à l'espèce humaine,' says *Buffon*). The great Muscles of the Pelvis and Thigh almost completely hide the strong Bones of this region.

The Hip-Joint can bend and stretch through a right angle and a half (135 degrees). This range of movement is completely available *only when the Knee is flexed.*

Hence the importance of Bent Knees in certain positions in Games, e.g., in volleying in Lawn Tennis, where a rapid Hip-Movement may be very useful.

The muscles which rotate the Thigh outwards are stronger than those which rotate it inwards. Hence *the Leg, when at rest, has its front surface not turned directly towards the front, but turned slightly outwards. So the natural way of Walking is with the feet turned slightly out.* To walk with the feet parallel and pointing straight forwards is not a natural, but an acquired step. However, see the note as to the effect of Boots and Shoes.

The cushion of fat in the region of the seat makes it the most suitable, because the least dangerous, part for the application of corporal punishment.

In the seated position, to obviate pressure, a thick cushion

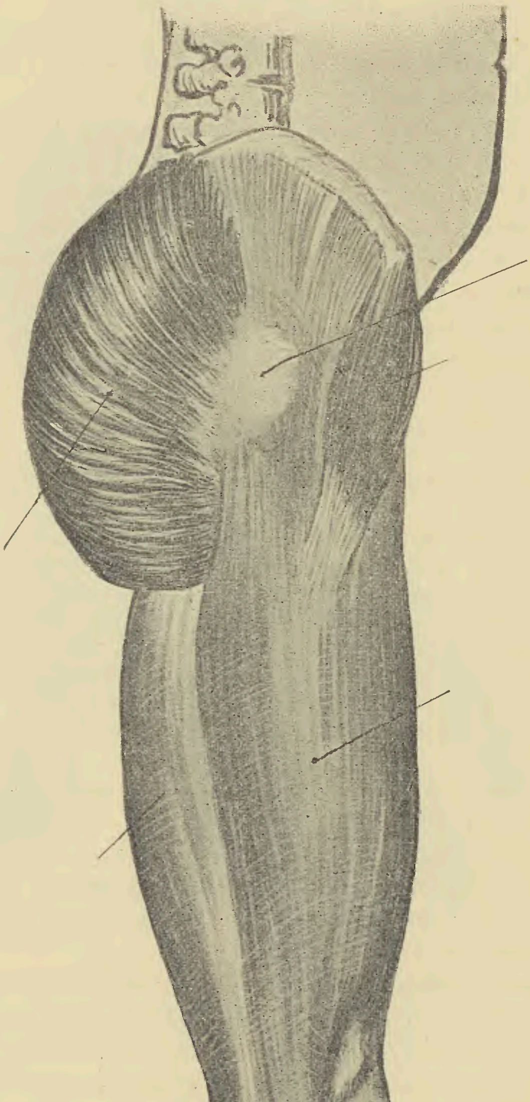


Fig. 162. The Thigh (from the outer side).

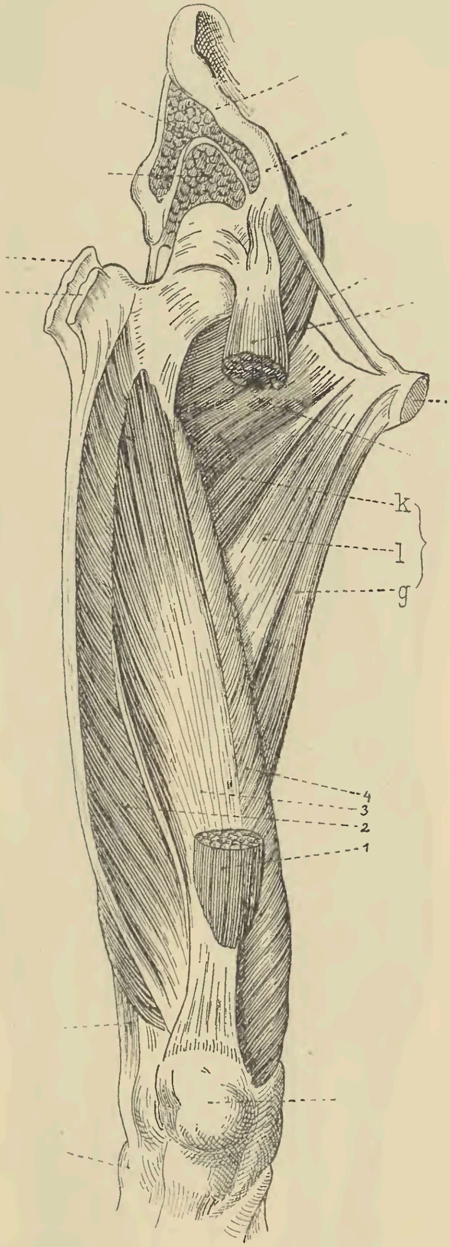



Fig. 163. Thigh Muscles (after one has been removed).

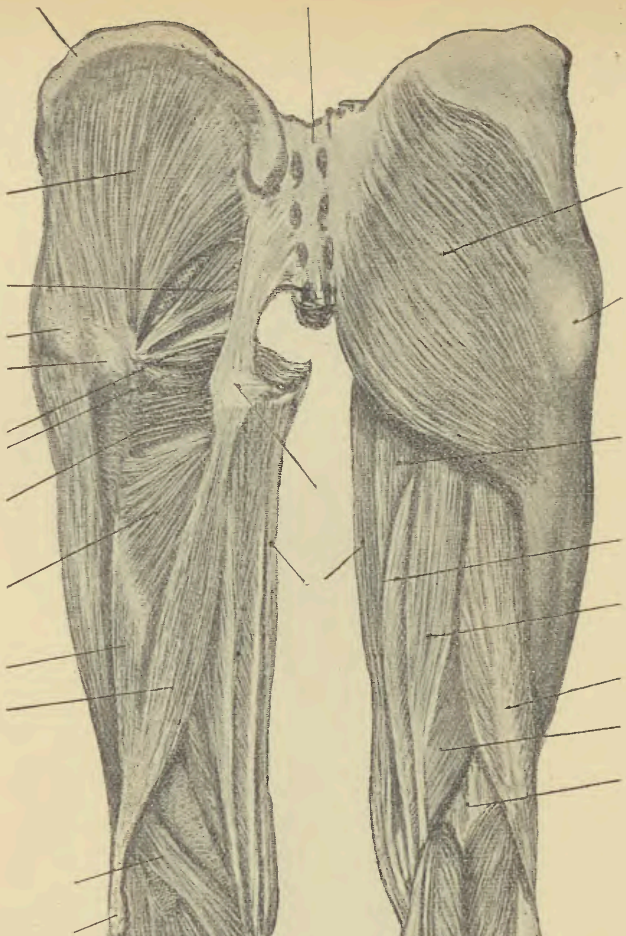


Fig. 164. Leg Muscles after some of those on one side have been removed.

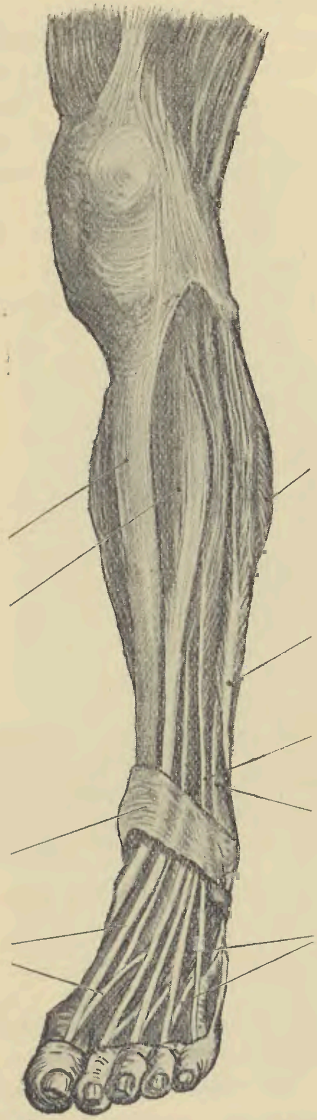


Fig. 165. Lower Leg Muscles.

of Fat is laid over the Bones. Hyrtl's saying is well-known: 'We sit on the Fat of the seat as on a mattress, and grasp with our hands as with thick gloves'.

In sitting on a smooth and hard surface the body rests upon three points. *In sitting on a soft cushion the pressure is imparted to the Muscles and hinders the Circulation in the whole region.* People who sit much and sit continuously at work, therefore, should never sit on soft cushions, but on hard chairs or benches.

There is nothing to be said against a certain amount of covering, if only it is not too yielding.

Figures 164 and 165 represent the Muscles of the Leg.

FOOT-MUSCLES.

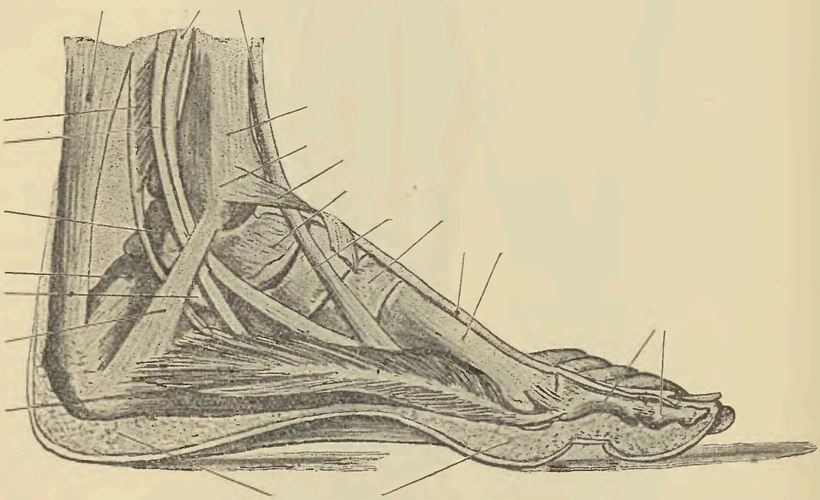


Fig. 166. Muscles of the Foot (inner side).

Above we had the Bones of the Foot; here we have its Muscles, while fig. 167 gives those which are on the sole.

When the leg is stretched out straight, the bands or Ligaments of the Knee are tense, and the Lower Leg cannot rotate any further. If these Ligaments are slackened by the bending of the Knee (at a right angle), the Lower Leg can then rotate with a scope of half a right angle. This movement can be felt by the Hand.

This, again, has a direct bearing on many games.

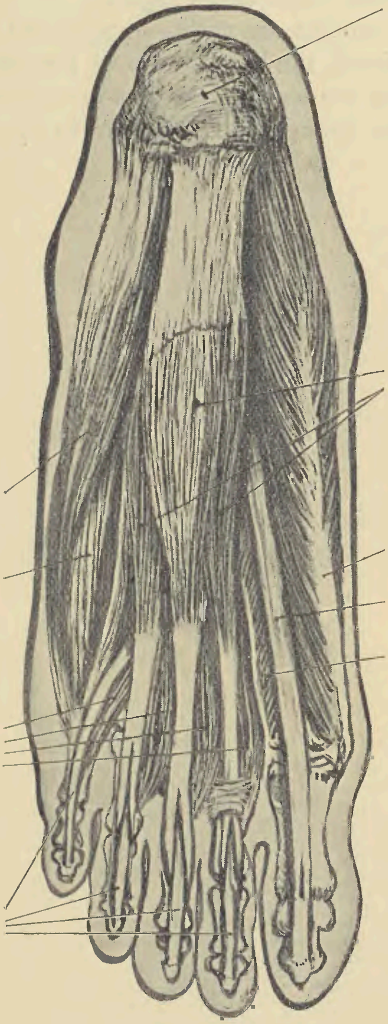


Fig. 167. Muscles of the Sole.

The movements of the Leg, as compared with those of the Arm, are narrower and simpler. In the Arm we have the peculiar Shoulder-blade, the rotation of the Radius round the Ulna, the independent movement of the Thumb, and the wonderful mobility of the Hand and Fingers.

The Leg movements are not so complicated: the Bones round the Pelvis are fixed, the movements of turning and rotating are trifling, the Toes are shorter and less movable than the Fingers, and the Big Toe cannot be 'opposed' to the rest of the Toes.

# PART IV.

## I.

## THE HEART AND THE CIRCULATION OF THE BLOOD, THE RIGHT AND LEFT SIDES, EXERCISES, ETC.

## THE CIRCULATION OF THE BLOOD.

In England some of our great rivers help to fertilise our country, to carry useful materials from place to place, and also to carry away sewage etc. down to the sea: the water in these rivers may be compared with the blood in the 'rivers' of our body.

The blood is a fluid which is always circulating throughout our body.

(1) It supplies all our parts with whatever they need for their life and growth. Life and growth cannot go on without certain materials, nor can these materials be used without Oxygen.

(2) Besides supplying fresh materials, and Oxygen by means of which these Materials can be used, the blood tries to carry off from all our parts those materials which are or have become useless, whether they are poisonous in themselves or the results of decomposition. The blood tries to carry off these materials to the organs whose duty it is to get rid of them, viz., the Carbonic Acid gas to the Lungs, and the Waste products etc. to the Kidneys, Skin, and Bowels.

(3) This fluid is borne along in a wonderful system of tubing, that forms a network throughout the body: the tubes are of different thicknesses, the tiny little capillaries, as they are called, being only visible when magnified. Within these tubes the blood is constantly moving: it is being pumped along.

(4) The pumping-engine is the *Heart,* which begins to work even in the unborn child, and goes on till we die. It receives blood from some tubes and forces it again into and through other tubes.

(5) The tubes into which the heart forces the blood are called *Arteries:* they carry the blood to all the organs of the body. In these Arteries we can everywhere feel a throbbing pulsation, a rhythmic movement. These Arteries lead and branch into smaller tubes, and these again into still smaller tubes, of which the last and thinnest are called Capillaries, because they are like tiny hairs.

These Capillaries presently join again to form larger tubes, which again join into still larger tubes.

(6) These larger tubes are called the *Veins*, and they carry back the blood to the heart: during the course of travel the blood has streamed through many organs of the body. It is

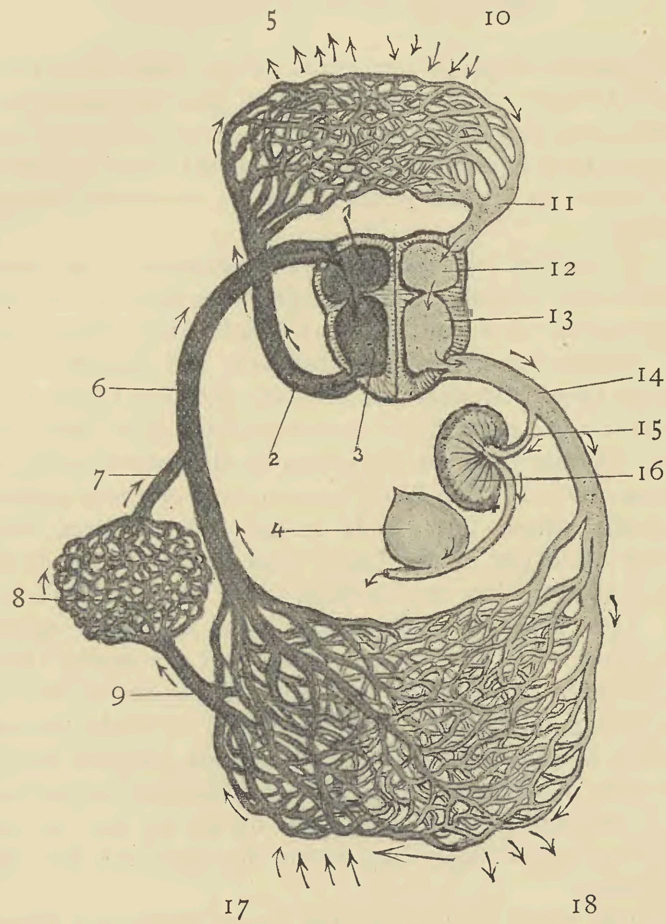



Fig. 168. The Circulation: Artery-Blood is light; Vein-blood is dark.

1. Right Auricle; 2. Lung Artery (Pulmonary); 3. Right Ventricle; 4. Bladder; 5. Carbonic Acid given out; 6. Vein (Vena Cava); 7. Liver Vein; 8. Liver-Capillaries; 9. Vein (Portal); 10. Oxygen absorbed; 11. Lung Vein (Pulmonary); 12. Left Auricle; 13. Left Ventricle; 14. Aorta; 15. Renal Artery; 16. A Kidney; 17. Carbonic Acid absorbed; 18. Oxygen given out.

important to realise this, because many people imagine, for example, that when they rub Alcohol into their skin, it does not enter into the circulation at all. As a matter of fact, some of it gets into the Capillaries, and thence to the organs and to the heart.

This journey of the blood from the heart to arteries, from arteries to capillaries, from capillaries to veins, and from veins to the heart, is called the Larger Circulation-System.

If you wish to bear in mind the order, apply the Loisette-System of Memory, * thus:

*Heart-Arteries*—after his cap—*Capillaries*-Pillories-pain-*Veins*.

(7) The smaller System carries the blood from the heart to the *Lungs*, where the blood gets rid of its Carbonic Acid gas, and absorbs Oxygen; then it carries the freshened blood back again to the heart.

It remains for the Lungs to get rid of the Carbonic Acid gas and to absorb more Oxygen.

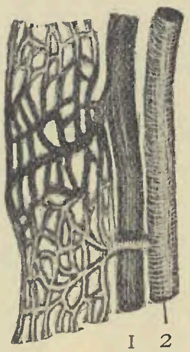



Fig. 169. Branch of an Artery-Trunk (1) which breaks up into Capillaries. These collect in the small vein (2).

## THE HEART.

The Heart is a hollow muscle, with striped muscle-fibres (see below): these are generally a sign that the Muscles are controlled by the will, but here the stripes are somewhat different. By means of its muscle the Heart can press the blood into the tubes somewhat as you can squeeze air out of an india-rubber ball with a hole in it.

Diagram 172 shows the shape of the Heart. Notice how it is divided into a smaller part (above) and a lower part (below).

* See 'How to Remember.' (Warne & Co.)

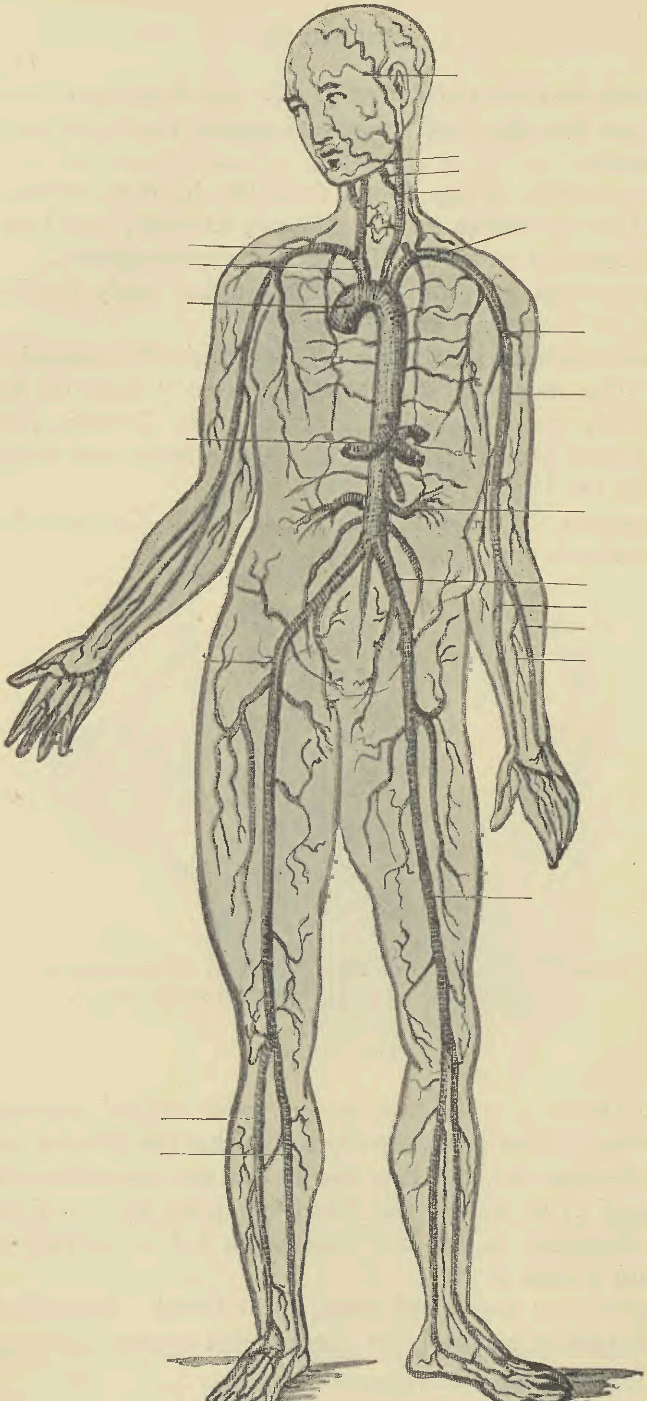


Fig. 170. The main Arteries of the body.

As a rule the size of the Heart corresponds roughly to that of the closed fist. Its size, however, in relation to the height of the body and the width of the great Arteries, varies greatly at different times of life. We shall refer later to these different measurements, for they are of exceptionally great importance as regards the effects, and therefore the judicious choice, of Games and Exercises at different ages. The Hearts of women are smaller and lighter.

The Heart is in the cavity of the chest or thorax, between the Right Lung and the Left Lung, but *slightly* to the left. The edges of the lungs on both sides overlap the Heart in

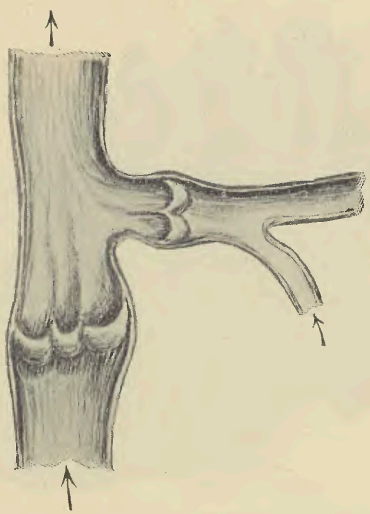


Fig. 171. The arrows mark the course of the Blood-stream in the Large Vein and the Smaller Vein which opens into it from the side.

front: they overlap more or less according to whether we are breathing in or breathing out. This is of great interest, because the Lungs and their Breathing affect the Heart and its Pumping very considerably.

Round the Heart is a sheath of membranes, called the Pericardium.

There is some fat underneath these membranes, especially in the furrows and at the apex of the Heart. In stout people who do not exert themselves much physically, this is apt to increase in quantity and to interfere with the action of the

Heart. This is called Fatty Degeneration. It is not cured by Brandy!

Each side of the Heart is divided into an upper and a lower portion, the upper being called the 'Auricle', the lower the 'Ventricle',* but the two sides of the Heart are not equal.

The muscles of the Left Ventricle are three times as strong as those of the Right. The reason for this difference is that the left side of the Heart has to force the blood into the Larger Circulation-System, and the right into the Smaller. To fill the Larger System requires by far the greater exertion of force.

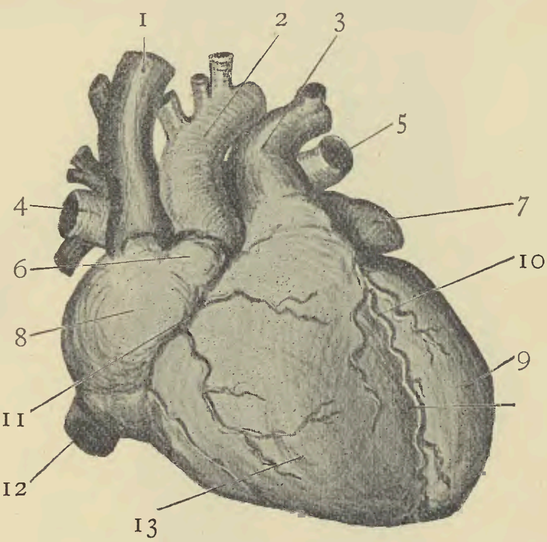



Fig. 172. The Heart (front view with severed ends of the large blood-vessels).

1. Upper Vena Cava; 2. Aorta; 3. Lung-Artery (Pulmonary); 4. Right Lung-Vein; 5. Left Lung-Vein; 8. Right Auricle; 9. Left Auricle; 12. Lower Vena Cava; 13. Right Ventricle.

The Valves are interesting: they allow the blood to flow the right way, for the blood then opens them as if they were Lock-gates. But, when the blood tries to pass the other way, the more it presses against the gates the closer they fasten, if everything is well.

If the Valves are not exactly closed, however, at the right

* As the blood flows from Artery to Vein, and as the Auricle comes above the Ventricle, the letters A. V. (cf. Authorised Version) will be a convenient way of remembering the order.

moments, then the Circulation will not be right; the edges of the Valves, for example, may be altered, so that some blood will flow back. Up to a certain point the heart can counterbalance the defect by a thickening of its Muscle, and by consequent increase in the power of exertion—in many cases this can go on for years. No sooner, however, is any extraordinary demand made upon the action of the heart (e.g., by violent physical exertion), than this compensating action comes to nought, and the disturbance of the circulation makes itself doubly evident. For this reason, only very easy Exercises should be attempted in cases where a weakness of the Valves

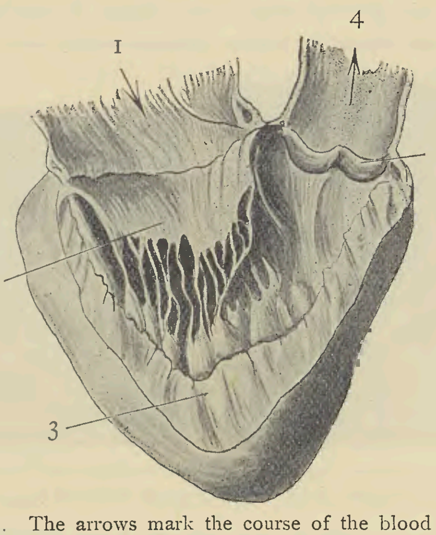
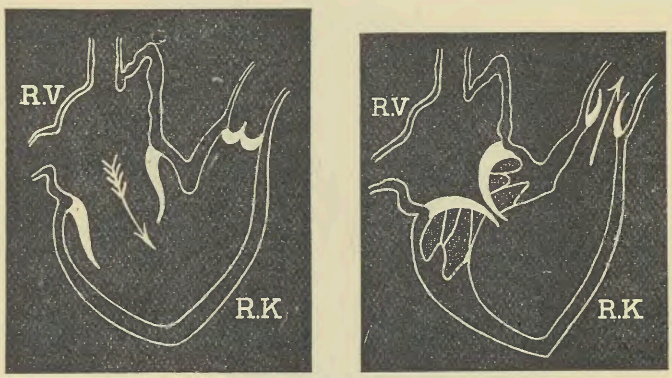



Fig. 173. The arrows mark the course of the blood in the Left Auricle, Left Ventricle, and Aorta (1, 3, 4).

exists: all more violent and severe Exercises are apt to be harmful. Schoolboys with this kind of weak Heart should be excluded both from ordinary Gymnastic lessons and from Games. In such cases, Bicycling, Rowing, and Swimming, are particularly injurious. The extent to which moderate and careful regulated mountaineering may be beneficial will be briefly discussed below.

## THE ARTERIES.

The Arteries, as we have seen, bear the blood from the Heart to the various organs. Their distinguishing signs are their throbbing Pulsation, and their bright red blood. The Lung-Artery alone, which starts from the Right Ventricle, contains, not bright red, but dark, blood. The Arteries are tubes with firm, yellowish-white, and very elastic, walls. Sooner or later, after the most vigorous period of life, the walls of the Arteries begin to lose their elasticity; Chalk-salts are deposited in them. The Brain-Arteries are particularly apt to become brittle for this reason, and occasionally they burst, thus producing Apoplexy; this is generally in consequence of something which greatly increases the supply and the pressure of the blood in the Brain. Hard Arteries are a sign of bad health in the young: but it is not yet proved that they cannot become soft. It probable means that there is some serious mistake, e.g., in the Diet.




Figs. 174 and 175. The Right Auricle and Ventricle, with the Valve open (174) and closed (175).

Notice where these Arteries begin, for it will be important to remember this when we consider why most people use the Right side more than the Left, and how far this is right.

Between the smaller Arteries—and the Arteries are smaller the further they get from the Heart—there are cross-connexions, which help to prevent irregularities in the blood-supply, e.g., when a small Artery is tied up.

THE ARTERIES, AND THE USES OF THE RIGHT AND LEFT SIDES.

The Heart lies more towards the Left Side of the Chest or Thoracic cavity; the Liver lies on the right, and the Spleen on the left; and the Arch of the Diaphragm is higher on the left side, etc. Nevertheless, all these inequalities within the body have no very obvious effect on its exterior form.

If, however, we regard the latter more narrowly, we see that here the symmetry is not absolutely even: *in most people the Right Side has the advantage.* According to E. Weber, the Muscles of the right arm are, on an average, 6 per cent. heavier than those of the left, those of the right leg are 7 per cent. heavier (that is to say stronger) than those of the left leg. The bones of the right arm are also the stronger. In adults the right arm is somewhat longer than the left.

A much more striking difference, however, is found in the fact that usually the right arm is not only a little stronger, but also *much more skilful and serviceable* than the left. This inequality has not come about simply as a result of habit, education, or practice, that is to say, by the more general use of the right hand and arm in all departments of life; rather, *it depends upon definite* differences in the structure of the human body. Even in the new-born child, a stronger development of the right arm is perceptible.

By no means everybody, however, is right-handed, certain people prefer to use the left hand wherever it is possible, in spite of the training and practice which prescribe the use of the right hand in many occupations (eating, writing, drawing, carving, etc.), and in spite of the circumstance that many instruments (the augur, screw, scissors, musket, etc.,) are especially adapted for the right hand. In such exceptional cases the left hand is from the beginning the stronger and more skilful.

Finally, there are persons who are equally skilful in the use of right and left.

The French Savant, Malgaigne, found that out of 182 people 5 were left-handed, that is, from $2\frac{1}{2}$ to 3 per cent.; and 2 were equally skilful with their right and left hands. The preferential use of the right hand is found among all civilised races into remote antiquity. In the most ancient pictorial representations, the chief weapons (sword and spear) are wielded in the right hand. In common parlance, also, 'left-handed' stands for clumsy, while the phrase to do anything 'right' or 'rightly' (in Latin *dexter* means right, and *dexteritas* skill) shows the preference given to the right side. In the case of the right arm, at least, the stronger development bears some relation to the conditions of *the blood-supply*. Consequently the blood circulates under higher pressure from the heart, and the mounting blood-stream which goes to the right arm exceeds in force that which goes to the left. This explains why, in the large majority of cases, the right arm exceeds the left in power and capacity.

In two individuals out of every hundred, the divergence from the common type consists in the fact that the right Subclavian, as it is called, commences behind the left, and consequently further from the heart than the latter. In such cases, therefore, it is the left Subclavian which takes its rise nearer to the heart, and is subject to the higher pressure; it is the left arm which receives the greater supply of blood. Not only does the number of these cases correspond to the proportion of right-handed to left-handed persons, but also, as a matter of fact, in many instances exactly this peculiarity in the position of the blood-vessels has been found in the bodies of those who during life were decidedly left-handed. Hence both the greater strength and the greater skill of the right hand and arm, and the rare occurrence of superior capacity in the left hand, may be referred with great probability to conditions of structure pre-existing in the body.

The extent to which the stronger development of the right leg is due to similar causes cannot be here discussed.

*Are we to regard this inequality of the two halves of the body as a defect or as an advantage?* In our opinion, as the latter; and for the following reasons. The perfecting of any manner of life depends upon the principle of *Division of Labour* and Specialisation. Now, the limbs of vertebrate Animals are chiefly used for motion. Those Animals in which this is especially the case, e.g., the four-footed Animals, are the least capable of self-defence. The jaws, and (in many of them) the head, armed with horns or antlers, are their weapons, and these are very unmanageable. It is otherwise with those which can use the paw to strike, seize, and tear. *In Man alone* is the Division of Labour such that the foot specially serves the purposes of motion, while the hand, the incomparable 'tool of tools', if guided by intelligence, helps to elevate man to the practical lordship of creation. True, the ape is to outward appearance provided with four hands (for the hind-hands of the ape are structurally feet), but even the skilful fore-hands of the ape, with their long narrow structure, short thumbs, and thin, withered, and wrinkled balls, are a mere caricature of the noble hand of Man: they are organs primarily adapted for seizing and climbing, and are mainly used for motion. The hand of Man (see illustrations) may upon occasion subserve these purposes, as in climbing, swinging, crawling, swimming, etc., but these actions are insignificant in comparison with its varied uses in every department of life.

In most forms of technical work, the mode in which the hands are employed is that *one of them, and that generally the right one, performs the most delicate work,* while the other plays the subordinate part of fetching, carrying, and holding. While the right hand is writing or drawing, the left holds the page or book; while the right hand is sewing, the left holds and stretches the seam; while the right is painting, the left holds the palette, etc. At the piano, the accompaniment falls to the share of the left hand; on the violin, it touches the strings while the right carries the bow. Briefly, in most cases the left hand has to *second* the action of the right, and is the right hand's servant. It is this Division of Labour between the right and left (*in no animal is there this distinction in the use of the fore-limbs*) which has enhanced in such an extraordinary degree the capabilities and the skill of the human hand. *The eye has accustomed and adapted itself* to this preference for the right hand: for the right hand our instruments are adapted and designed.

What a waste of time and trouble it would be, and how far we should lag behind in progress and in manual dexterity, if —though it might be for the sake of harmonious development— we had to learn to do everything *equally* well with the right or left hand: if we had to learn to write with the right hand to the right and with the left hand to the left, as in 'through the looking-glass' writing; or to draw, sew, carve, etc., with both hands.

With regard to writing, the eye would then have laboriously to learn to read to the left the writing of the left hand. This is extremely difficult: whenever we meet with such left-handed writing—and the great Leonardo da Vinci wrote his voluminous manuscripts with the left hand in this fashion—we hold it, as everybody knows, in front of a looking-glass, so as to decipher the words and letters by thus turning them into right-handed writing.

In conclusion, then, so far as practical life is concerned, the Division of Labour between right hand and left has been a valuable means of enhancing human dexterity, and must therefore be regarded as a great advantage.

In our Games and Exercises many feats of skill are performed—except in the case of left-handed people—with the right hand only. In order to bowl or throw a ball, or to play with a racket, we use the right hand, as we do for the sword and foil; with the right we send an arrow from a bow; the trigger of a gun is pressed with the right forefinger, and we take aim with the right eye, etc.

Even if in Gymnastics (in the narrower sense of the term) we make it a principle to perform every exercise in reverse, that is, both to right and left, there is no object in carrying this principle into such gymnastic feats as are to serve useful ends in life, and so cannot be performed without giving the preference to the right hand. On the contrary, wherever (in consequence of the natural tendency already existing) the performance of any exercise is carried out with one side of the body, by preference and most successfully the practice of the one side gives the greatest proficiency. Unquestioning obedience to the principle of exercising both sides would make us stop short of the highest degree of proficiency.

Thus in the various forms of bowling and throwing, in fencing, in jumping (either with or without a pole), and similar exercises, the demand for an *equal* development of both sides is purposeless and a hindrance to the attainment of the highest proficiency.

On the contrary, in the exercises of which the object is not the attainment of any particular result, but the strengthening of certain muscle-groups, or the prompt co-ordination of numerous muscles and nerves, the even development of right and left is rightly required. And it may be well that each should endeavour to reach *a certain stage of proficiency* with the left-hand at various Games and Exercises, if only for a change, and for a good Handicap in Games, and for ensuring a certain extra amount of exercise, I should be disposed to recommend a partial development of the left hand and the left side. See 'Lessons in Lawn Tennis'.

The Veins are more numerous than the Arteries, they have thinner and more elastic walls, they have no throbbing pulsation,—and except for the Lung-Vein—they have not the purified bright red blood with much Oxygen, but the dark red blood with less Oxygen and more Carbonic Acid etc.

Close underneath the skin there is a richly developed network of veins. They are visible under the skin, in the form of bluish stripes, or even of thick blue cords. They become particularly swollen in severe physical exertion, especially when the exertion includes pressure or straining, because then the right side of the Heart is prevented from discharging its contents, so that the blood is dammed up in the Veins. Then the distended vessels stand out under the skin of the arms, neck, and head, as, for example, in the slow and laborious lifting of a heavy dumb-bell.

The Surface Veins are connected with those in the deeper parts by numerous intermediate branches.

The blood in the Veins flows sluggishly towards the Heart, so that its movement is liable to disturbance, but in the Veins also there are Valves (cf. supra).

## THE CIRCULATION OF THE BLOOD, IN MORE DETAIL.

(111) 1. *The Larger Circulation-System.*

The bright red blood, comes from the Lungs rich in Oxygen; then it passes from the left auricle into the left ventricle and, by its contraction, is forced into the Aorta, which in turn conveys the blood to the other Arteries of the body. The great Arterial trunks divide into smaller and smaller Arteries, and the latter finally, as we have seen, break up into the Capillaries, which are so thickly dispersed throughout the body that there is no part which the prick of a fine needle can penetrate to any depth without meeting and injuring Capillaries: the blood issues, or at least can be squeezed out, from the prick. It is in the Capillaries that the blood gives off Oxygen and nourishing substances to the tissues of the body, and takes up Carbonic Acid and other Waste-products so as to get rid of then.

It is by reason of this loss of Oxygen and this absorbing of Carbonic Acid that the Blood changes colour in the Capillaries; it becomes a dark red, something of the colour of the coarse sealing-wax used for packing. The Capillaries next collect into small Veins, the Root-Veins, and these into larger Veins, which, uniting to form large trunks, finally lead to the heart by the two Venæ Cavæ: the Lower Vena Cava collects the blood of the Veins below the Diaphragm, and the upper Vena Cava that of the Veins above it. The Venæ Cavæ empty themselves into the Right Ventricle. The Larger Circulation-System is therefore completed.

2. *The Smaller Circulation-System.*

The dark blood of the Veins makes its way from the Right Auricle to the Right Ventricle, which forces it into the Lung-Artery; this, therefore, unlike the Arteries of the body, carries not bright, but dark, blood. The Lung-Artery branches tree-like into the Lungs, and breaks up into Capillaries. Here the blood is purified, Oxygen being absorbed from the freshly-inhaled air in the Lungs, and Carbonic Acid gas being given off, to be got rid of by expiration. Hence the blood in the Lungs has a brilliant red colour. These Capillaries, containing the purified blood (charged with Oxygen), collect into small Lung-Veins and these into larger trunks, which open into the Left Auricle. The Smaller Circulation is therefore completed. and the Larger Circulation starts again from the left side of the Heart.

Thus the left side of the Heart controls the Greater Circulation, and the right side the Smaller.

It is only by forcing (with each contraction) an equal amount of blood at the same moment from the Right Ventricle into the Lung-Artery, and from the Left Ventricle into the Aorta, and afterwards by the equal filling of either Auricle with blood, after each contraction, that the heart can keep up an even and uninterrupted circulation of the blood through both the Larger and the Smaller Circulation-System.

3. *The ancients* knew of the movement of the blood, but not of its circulation. About 300 B.C. Herophilus and Erasistratus gave out the erroneous doctrine that the Arteries were filled with air—hence the name of Arteries, i.e. Air-vessels, which survives to our own day. This view was refuted by the physician Galen (131—201 A.D.), who was famous also in the history of Physical Culture, for a work on Ball-play.

It was William Harvey who first clearly showed the nature of the Blood-Circulation.

## ACTION OF THE HEART.

The Heart is perpetually contracting and expanding, alternately. In the contracting, which begins with the Auricles, the blood is driven from the Auricles, into the Ventricles, and then from the Ventricles into the Arteries. A pause ensues, during which the empty heart fills again. Thus the Heart acts as both a sucking-pump and as a forcing-pump.

The action of the Heart is under the influence of Nerves, as indeed all muscular actions are. These Nerves originate in Nerve-cells, but act quite automatically and involuntarily and therefore, as we show elsewhere, with the least possible expenditure of force: they are wonderfully able to adapt themselves to all sorts of changed conditions.

## EFFECTS OF BREATHING ON THE MOVEMENTS OF THE HEART.

Since the Heart is surrounded by Lung-tissue, the act of breathing, with its alternating inspiration and expiration, and the varying pressure upon the Heart, must have a certain influence on the action of the Heart, since the Chest or Thoracic Cavity is closed in by its wall. Without entering into a detailed description, we may say that Inspiration helps to fill the Auricles, and actually sucks in the blood-stream from the Veins to the Heart, while Expiration helps the emptying of the Heart into the Arteries. This point is of the greatest importance.

*In straining—e.g., in lifting* a heavy weight—we keep our Chest or Thorax rigid, so as to give the Muscles of the Shoulder and Upper Arm a firm basis: the Chest is kept rigid by the Expiration-Muscles being contracted, until the weight has been lifted. During these moments, the Ventricles (Lower parts) are emptying themselves into the Arteries, but the Veins near the Heart are being pressed hard and are unable to empty themselves into the Auricles (Upper parts), and so become distended. This is why the Veins are wont to stand out, and the face to get red; on the other hand, the Artery which should supply the Heart is almost empty. The Heart needs extra Oxygen so as to resist the pressure of the Lungs, but cannot get it.

When the exertion ceases, the compressed air, overcharged with Carbonic Acid gas, escapes from the Lungs through the mouth, and there is relief. The Vein-blood pours into the right side of the Heart, distending it a good deal for the moment.

Both the emptying of the Artery which supplies the Heart with Oxygen, and the (later) rushing of the pent-up Vein-blood into the right side (the weaker side) of the Heart, are apt to be injurious.

## THE PULSE.

As the Ventricle (Lower parts) of the Heart contracts it drives waves of blood through the Arteries; at first these waves flow fast, but gradually they die away in the Capillaries. They can be felt as pulsations in the wrist.

The Pulse is interesting as giving us a clue to the Heart's action at the time (see below).

(1) The frequency of the Pulse varies according to age, and in the female sex it is (on the whole) somewhat greater.

These Figures represent an average.

| Age. | | Number of beats per minute. |
|---|---|---|
| At birth | | 130—140 |
| 1 year old | | 120—130 |
| 3 years old | | 100 |
| 5 years old | | 90—94 |
| 10 | | 90 |
| 10—15 | | 78 |
| 15—50 | in the male | 71—72 |
| | in the female | 80 |
| 70 | | 79 |
| 80—90 | | over 90 |

2. The height of the body also has an influence on the number of beats. In persons of the same age, but of a different height, we note that a higher rate goes with the smaller height. In adults the difference amounts to some 3 to 5 beats per minute.

3. Further, the Pulse is more rapid by some beats while one is standing than while one is sitting (i.e., by about 9 beats), and (by about 3) while one is sitting than while one is lying down.

Among other circumstances which effect the Pulse are:

4. Disease. Fever especially, i.e., the raising of the temperature of the body above a certain degree, quickens the Pulse.

The Pulse is also quickened by

5. Muscular movement, which increases the rate of it according to the amount of exertion made by the muscles in a given time, and also according to the training of the muscles. Hence the Exercises which have most effect in greatly and instantaneously quickening the Pulse are those of *speed* and *strength.*

*Examples.* In rapid running (as in a race), covering let us say about 220 yards in 25 seconds, you may quicken the Pulse from 75 per minute at the start to 180 to 200 or more at the goal.

In the same way the Pulse rises to 150 to 200 and more owing to quick cycling and cycle-racing. If the pace is kept up for a long time the pulse nevertheless slackens, a sign of fatigue of the Heart. For the greatly quickened action of your Heart, as shown by your higher Pulse-rate during violent exercise, is based on processes which go on inside your body.

6. *Training* (cp. 5), with its regular amount of daily exercise, its strict regimen, its abstinence from luxuries, brings down the Pulse (in repose) to below the normal rate. According to observations made by Kolb, the Pulse-rate of men in training for Boat-races (naturally we have here to do with pow-

erful men of 20 to 25) was, on an average, 63 in the morning, and up till noon it remained under 70.

7. Finally, the Pulse is quickened by strong excitement, either intellectual or of some other kind.

Irregularities, i.e., the loss of Rhythm, may appear for a time after violent exercise, for instance, after quick running, rowing, bicycling, etc.; or during and after a severe exertion of strength, as in wrestling and lifting heavy weights. In these cases they are phenomena of Heart-fatigue, and pass away quickly, in proportion to the shortness of the effort which has caused them; while in the great feats of endurance the normal condition takes longer to restore.

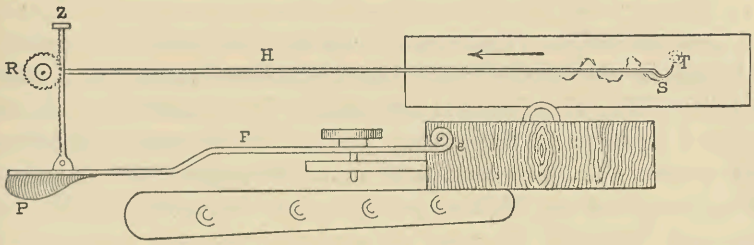



Fig. 176.

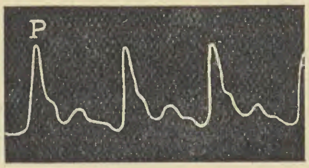



Fig. 177.
Marey's Pulse-Register or Sphygmograph.

Thus the Pulse can tell us how the Heart is acting. Marey's Pulse-Register (or Sphygmograph) gives a more accurate notion of its working than the usual feeling with the finger can do. The instrument (Diag. 176) need not be explained here; it will be sufficient to say that it registers the Pulse beats by scratches on a surface blackened with soot, as in Diag. 177.

We shall see below that Kolb has used this instrument in order to show what effect various exercises have upon the Heart etc.

## BLOOD-PRESSURE.

*The time occupied by a complete Circulation,* the blood being forced out of the Heart and then returning to it again, is:—

| | | | | | |
|---|---|---|---|---|---|
| At 3 years of age, | 108 | Pulse-beats | in | 15 | seconds. |
| „ 14 „ „ „ | 87 | „ | „ | 18.6 | „ |
| In the adult | 72 | „ | „ | 23.2 | „ |

The amount of blood which streams through 1 Kilogramme (2 lbs. $3\frac{1}{4}$ oz.) of the body in one minute is as follows, a Gramme being 15.43 grains:—

| | | |
|---|---|---|
| At 3 years of age, | 306 | Grammes |
| „ 14 „ „ „ | 246 | „ |
| In the adult, | 206 | „ |

1. During life the Circulation-System is not merely full: it is a little over-full. Technically, we say that the total amount of blood in the body somewhat exceeds in volume the cubic capacity of the blood-vessels and tubes. The blood therefore exercises a pressure on the elastic walls of these vessels and tubes. This pressure is, however, not equal throughout the System. Rather, we find the highest pressure close to the Heart. Hence, when we feel high pressure at any one part, we must always remember that the pressure at the Heart will be still higher. This fact is constantly forgotten.

2. In the Aorta the blood-pressure is considerable. Further on, in the branches of the small Arteries, it steadily diminishes; it becomes even smaller in the Capillaries, and in the Veins, and at last it is 'negative' in the great Venous trunks close to the Heart. This is why the Veins are usually slack and imperfectly filled.

3. Since an equal quantity of blood must pass through each part at each moment, the quickness of the current is naturally greatest where its channel is narrowest, and slightest where its channel is broadest, as we see in the case of rivers.

4. The distribution of blood is by no means uniform throughout the different parts of the body, but is subject to great variations. *The more active an Organ is, the richer does it become in blood: while in action, its contents may exceed by 30 $^{\circ}/_{\circ}$ or even 47 $^{\circ}/_{\circ}$ the amount which it contains in repose. While active Organs become very rich in blood, the blood is withdrawn from those which are inactive.*

During the process of Digestion, the blood-vessels of the Digestive Organs are greatly distended, and the muscles and Brain become impoverished. Hence during the period of Digestion a feeling of muscular fatigue is wont to come, together with an aversion to severe mental effort.

*If, nevertheless, severe muscular exertion is undergone during Digestion, the muscles brought into play become very full of blood, and the process of Digestion is retarded. The Brain has first claim upon the blood, then the Muscles, and the Organs of Digestion come last. The higher parts are served first: the lower parts, the faithful slaves, are served last.*

It follows that, as regards the time at which Exercise should be taken, *any great physical exertion immediately after a meal retards the digestion, and is therefore unwholesome.* No gymnastic lessons should be arranged for within two hours immediately after the mid-day meal, if it be at all heavy, neither should these hours be used for active games, or for swimming, rowing, cycling, quick walking, etc.

It must be remembered that, with regard to some articles of food, if they are not digested within a certain time they will not be digested at all, but they will ferment. This is a must essential point to remember: for, if we take hard Exercise, the blood will go from the Digesting-work to the Exercise-work, by preference.

Again, if the skin becomes very full of blood, e.g., when one is in the sunshine, or in a hot bath, and so gets red, the inner organs at the same time become paler and poorer in blood. While more perspiration is sent out by the skin, less urine is sent out by the Kidneys. Perspiration will thus often relieve the Kidneys.

5. The blood-pressure also increases according to age, size, and weight, and according to the Diet.

### THE WORK DONE BY THE HEART, ESPECIALLY DURING EXERTION.

The Heart does as great an amount of work in one hour, in proportion to its size, as the muscles of the leg perform in mountaineering during the same time. Other muscles of the body besides the legs are capable of an equal amount of exertion.

Very different is the case, however, when we come to consider the amount of work done in the day. In our supposed example, a mountaineer would perhaps be able to do as much as 4000 metres * in a day at the same pace, i.e. at 500 metres in an hour: that is to say, he might be able to climb for 8 hours. This would be an unusual feat, and after it, he would have finished for the day, and would need rest and refreshment. The Heart, on the contrary, works to this amount without ceasing all through the twenty-four hours, that is, it does three times as much in the day.

Consequently, the usual action of the Heart in repose or moderate exertion, in proportion to the weight of its muscle-substance, exceeds threefold the greatest amount of work we can perform with the 'skeletal' muscles in the course of a day.

But, as we shall presently see, *in violent muscular movement the work of the Heart is increased (for a while) to 6 or 8 times its normal amount.* Considering this increase, we see that the Heart can do four or five times as much work, in proportion to its weight, as the other muscles of the body.

Hence the Heart is distinguished from the other muscles by its extraordinary faculty of exertion.

The reasons are as follow:—

1. From the dawn of life to its final extinction the Heart is ceaselessly at work, without pause or break. It is *the most practised muscle*, *the best-trained* muscle, in the whole body.

2. It enjoys peculiarly favourable conditions with regard to supplying and driving out the blood, so that Waste-products, which in other parts of the body are so apt to have a paralysing effect, are quickly carried away and are prevented from accumulating.

3. The Heart works *Automatically and Rhythmically*, and unlike the other striped muscles, does not respond to the will, to voluntary Nerve-Stimulation, as it is called. The example of the breathing muscles, which are to a certain extent under the influence of the will, but usually work Automatically, shows how little the Automatic (i.e. the involuntary) Nerve-centres and muscles are subject to the ordinary laws of fatigue.

Even the voluntary muscles attain by far the greatest total

* A metre is about 39 inches.

of exertion in movements which, repeated in an unvarying rhythm, have become at least half-automatic, e.g., in walking, running, mountaineering, cycling, rowing, and many movements in Games.

The following point also must not be overlooked:

*Muscular exertion imposes a double task* on the Organs of Blood-Circulation and on the Breathing Organs. In the first place, they have to supply the Muscles which are in action with a larger amount of energy and of Oxygen, and, in the second place, they have to get rid of the Waste-products, and the Carbonic Acid gas, from the body. More Oxygen and more energy have to be given, more Waste-products and more Carbonic Acid gas have to be taken away.

The Heart and the Lungs are faithful servants: they respond to these increased demands by an increased activity: the Heart drives a larger quantity of blood charged with Oxygen into the Organs which are at work, while the more frequent and deep breathing throws off from the body the greatly increased amount of poisonous Carbonic Acid.

Consequently, it is the need of Oxygen which, more than anything else, dictates the amount of work to be performed by the Heart.

Zunz found that the amount of Oxygen consumed by the horse in repose was from 1300 to 1400 cm. per minute. During moderate exertion the consumption of Oxygen rose to 4500 cm., and, in more severe exertion, such as could only be kept up for 1½ to 2 hours, to 7500 cm. In the last case *the consumption of Oxygen was, therefore, six times as great as in repose.*

But, in repose, the whole amount of Oxygen in the blood is not used up; only about half of it is used up. Hence it follows that up to a certain point, i.e., up to double the amount of consumption which goes on during repose, moderate muscular exertion may be performed practically by putting the Oxygen which is already in the blood to better use, without making any demand for increased exertion of the Heart.

But, if once the limit is passed, the Heart must use greater effort to force the blood into quicker circulation: that is to say, the amount of work required of the Heart increases with the amount of Oxygen which is used up.

How considerable this increase may be is shown by Zunz's experiment upon the horse, in which a sharp trot—no extraordinary exertion—multiplied the amount of Oxygen fifteen- or eighteen-fold.

How does the Heart meet these increased demands? It meets them in two ways:

1. It greatly multiplies the number of contractions in a given space of time (see above), and

2. at each contraction it drives out a larger quantity of blood (hence the increased volume of the pulse).

## THE CONDITION OF THE BLOOD AFFECTS THE EXERTION OF THE HEART.

1. We have already seen that, in repose, we use only a part of the Oxygen in the blood, and that, in moderate muscular exertion, the extra amount of Oxygen which is already in the blood may be sufficient for the muscles which are being employed, without our having to throw more work upon the Heart.

2. Now the amount of Oxygen in the blood depends largely upon *the red Corpuscles* (see below). The richer the blood is in these Corpuscles, the larger is the amount of Oxygen it contains, and therefore the larger is its reserve store of available Oxygen; and, again, the smaller is the demand for effort of the Heart. The power of the Heart has limits, and in violent exertion these limits are quickly reached; it follows that, when the blood is very rich in Oxygen-bearing elements, the strength of the Heart is better husbanded; the Heart holds out longer under a great strain (such as racing, cycle-racing, and so forth) than when it is poor in red corpuscles.

The outcome of this is that, *in anæmic and bloodless persons, the utmost exertion of the Heart is sooner called for*, and fatigue of the Heart sets in sooner and forbids the continuance of violent exertion, sooner than in those who are full-blooded.

3. Moreover, the proportion of *water* in the blood must be taken into consideration. It is obvious that *concentrated* blood, which contains only a small amount of water will (other things being equal) carry into the Veins at every Heart-beat a larger number of corpuscles than blood which is very watery.

Supposing that in one person 100,000 red corpuscles float in one litre, and that in another person the same number float in $1\frac{1}{2}$ litre, being evenly distributed in the two persons; then in 100 grammes of the first person's blood there will be 10,000 red corpuscles, of the second person's blood there will be only 6666.

What are the practical lessons to be drawn from these considerations?

In order to husband the strength of the Heart during great muscular exertion, and thus to raise the level of possible achievement, a system of training should observe the following points:

1. *Open Air*, especially the Air which is richest in Oxygen (e.g., sea-air, mountain-air, forest-air) should be chosen by preference. But, if the choice is not given, then Ventilation should be carefully attended to.

2. Since an Albuminous Diet increases the number of Oxygen-bearing Corpuscles and the amount of 'Hæmoglobin' contained in the blood, an exceedingly Albuminous diet, is recommended during the time of preparation for any strenuous exertion.

Personally, I avoid anything that contains Waste-products, e.g., any Flesh-food. I shall show that an Albuminous or Proteid Diet in the form of Peas, Lentils, Wheat, Protene, Cheese, etc., is cheaper than Meat, and is free from Waste-products.

Secondly, an *excess* of Albumen or Proteid is itself apt to produce Waste-products: there is a limit beyond which Albumen and Proteid ceases to be of use. The common method of 'Training' is wont to ignore this limit: the excess is not only useless waste—it is positively injurious, and gives the Heart excessive work in getting rid of it.

3. Persons who are training try to thicken the blood, and to reduce the amount of its watery contents, by sparing use of fluid, as well as by inducing violent perspiration (e.g., by means of Turkish Baths).

With reference to the last-named point, it must be mentioned that in prolonged exertion under certain conditions, such as a quick walk in very hot weather and when the air is very moist, the lack of water in the blood may be a source of very great danger and may produce Heat-Apoplexy.

### CONSUMPTION OF MATERIALS BY THE HEART.

When we consider the large amount of work entailed on the muscles of the Heart, we see clearly that the Heart requires a great deal of the material which is supplied for consumption, i.e. the Food. This consumption depends on the amount of Oxygen required.

If to the work done by the Heart we add the action of the Breathing muscles, we find that on an average 15 % of the whole amount of material is wanted for keeping up the action of the Heart and Breathing-muscles alone.

Hence it is plain that, apart from the great importance of their actual work, the action of the Heart and Lungs is intimately connected with the changes which exertion produces. The quickening of the action of Heart and Lungs by Exercise therefore deserves special consideration.

### FORCES THAT AFFECT THE CIRCULATION OF THE BLOOD, BESIDES THE PUMPING ACTION OF THE HEART.

1. *Gravitation*, or the tendency of the blood to move vertically downwards, is especially seen in the Veins that run down from the head and neck to the Upper Vena Cava; but gravitation hinders as well as helps. Much will also depend on the position of the parts of the body. Thus, if I hold my arm up, the blood will flow out of it; if I stand for a long time, the blood will flow into my legs, and the vessels may become expanded, and in some cases Varicose Veins may be partly the result of this, just as Piles may be partly the result of too long sitting. *

2. *Breathing*, as we have seen, and deep Breathing especially, exerts a sucking action on the great Veins, and so helps the Circulation.

3. The second force which helps the circulation is muscular motion. More blood streams to the muscles which are at work; the muscles themselves, contracted and hardened, press against the limp walls of the Veins about them, and help to force along

* Dr. Schmidt, however, does not here estimate the effect of Diet on Varicose Veins etc. I find that no amount of standing affects the Veins of my legs very appreciably, unless my Diet has been wrong. [E. H. M.]

the blood-streams in these Veins. The effect on the Circulation is most powerful when the greatest masses of muscle are set in motion, and it becomes steadiest when the muscles are contracted and relaxed in a regular rhythm, like that of the legs in walking. These two conditions are found most of all in Exercises of speed and endurance.

4. The effects of certain movements of the *thigh* upon the great Vein underneath its ligament are very interesting. By sharply

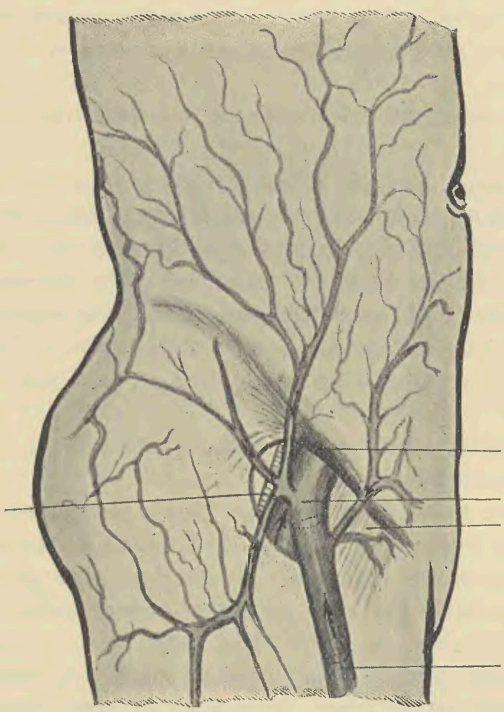


Fig. 178. The Thigh and its Ligament.

rotating the thigh outwards and by stretching it backwards, and by repeating these movements, the Vein-blood is pumped towards the Heart.

These movements are made by your leg when you are climbing mountains, running, rowing on a sliding-seat, swimming, or walking along sharply. They are made also in a large number of games when those games are played properly: e.g., many (correctly made) strokes at various racket-games involve these movements.

But, when they are slow, these movements do not always counteract the downward Gravitation of the blood. Hence in slow walking with short steps the legs may remain distended with blood, and may feel heavy. While the sturdy walker, with his energetic stride, may keep quite fresh, the slowly sauntering lounger may soon feel in need of rest, although the former does many times as much work as the latter! *The proper distribution of blood in the body in walking can only be maintained by a certain degree of speed and energy.*

### EXERCISE AND FATIGUE OF THE HEART.

The Heart, like all other Muscles, can be affected by Exercise. But, as it works continuously, and rhythmically, and is the best-trained Muscle in the body, and as it is helped by other Muscles, it does not need to make extra Effort, and therefore does not grow beyond its natural size, unless some special demand is made upon it frequently. If such is the case, then the Muscle becomes stronger and the walls thicker and firmer.

The demands may be due not only to special Exercise, but also to errors of Diet etc.

If, to meet these demands, the Heart is constantly forced to deal with an excessive quantity of blood, this excessive quantity within its chambers expands its walls by pressing against them. This is especially the case with the weaker side of the Heart, viz., the right side.

The Muscle of the Heart tries to meet permanent additions to its labour by a great thickening of the Muscle-substance itself; and for many years together it can master an extraordinary amount of extra work; but in the end it becomes exhausted, and the tired Muscle degenerates.

Under these conditions it is injurious to overstrain the already overstrained Heart by any violent exercise: it is injurious to disturb the balance of supply and demand which has been brought about with so much trouble. In a word, persons suffering from Heart-disease should not be allowed to engage in any great physical exertion. The easy Gymnastic-Exercises (those of the Swedish system of Medical Gymnastics especially), which help to relieve the Heart from these morbid conditions of the Circulation, should only be tried under medical supervision.

But it is not every strain that injures the Heart: strains which only make it exert itself for the time may even be very beneficial. Running is a typical strain upon the Heart, of which the resulting fatigue is wont to pass rapidly away. After a rapid run, such as a race of over 200 yards in 25 seconds, the number of Pulse-beats in a minute rushes up from 75 to 180, 200, or even more; the Pulse becomes small, irregular, and now and then intermittent. Perhaps the pale face of the runner as he reaches the goal betrays that the power of the Heart is diminished; the blood is ill-distributed throughout the body; the Larger Circulation is impoverished, while the Smaller, which circulates through the Lungs, is, on the contrary, over-rich. But as a rule these symptoms only last for a few moments. The Pulse again becomes full and regular, the cheeks regain their colour. The quickening of the Heart's action persists for a short time, but soon (perhaps in about 10 or 15 minutes) it returns to its normal rate.

Of course the recovery would not be so rapid if the quick running were continued: in fact, the Greek runner from Marathon never recovered at all. The Heart had to keep up its highest possible power and effort for too long. These runs may demand so much will-force and so much effort as to be very like feats of strength as well as of speed. Palpitations and breathlessness should, beyond a certain point, be a signal that the rapid movement should come to an end, at least in practice. In a race it will pobably be of little use to suggest such a thing. The Heart should never be allowed to reach the stage of exhaustion. Fortunately, General Fatigue is wont to overpower the will: the Waste-products accumulate to such an extent that further rapid movement becomes not only dangerous, but even impossible.

Apart from avoidable excesses, *Exercises of speed and endurance* have the greatest and most favourable effect on the growth and capacity of the Heart. They *are actually indispensable to its normal development.* If we seek examples in the brute creation, we find that in *Animals* kept in captivity and deprived of active exercise, the Heart is much smaller in proportion than in those accustomed to freedom and plenty of rapid movement. The proportion of the weight of the Heart to that of the body is in the pig no more than 4.52 to 1000; in man it is 5.00 to 1000, in the hare 7.70, in the stag, 11.55 (Ranke). Thus the Heart of the stag is relatively twice as large as that of the pig. We also know that *in man the Heart remains too small if insufficient exercise is taken in youth.* This not only implies physical weakness and reduced capacity for exertion, but *gives a great advantage to all kinds of unhealthy and morbid conditions.* It is a striking fact that in *Consumptive* patients (Consumption, by the way, is far the most common and fatal malady in Germany, one in three persons dying of it in the most productive age, i.e., from 15 to 60) *the Heart is almost invariable too small,* and the Heart-muscle ill-developed.

Hence Consumption and other scourges might be largely avoided if moderate Exercises of speed and endurance were regularly taken in early life.

In certain changes of the Heart-muscle, and especially in cases of *Fatty-Degeneration,* this effect of Exercises of speed has been turned to account in order to work very gently and so to strengthen the enfeebled Heart. Fatty Heart, that is a Heart surrounded with a great quantity of adipose tissue, is, however, *almost always a result of general fatness.* In stout persons the masses of fat deposited in the skin will hinder the Circulation in the Veins, while the large accumulation of fat in the 'Mesentery' will force the Diaphragm upwards and will greatly impede its movement. Consequently, breathlessness and fatigue of the Heart set in with such people, after a moderate amount of exertion. Oertel, who has thrown much light on all these conditions, was the first to propose *carefully and systematically regulated mountaineering, together with limitation of the supply of liquid,* i.e. a regular 'Training' of the Heart-muscle, as a Health-Exercise for relieving stoutness and Fatty Degeneration of the Heart.

*Quite different is the effect of Exercises of strength.* All such exercises, in which, if only for a moment, the utmost exertion of the muscles of arms or shoulders is required, mean that there is straining or pressure. The effect of this on the Heart and Circulation we have already seen. This process, if momentary, is undoubtedly without a bad effect on the heart. *But if it is repeated and carried to a great extent, as in the habitual lifting and wielding of heavy weights, it cannot but leave permanent results.* Hence the exclusive pursuit of these Exercises of strength often results in weakness of the Heart, degeneration of the Heart-muscle, or Dilatation of the Heart, though these may be deferred for a considerable time, even for years. If one has repeatedly had occasion to examine famous Athletes (or rather Heavy-weight Lifters) there will always be a sad contrast between the more than vigorous muscular Torso and the faint weak Heart.

It is to be noticed that the *beginner* will strain where the skilful or the experienced will use little effort. The beginner wishes to do the thing at all costs. Teachers should point out the most economical movements, though this saving of labour can be carried too far when the learner has got beyond a certain age. It is especially necessary with the very young.

## GROWTH OF THE HEART AND BLOOD-VESSELS.

It is necessary to know about the growth of the Heart at different times in life, so that we may know the best Exercises to take at those different times. For instance, children have small Hearts, and thus they should (after a certain age) go in for the shorter Exercises of speed rather than for the quieter Exercises of endurance.

Beneke worked out the following *Averages*, as the result of careful measuring and weighing.

| Age. | Height. cm. | Volume of the Heart. cm. | Circumference of the Aorta close to the Heart. mm. |
|---|---|---|---|
| At birth | 49—52 | 20—25 | 20 |
| End of 1st year | 68—72 | 40—45 | 32 |
| „ „ 3rd „ | 88—90 | 56—62 | 36 |
| „ „ 7th „ | 112 | 86—94 | 43 |
| 13th to 14th „ | 140—150 | 120—140 | 50 |
| When fully developed | 167—175 | 215—290 | 61.5 |
| At maturity | 167—175 | 260—310 | 68 |

Transferring these figures to a common basis of 100 cm. for the height of the body, we find:—

| Age. | Relative volume of the Heart. cm. | Circumference of the Aorta close to the Heart. mm. |
|---|---|---|
| At birth | 40—50 | 40 45 |
| End of first year | 46—54 | 43 |
| 3rd | 63—70 | 39 |
| 13—14th | 83—100 | 38 |
| When fully developed | 130—168 | 37.5 |
| At maturity | 150—190 | 40.0 |

The latter calculation shows that a grown man possesses relatively three or four times as much Heart-muscle as a new-born child, in proportion to the height of the body.

With regard to the yearly growth of the Heart, Beneke has obtained the following figures, leaving out of account the first year with its large quota.

| | |
|---|---|
| From the 2nd year to the 4th the Heart makes an annual growth of | 9 cm. |
| " " 5th " " " 7th " " " " " " " | 7 " |
| " " 7th " " " 14th " " " " " " " | 5. 6-7, 6 " |
| During the period of development (if lasting 5 years) | 19-30 " |
| (if lasting 2 years) | 47, 5-75 " |
| (if complete in 1 year) | 95-156 " |

Excessively rapid development of the kind is not uncommon, especially in the female sex.

We must notice the following points here:

1. While the volume of the Heart increases twelve-fold from the period of childhood up to the period of complete Development, the circumference of the passage from the Heart (called the Aorta) only increases three-fold.

Hence in children the blood-pressure is slight: the heart works more quickly, and drives the blood more easily and more quickly through the body. The exchange of matter between the blood and the tissues is far greater. It is most important for growing children that this should be so: that new materials should be constantly deposited.

During the development period, the Heart practically doubles its size, but the passage from it, the Aorta, only increases by about one-fifth. *Henceforth, therefore, we shall have a large Heart, but narrow Arteries:* the blood-pressure will be raised, and the Heart will have to work more slowly and with greater effort in order to force the blood through the narrow Arteries.

THE HEART'S NEED OF EXERCISE.

'*If Practical Hygiene is to become a fact,*' says Beneke, '*it should first fix its attention on the development of a powerful heart.*' In truth a normal development of the heart before and during the period of maturity is of the most decisive importance for the maintenance of Health, and of capacity for work, and of power of resistance.

The laws of development already explained strikingly show how necessary it is to stimulate the growth of the Heart before and during the period of development, i.e. they strikingly show *the need of special Exercises for the young.*

*But the need becomes doubly pressing in view of the particular effects of School-life, and of the continuous sitting* which it imposes upon children for a great part of the day. To promote the growth and the nourishment of the body, by stimulating the Breathing, Circulation, and Changes in the body, is the chief object with which Exercise and bodily movement should be enjoined on children before the period of development: this is all the more so because the sedentary hours in School tend to produce the very opposite effects. They do *not* promote the growth and the nourishment of the body by stimulating the Breathing, Circulation, and Changes in the body.

If we would stimulate these changes in the body, we must first secure a lively unimpeded Circulation of the blood, and this is exactly what is impaired by hours of sitting still. The two great accessories of Circulation, Motion, and Deep Breathing, have no place here. For the breathing is also reduced to a minimum when children sit on forms in school. Freer movement must quicken the Circulations, must disburden *the Heart, which works at a disadvantage in the sedentary posture*, and must give it freedom of action.

The experiments of Axel Key have taught *the terrible effect of the beginning of School-life on the blood-making organs of children in some places abroad.* While after the first year of School (the data are collected from thousands of school-children in Stockholm) every 13th child was poor-blooded and anæmic, after the 2nd year every 5th child had fallen into this condition. The reduction of the activity of the Heart and Lungs in School-life is the main cause of this spread of anæmia and bloodlessness in children of the School-going age.

This points to *Exercise of the Heart as the chief object of Physical Exercise for the young.* This object is best attained by *Exercises of Speed*, especially in the form of *Games* which require rapid movement.

*Simple Gymnastic Exercises without change of place lack any strong effect on Heart and Lungs.* The same holds good of Exercises with Apparatus, apart from the fact that the chances of over-strain are more than likely in the case of awkward and unpractised children. *In the child the process of straining or pressure means a much more serious disturbance of the Circulation than in the adult;* for the very reason that in childhood the Circulation and changes proceed more actively than in adult life, and that the Heart is much smaller and weaker in proportion, the pressure has a much greater effect. The obstruction of the Veins (see above) makes itself felt much sooner, these Veins swell, and the face gets red (or even bluish, owing to the Carbonic Acid gas in the blood). A very similar result would be produced by violent screaming or coughing. Heavy Dumb-bells would be generally very bad for the young.

With Exercises of Speed, especially such as do *not* demand the maximum of effort in a short time, and so take on rather the character of exercises of strength and not of strain or endurance, the case is exactly reversed. The fact that the Heart is small and the Arteries wide, and that the Circulation is therefore made very easy indeed, renders growing children particularly fit for Exercises of Speed; the recuperative power of Heart and Lungs is at its highest. A grown man is no longer able to race and scamper about as a boy at play can do for hours together: the conditions of blood-pressure have changed. How easily does a boy run upstairs to the third or fourth landing, many times a day. A grown man is wont to go up more deliberately; at the top he feels his Heart beating and his Breathing coming hard, and he is often forced to stop for a moment and take breath, until the action of the Heart and Lungs has recovered itself.

The time for Speed-Exercises, such as Football, lasts on during the period from 16 to 20 or 25.*

Very different are the conditions which prevail in adults up to the most vigorous years of manhood. The Heart becomes comparatively large and has to drive the blood into the narrow Arteries with great force and at high pressure. A disturbance of the Heart's action, brought about by pressing strenuous exertion to the point of fatigue of the Heart, is not so quickly compensated. Exercises of Speed affect a person much more strongly than before and during the period of development.

On the other hand, the Changes in the body become comparatively slight. Growth being completed, severe Exercises of Strength and Endurance do not interfere with the development, as they do in a growing child or lad.

After this period certain new conditions begin slowly to make themselves felt; we have to be more cautious in some of the demands we make on the Heart, since they lessen its power of exertion. In many persons, decided obesity sets in before the thirties, and impedes the action of the Heart. At this time, too, the changes induced in the blood-vessels, particularly the Arteries, have to be taken into consideration. About the 40th year, in some cases earlier, in some later, the walls of the Arteries begin to lose their elasticity, they become stiffer, and chalk-salts are deposited in them. Exercises of Speed, in youth the most excellent for strengthening the Heart and for promoting Circulation, are now the first to be renounced, They can only be taken, as a general rule, in a modified form, especially that of prolonged movement at a moderate pace. Possibly Golf may approach to the ideal, but I should imagine Tennis, or a Four at Lawn Tennis or Eton Fives, to be very excellent.

It is now especially that we must absolutely refuse to give up Exercise; in these very years the Heart must still be trained and practised. *This is a lesson which every former Athlete must bear in mind:* it applies to all equally, whether they have been Runners, or Rowers, or Walkers, or Cricketers, or anything else.

*Any one who has been accustomed in his youth to giving his Heart severe Exercise, can do nothing worse than, when it*

* I cannot quite agree with Dr. Schmidt that 'the best Football players are generally lads from 16 to 19', or that good records, made in racing at this age, 'are seldom exceeded later'. (E. H. M.)

*refuses the more violent efforts, to throw up the whole thing and cease from physical Exercises altogether.* So sudden a change the Heart-muscle cannot endure without suffering for it. Like every other muscle, its fibres degenerate when their work is reduced to a minimum. Even if the strength and effervescent energy of youth are gone, the old man will be

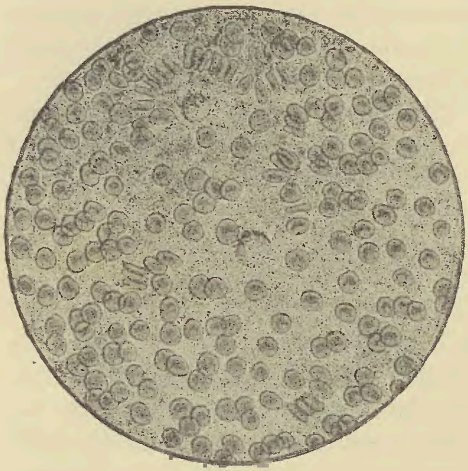


Fig. 179. Blood-corpuscles magnified 500-fold. Notice the two white corpuscles.

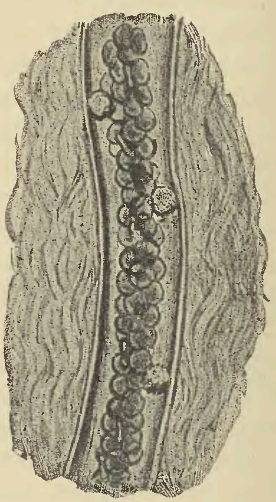


Fig. 179*a*. Blood-stream. The red corpuscles are in a mass and move faster than the white corpuscles (along the wall).

most likely to preserve a pleasant degree of physical freshness and vigour by constant and sufficient Exercise. *

## THE BLOOD.

The blood looks red, but it is not all of the same colour. We have seen, for example, that in the Arteries it looks bright red, in the Veins it looks dark red. Nor is it really coloured

* The danger is not fully pointed out here by Dr. Schmidt. To have exercised your Heart and Lungs means to have made them grow. Therefore, if you cease to exercise them, some parts will be liable to remain unused; some parts of the Lungs will be empty, and the Tubercle-germ will find them swept and garnished: it is just such a home that the germ craves for. Full many a past Athlete has allowed death to creep into the empty and disused portion of his over-developed Lungs. (E. H. M.)

itself: the red colour comes from tiny bodies, called Corpuscles, that float in it. It is the red Corpuscles that make the blood look red, though we can only see the individuals under a microscope. Prick your finger, and put the drop of blood between two thin pieces of glass, and then put these under a microscope.

In the small part of the drop that you will see, you will immediately become aware of many hundreds of yellowish-green discs, slightly depressed in the middle. These are the red Corpuscles, which give a deep red colour to thicker layers of blood. Scattered singly among these red discs we see others, colourless, but slightly granulated, and faintly brilliant, and usually rather larger than the red Corpuscles. These are the white Corpuscles.

There are, on an average, 340 red Corpuscles to one white. In Anæmia the proportion of white Corpuscles is considerably larger; and this is the case even more in a disease of the blood in which the red perish and the white are greatly multiplied (Leucæmia or White-blood Disease). In Anæmia also the number of red Corpuscles in circulation is much reduced.

The greatest diameter of a corpuscle averages 0.00774 mm. In 1 cm. of healthy blood there are about 5 millions of red Corpuscles. They contain an iron red pigment, held together with albumen. This is called Hæmoglobin.

The colourless liquid of the blood, in which the Corpuscles float, is called Serum.

The principal elements in solution in the blood are:—

1. Albumen (about 8.2 %).
2. Fibrin (about 0.8 %).
3. Salts, more especially common salt (about 0.85 %).
4. Besides its solid and fluid elements, the blood contains considerable quantities of gaseous materials. Of these the most important are *Oxygen and Carbonic Acid* gas, for the gaseous Nitrogen which is absorbed from the air is a negligeable quantity.
5. As we have seen, blood in the Arteries contains most Oxygen; blood in the Veins most Carbonic Acid. The bright red colour of the blood in the Arteries is due to the Oxygen; as the Oxygen is used up the blood darkens, until it assumes the colour of the blood in the Veins. If the dark blood, drawn from a Vein, is shaken up with Oxygen, it becomes bright red. Carbonic Acid has of itself no effect on the colour.

In man the volumen-percentage of Oxygen in blood in the Arteries is 17, that of Carbonic Acid, 30.8. In blood in the Veins the percentage of Oxygen is about 8 °/₀ lower, that of Carbonic Acid about 9 °/₀ higher.

*In a person who has died of suffocation nearly all the Oxygen of the blood has disappeared, while the Carbonic Acid in it is greatly increased* (up to 52.6 volume per cent).

The more red Corpuscles the blood has in it, or, in other words, the more iron it contains, the more Oxygen it will be able to take up. *The red Corpuscles are thus Oxygen-bearers:* they absorb the Oxygen from the air by inspiration, carry it through the body, and give it off in the Capillaries so that the vital processes may be maintained.

*In violent exercise the amount of Oxygen taken into the blood can be multiplied five- or six-fold.* If we multiply it by five, it comes to 1800 cm., or nearly two litres of Oxygen-gas per minute. Such a huge amount is rendered possible because the red Corpuscles spread over an extraordinarily large surface.

All this is of very vital import. Crowded School-rooms, Lecture-rooms, Churches, Carriages, many rooms in Hotels, in Homes, etc., soon come to contain enough breathed-out Gas, including Carbonic Acid gas, to be positively harmful. When the rooms are lighted by fires or by Gas, still more Oxygen is used up, still more Carbonic Acid gas is given out. The dangerous consequences are being ignored by millions all the world over every day and hour and minute of the year. Education with regard to Ventilation is not part of our English or American Education. Why not?

We shall refer to this again when we come to speak of the Lungs.

Besides the Blood-vessels there are other nutrient channels in the tissues of the body: these are called Lymphatics, and help to serve as carriers and filterers, and also as a drainage-system. The Lymphatics of the Digestive-Organs have another part to play.

# PART IV.

## II.

THE LUNGS. BREATHING AND ITS EFFECTS.
BREATHING-EXERCISES. THE SKIN.

The Organs for Breathing have to draw the surrounding air into the body, and to help the blood to act on that air and to be acted on by that air. The blood must absorb enough Oxygen to enable it (a) to carry on the Changes in the body, and (b) to get rid of the poisonous Carbonic Acid gas which is formed as these Changes take place; or of that and other poisons which are taken in with the air.

These Organs are the Mouth-opening and the Nose-opening which lead into the throat. Then, in the front of the neck, come other 'Organs' (called the Larynx and the Bronchial tubes; and then the Lungs, in the cavity of the Chest or Thorax, and close on the lower side by the Diaphragm.

The Lungs are the great Air-Reservoirs of the body. The air which streams into them must pass through the Mouth or Nose etc., and the air which is breathed out must pass the same way. Some gases, however, pass out through the Skin etc. As we breathe in, the Chest-cavity is expanded: as we breathe out, it is contracted.

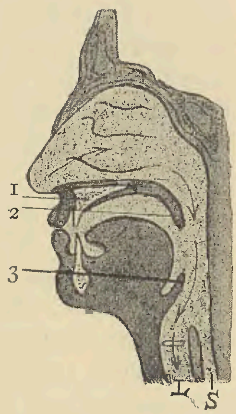



Fig. 179*b*. 1. Hard Palate; 2. Velum Palatinum; 3. Epiglottis.

THE NOSE.

The Nose effectively protects the deeper-lying Organs; for in its narrow passages the air, which is drawn in, is everywhere brought into contact with the warm moist Mucous Membrane. Here this air is warmed and moistened, and the coarse particles of dust etc. are left clinging to the damp and sticky surface. It is therefore right to insist that, in all Exercises which call for deep breathing, such as cycling, mountaineering, running, rowing, and most Games, *the breath should be taken in as much as possible through the Nose.* For, when the Organs of Breathing are forced into stronger action, the possible harm which may be done by dry, cold, or (more especially) dust-laden air is correspondingly increased.

This is often easier said than done, especially when one is out of breath during and after exertion. In such cases the wider Air-passage, the mouth, is naturally used.

Personally, I should suggest that you should begin with Breathing-Exercises *under easy conditions;* these will help you to acquire the *habit* of breathing correctly. To keep the mouth shut, and to breathe in deeply and slowly, and so as to inflate the Lungs *upwards and outwards*, this must be practised especially in the early morning, with the windows open. By degrees the Habit will come, and you will find that you will keep your mouth shut more and more regularly during sleep, and by degrees during hard Exercise also. For the prevalence of the habit of In-Breathing through the mouth, see below. This habit will not be cured unless you practise Breathing as an absolutely separate Exercise.

Breathing-Exercise (through the Nose) ought to be an integral part of Education, especially of the young, all the world over. In America there has recently been a great movement for nose-breathing. Many people in great cities, especially in New York, have had large portions of the insides of their noses removed, so that the nose-passage may be free.

## THE LUNGS.

The Lungs are two spongy elastic masses, shaped like blunt-pointed cones, and enclosing the Heart between them: these fill up the chest or thoracic Cavity.

At birth they are rosy-red, but soon they assume a bluish-grey colour, and are usually punctuated with black dots, which are caused by dust (more particularly coal-dust) deposited in the Lung-tissues. It is the position of the Heart on the left side that dictates that the Left Lung should be smaller than the Right. A deep groove from back to front divides the Left Lung into two lobes; grooves also divide the Right Lung into three lobes.

The Trachea or Air-passage divides into a right trunk and a left trunk: each of these trunks subdivides into as many branches or Bronchi as there are lobes in the Lung to which it goes. These Bronchi again divide into finer and finer branches. At the ends of these are little vessels, like grapes on a stalk. In these little vessels or Vesicles the air comes into contact with the blood and gives the blood its Oxygen, and receives in return—a poor return we should say!—Carbonic Acid gas. These little vessels, if spread out, would cover a surface of over 200 square yards: of these over 150 square yards come into contact with the little Blood-Capillaries.

## BREATHING.

The Breathing by the Lungs, the exchange of gases (the getting rid of Carbonic Acid and the absorbing of Oxygen), is called the 'External Breathing'. Opposed to it is the Internal

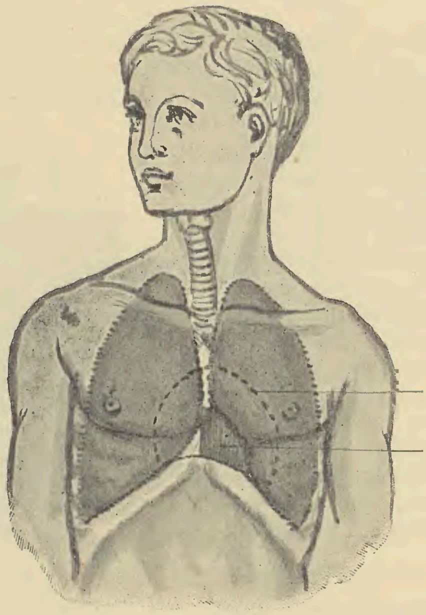


Fig. 180. The Heart and Lungs in the Thorax.

Breathing, that is, the exchange of gases which takes place between the Capillaries and the Tissues, in which the blood from the Lungs parts with its Oxygen, and absorbs Carbonic Acid. The second of course depends largely upon the first, and the first upon the second.

Breathing consists of two rhythmical and alternating processes, Breathing-in and Breathing-out. With Breathing-in the Chest or Thorax is dilated by the Breathing muscles. As the Lungs lie close to the wall of the Chest or Thorax, they come when the wall draws them in: air is thus sucked into the Lungs, which are (passively) expanded according to the size of the Chest Cavity. When the Breathing muscles cease to act, Breathing-out follows; the elasticity and the weight of the Chest-walls, the relaxing of the Diaphragm, and the elasticity of the Lung-tissue, all compress the expanded Lungs and force out a corresponding quantity of air. It is only in forced Breathing that the help of the muscles is called in so as to reduce the space within the Chest. In quiet Breathing, only the act of In-Breathing is performed by the action of the muscles, and out-Breathing is a passive process.

The action of the Breathing muscles is due to the stimulation of certain Nerves, and it usually proceeds quite involuntarily and automatically, as in the Heart. It also adapts itself to the Exercise etc. that we take.

But for a time these Muscles, unlike the Muscles of the Heart, can be subjected to the will: we can, up to a certain point, breathe quicker or slower; we can even stop breathing, as in great exertion and while holding the head under water.

Advantage ought to be taken of this: we ought to give up a certain space of time at intervals every day, so as to practise various kinds of Breathing, especially the taking of long and deep breaths. Apart from improved Health, the improved 'Wind' in Exercise is extraordinarily marked.

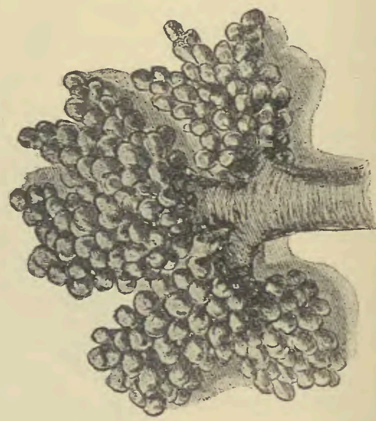


Fig. 180*a*. A Bronchus in the Lung, with little Vessels (Vesicles) at the end of it.

The Lungs never get rid of all their contents at once. There is always some air which we cannot breathe out—we have not the power; some air, again, we do not use for ordinary quiet breathing—it is in reserve.

In ordinary Breathing only one-sixth or one-seventh of the air in the Lungs is subject to renewal. In forced Breathing this amount may be increased about six-fold.

In violent Exercises and Games the volume of Respiration may be multiplied, as we shall soon see, by 14, or even by 21. Hutchison has invented an instrument for measuring the Breathing-Capacity.

The Capacity (1) increases with the height of the body. (2) With regard to age, the vital capacity of the Lungs increases up to maturity, and is greatest at about 35. (3) *It is reduced in an increasing degree by more than normal obesity.* (4) With regard to the effects of Occupation, generally only farmers and those who work in the open air have normally developed Chests; the Chest is narrower in persons who pursue their callings in workshops, and narrowest in those who work in mills, counting-houses, and shops. 'For its full development,'

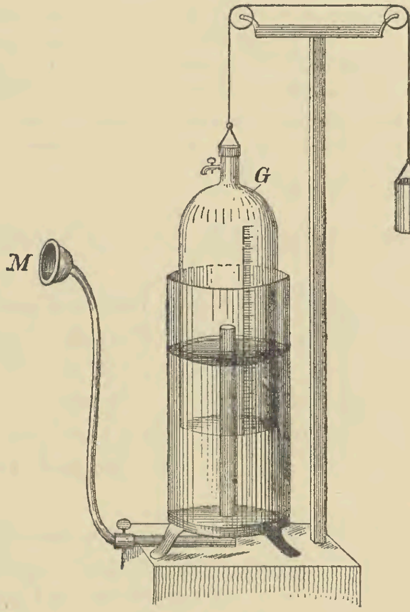



Fig. 181. Spirometer. M denotes the mouth-piece.

as Ammon justly says, 'the chest requires full and frequent inspiration and expiration of fresh air.' *

## FREQUENCY OF BREATHING.

The number of breaths per minute is subject to variations similar to those of the Pulse. A breath occupies the time of 3 or 4 beats of the Pulse. Quetelet gives the following figures with reference to the frequency of respiration at different ages.

* Hutchison's statement, that the average Lung-capacity of full-grown Englishmen, easily exceeds that of Continental Europeans, is called in question by Dr. Schmidt. I should doubt whether English Athletes (e.g., Football- and Cricket-Professionals and the increasingly large number of those who practise the Sandow and similar exercises) have been reckoned in by Dr. Schmidt. I should say that they ought to have as fully developed Lungs as farmers etc. (E. H. M.)

| Age. | | Number of Breaths. |
|---|---|---|
| At birth | . . . . . . . . . | 44 |
| „ 5 | years of age . . . | 26 |
| „ 15—20 | „ . . . . . | 26 |
| „ 20—25 | „ . . . . . | 18.7 |
| „ 25—30 | „ . . . . . | 16 |
| „ 30—50 | „ . . . . . | 18.1 |

In young people with well-developed chests and in good training the figures are lower for the years between 20 and 30, and average in repose (i.e., while they are sitting or standing) from 12 to 15 per minute. The number is considerably increased during muscular exertion.

Of the two acts which together make up Breathing that of In-Breathing is rather the shorter. In cases of constriction of the air-passages, which makes the Breathing laboured, as well as in actual breathlessness, the act of In-Breathing is prolonged.

## QUICKENED BREATHING, AND BREATHLESSNESS.

The Breathing is quickened and forced when the Lung Area is reduced by Disease, or when the red Corpuscles are few (e.g., in Anæmia) and so do not cover so wide a space, and when the Circulation is impeded. In these cases the blood is in danger of being over-filled with Carbonic Acid etc., and the Lungs struggle to get rid of this and to bring in more Oxygen.

A similar quickening takes place when, owing to the increased Changes in the body brought about by muscular exertion, greater quantities of Carbonic Acid are produced and have to be thrown off, and when, at the same time, the increased consumption of Oxygen has to be met by an increased supply. As we have already seen, the latter can be met by a better use of the Oxygen already present in the blood, and, further, by the increased activity of the Heart, which pumps an amount of Oxygen-charged blood greatly in excess of (indeed many times as much as) the usual supply, through the muscles which are in action. But it is the special function of the Lungs to master the increased production of Carbonic Acid, i.e., to drive it out of the body by quickening the Breathing.

*The largest exertion of force, as we have already seen, is put forth when the effort is distributed among many large muscles.* This largest exertion of force can also be put forth without any strain being felt. On the other hand, *localised efforts, in parts* *of the body which are very far distant from each other, may force certain small muscle-areas to the strongest possible exertion,* and induce symptoms of extreme fatigue, and a feeling of overpowering weariness in *all* the muscular parts of the body, without reaching any considerable total of exertion, and *without bringing any great increase in the volume of the Breathing,* or any great ventilation of large quantities of air in the Lungs. Hence local muscular fatigue is no proof that the activity of the processes of Breathing, of Circulation, and of Change, has been plentifully and efficiently increased. That Exercise has tired you is no sign that it has been a good Exercise for the best functions of your body.

These functions are most effectively and thoroughly performed, thanks to various Exercises of speed.

The first effect of quick movement is an increase of the Breathing: the breath is taken more deeply, the Chest or Thorax being extended in all directions by the utmost exertion of the muscles of ordinary In-Breathing, helped by the muscles of 'forced' Breathing. The number of Breaths increases to double the original number. At the same time the Breathing movements preserve their even Rhythm. Such would be the result of a proper amount of the right kind of Mountaineering, of slow Running, of Bicycling, Rowing, Ball-games, etc.

The volume of Breath may be increased two-fold or three-fold, and Exercises accompanied by this amount of Breathing (vigorous walking, mountain-climbing, and so on) may extend over several hours. It is obvious that the total Exercise of the Lungs, if expressed in figures, would be enormous.

The case is different if a violent effort of speed, which at first only called forth this rhythmic increase of Breathing action, is continued with a view of attaining the maximum of speed (as in running or rowing). The amount of Carbonic Acid etc. in the blood then grows to such an extent that the volume of the Breaths must be considerably increased, and the rate of the Breaths goes up to 50 or 60 a minute, and even more. The first consequence of this is a change in the character of the Breathing itself, the In-Breathing becoming longer, the Out-Breathing shorter. Thus, in a race of medium quickness, 13 steps were taken during In-Breathing, but only 2 during Out-Breathing!

Soon, however, there comes a limit: the quickened Breathing can no longer cope with its task—it begins to give in. The Lungs are overloaded with blood, but the Larger Circulation and the Heart are poor in blood: the face becomes pale, and the muscles of natural and of 'forced' Breathing (see below) are exerted to their full. A 'Stitch' may ensue. The nostrils will quiver, the Mouth will be wide open. The Breathing will have lost its Rhythm, the In-Breathing being long and deep, the Out-Breathing sharp and *staccato*.

Now, or rather before now, is the time to stop. If the stop is made in good time, the Breathing and the Heart-beats will soon become quieter and more even. But if, by an effort of will, the hard Exercise be kept up (without Stimulants), then the recovery will take far longer: in some cases it may never come at all.

Hence we see that the principal cause of the condition of breathlessness is the overloading of the blood with Carbonic Acid gas etc., which is produced by the great exertion of force in the limited time. This is the reason why similar symptoms of breathlessness appear after breathing an atmosphere strongly saturated with Carbonic Acid: it accumulates in the blood because the Oxygen, by help of which it might be expelled, is lacking.

### EXCHANGE OF GASES WITHIN THE LUNGS.

The Air around us, when we breathe it in, is full of gases: besides its moisture, it ordinarily contains very much Nitrogen, a good deal of Oxygen, and a very little Carbonic Acid gas. The Air we breathe out contains slightly more Nitrogen, but considerably less Oxygen, and considerably more Carbonic Acid gas.

It also contains certain other gases which have not yet been adequately analysed.

Thus the Breathed-out air is

1. charged with Carbonic Acid, of which it contains more than 100 times as much as is contained in atmospheric air;

2. poorer in Oxygen, of which it contains 4.78 volumes per cent. less than the atmospheric air.

3. The amount of Nitrogen remains very much the same, that is, the gaseous Nitrogen is indifferent in its effect on the body, and is

exhaled as it is inhaled, without making any difference. (This is probably going beyond what we are warranted in asserting. So little is known for certain as to the changes that go on in our bodies. —E. H. M.)

If we keep in view the sum of the Oxygen inhaled (4.78 °/₀), and exhaled (4.38 °/₀), we find that in ordinary Breathing the amount of Oxygen drawn in slightly exceeds that of the Carbonic Acid driven out. *The driving out of Carbonic Acid is particularly small in proportion during sleep.* Hence the great need of getting all the pure air we possibly can during the hours of sleep.

In quickened Breathing, in consequence of muscular exertion, this ratio is reversed. The amount of Carbonic Acid driven out is greater than the amount of Oxygen absorbed.

The amount of the interchange of gases in the Lungs is subject to variations from the following causes:—

1. From *age:*—In children the amount of Carbonic Acid which is driven out is less absolutely, but twice as great in proportion to the weight of the body, as in the adult. 'Changes' in the body are much more active in growing children.

2. From *sex and physical condition:*—Generally it is greater by one-third in men than in women; and at the time of puberty it is actually twice as great. In the same way, muscular men consume more Oxygen and throw off more Carbonic Acid than weaklings. A healthy development of muscular strength invigorates *all* the vital processes, and among them Breathing.

3. The vital processes are similarly invigorated by *light,* especially by sunlight in the open air.

4. The *warmth* of the surrounding air also exercises a certain influence; as the cold increases the rate and depth of the Breathing likewise increases; more Oxygen is absorbed and more Carbonic Acid thrown off. In this consists much of the very valuable effect of Cold Air, especially by the sea or among forests in the hills. Here also there is actually a larger amount of Oxygen in the air itself.

5. The exchange of gases in the Lungs, as a sign of increased 'Changes' in the body, is considerably enhanced by *muscular exertion,* especially when it is Rhythmic and prolonged and extended over wide muscle-areas.

6. If, following the precedent set by Edward Smith, we let

1 stand for the volume of Breath in the recumbent posture, we find that it increases,

in a seated posture, to 1.18,
in a standing posture, to 1.33,
during a walk (slow walk) at 1600 m. an hour, to 1.9,
(ordinary walking) at 3200 m. an hour, to 2.76,
(easy marching) at 4800 m. an hour, to 4.3,
(quick marching) at 6400 m. an hour, to 5.0,
(forced marching) at 9600 m. an hour, to 7.0,
in long-distance races, to 9.0,
in short-distance races, to 13.0.

In rowing (over a course of 2000 metres in about 8 min.), Kolb computed that it was multiplied twenty-fold.

It may be further observed that this multiplication of the volume of Breath does not merely mean a similar multiplication of the exchange of gases. In greatly quickened Breathing the exhaled air does not contain so much Carbonic Acid gas as in ordinary Breathing, in proportion.

## MOIST AIR, AND SOME OF ITS EFFECTS.

Together with the Breathed-out air, water is exhaled from the body in the form of vapour; and we can easily convince ourselves of the moisture of the Breath by breathing on a sheet of glass. The amount of water which passes off from the body by means of the breath has been reckoned at from 330 gr. to 640 gr. in the 24 hours.

*The exhaling of the water with the breath depends a good deal on the amount of water contained in the surrounding air.* The air is always 'watery', but the amount of water differs. *The warmer the air is, the more water it will take up.* It is important to remember this.

If the air about us is able to absorb considerably more water than it contains, then we breathe out a large mount of vapour. This comes from the Breathing Organs, and thus arises a sensation of dryness. *If, on the other hand, the air about us is saturated with moisture, the Organs of Breathing cannot get rid of their superfluous moisture, and a feeling of oppression arises.* Thus it is in thick fog, in hot and sultry air, and in a Turkish Bath.* It may be remarked here that the parching effects of warm air when it is almost without moisture are very keenly felt, e.g., the dry wind in the desert. At a very low temperature we are not troubled by the dryness of the air.

## DETERIORATION OF THE AIR OWING TO GASES AND DUST.

When people are gathered together in any closed space the amount of Carbonic Acid gas must necessarily be increased, while the amount of Oxygen must be diminished, unless the air is constantly renewed.

It is true that the amount of Carbonic Acid in the outer air may increase considerably before it is injurious or even unpleasant: not until it has risen to 1 degree in the inhaled air does it cause discomfort. If it goes above 8 or 10 degrees, however, it endangers life itself.

*From the skin,* on the other hand, and especially from the openings of the digestive canal, a number of gaseous substances arise, some of which make themselves manifest through the sense of smell, and, if inhaled in large quantities, are positively injurious to health. The amount of Carbonic Acid in the air serves as a measure of these injurious substances in the air. When Pettenhofer describes air which contains more than 0.1 °/₀ of Carbonic Acid as bad, the deterioration is not due so much to the amount of Carbonic Acid itself, as to accompanying (organic) exhalations. In the schoolrooms, from 0.3 to 0.4 per cent. of Carbonic Acid gas has been detected after an hour of school, from 0.5 to 0.6 after 3 hours; in the class-room of an elementary School in one instance there was as much as 1.2 %. In Lecture-rooms 0.39 % has been found, in the public rooms of Hotels, 0.49 %; figures which imply an extreme degree of deterioration.

The deterioration should also be considered in Gymnasiums where there is no good system of ventilation. For, even if the allowance of air per head is much greater in the Gymnasium than in the School-room, it should be borne in mind that the quickened Breathing in gymnastic exercises gives off a much greater measure of Carbonic Acid gas to the surrounding air, and that the activity of the skin,

* We generally call this moist-heat Bath a Russian Bath, the dry-heat Bath a Turkish Bath; the Germans apparently reverse this.

stimulated till perspiration comes, likewise gives off a much larger amount of noxiousness; while in gymnastics in the evening there is the additional harm caused by the use of artificial light.

If in School-rooms there should always be proper ventilation to remove the foul air and introduce fresh air, so that the percentage of Carbonic Acid may never exceed 0.1, much more should this be seen to in the case of Gymnasiums. There is no need of an expensive system of ventilation: let *the windows, which should be opposite each other*, be freely opened so as to create a draught. *Plenty of Exercise will keep the people from catching cold.* But it is best of all to take Gymnastic and other Exercise in summer, and in winter, whenever it is possible, in the open air.

Extremely small solid particles are everywhere contained in the atmosphere of the world. Most of them are of the nature of *mineral 'dust'*, produced by the destruction of all parts of the earth's crust. The vegetable world adds a living element in the germinative seeds of the smallest forms of *vegetable* life. Of a far more mixed character is the dust about the crowded habitations of men. The dried and pulverised refuse of human and animal life, household and industrial rubbish, the smoke of fire-places, and especially of the chimneys of manufactories, the friction caused by the bustle in streets and other avenues of traffic, and so forth, are prolific sources of the dust, which gives a peculiar character to the air of cities. And, above all, fine dust collects *in interiors*. When a ray of sunlight falls through a chink into some comparatively dark interior, its course through the air stands out almost as if palpable, and, even to the naked eye, this ray of sunlight discovers *millions of minute dancing motes. Air like this bears the same relation to the pure out-door air*, washed, it may be, by a summer shower, *as a turbid muddy puddle does to a crystal spring.* And yet no one is duly disgusted at air of this sort.

It is true that the nose may intercept a good deal of harm and matter, and the lymph-cells a good deal also; but post-mortem examinations show that vast quantities of it penetrate to the very inmost recesses of the Lungs.

Let us now ask what are the evil effects of these dust-particles in the deepest parts of our breathing apparatus. And in this enquiry we will leave out of sight the serious consequences of inhaling actual poisons in the shape of dust, e.g., lead, phosphorus, arsenic, mercury, anilin, and so forth. It is an important part of the Hygiene of industrial life to prevent the poisoning to which workers in certain occupations are exposed.

For the purpose we have in hand, the first point to be considered is the mere mechanical action of inhaled dust. This consists in violent irritation; the multiform and often sharp particles cling to the delicate mucous membrane of the nose and throat, and produce redness, swelling, and increased secretion in the mucous membrane, as well as frequent coughing, when we try to get rid of the troublesome intruders; this may bring on catarrh.

Though a healthy membrane may often be able to resist the effects of occasional in-breathing of dust, and only show symptoms of catarrh after a long time, or after deeper breathing, still it is always bad for the mucous membrane of throat, nose, larynx, or bronchi, and especially when they are already affected by disease, or sensitive from previous illness. And, in any case, a very large number of persons suffer from disease or irritability of the breathing mechanism. First of all, in this connexion, we must consider Consumption (tuberculous affections of the Lungs), which, in an early stage, my long pass unrecognised. Here we have the most widely-spread national malady in Germany: it destroys 160,000 lives yearly, chiefly among the labouring population. In a Rhenish manufacturing town, for instance, 62 deaths out of every hundred are attributable to Consumption in the Lungs.

The germs of Tuberculosis have been clearly proved to exist in the dust of rooms which have been inhabited by persons suffering from Consumption. If we consider that in Germany there are from 8 to 9 hundred thousand persons suffering from tubercular disease of the lungs, and yet not confined to Hospitals, but mixing freely with the rest of the population in schools, workshops, counting-houses, social gatherings, churches, gymnasiums, etc., we may gain some idea of how broadcast the seeds of infection are sown. In England we are at last beginning to realise the effect of open air and ventilation upon Consumption.

The extent to which the proper use of Physical Exercise may strengthen the power of resistance among the young and among people in general will be briefly discussed later on.

As to Gymnasiums and many other closed places for Exercises (including ball-rooms), if the air in them contains the same amount of dust as the class-room, the higher rate of Breathing will bring a larger amount of it into the Lungs.

If we assume that three times as much air is breathed during an hour of hard Exercise as during an hour in class, then as much dust would be inhaled in one hour in the Gymnasium etc. as in three in the School-room. But this calculation is below the mark, The deep In-breathing which precedes the act of straining, and the quickening of respiration (to the verge of breathlessness) which follows on Exercises of Speed or severe Exercises of Strength, undoubtedly force the particles of dust far down into the Lungs. *Hence physical exertion in foul and dust-laden air is always a questionable good*: the ill effects may outweigh the benefits.

With regard to other sources of dust etc. in Gymnasiums and other closed places, little need be said beyond just mentioning mats and mattresses, dirt from the boots and shoes, dust from the clothes, etc., and suggesting some sort of polished floor without joints, and constant cleanings with damp cloths.

With regard to methods of Heating, a good central furnace (preferably with steam-pipes) is the best; Heating with gas is too expensive and uses up too much Oxygen. If the Gymnasium is heated by stoves, those should be chosen which can be made up from the passage outside, the opening being on the further side of the wall and not in the main building. American buildings are, as a rule, ridiculously overheated in the winter.

It may further be observed, that young people suffering from Consumption, to however slight an extent, should be excluded from such closed places of Exercise.

If Government has any duty towards citizens, it is the duty of helping them to be as healthy as possible. Yet almost everywhere there is the same gross neglect of ventilation: Vaccination, education of a certain kind, water-supply, and so on, are attended to; but Ventilation is left to itself. And, in daily life, if one person insists on all the windows being closed, the ninety and nine must suffer. Women are the worst offenders here. Why should we not have *Open-Air Rooms and Open-Air Compartments* in Hotels and Trains etc.? Surely it is almost as important to be able to escape Carbonic Acid and other poisons as it is to be able to escape Tobacco-smoke. Those who did not like the Open-Air Compartments could avoid them.

## EXERCISES FOR THE LUNGS.

Of all exercises, those which specially affect the Lungs are among the most absolutely essential. They are essential not only for the proper development of the whole body and every single part of it, but also for preventing and curing diseases of the Lungs and illnesses in general.

Particular objects are as follows:—

1. to strengthen the muscles of ordinary Breathing, e.g., the Diaphragm;

2. to strengthen the extra muscles of Breathing: those from the Shoulders, the Arms, the Spinal Column, and even the Pelvis, may act upon the Chest-Cavity or Thorax;

3. to preserve and to increase the elasticity of the Lungs and Chest-Cavity or Thorax, and to develop evenly all parts of the Lungs; also to expand the Thorax and permanently to heighten the capacity of the Lungs;

4. to deepen the ordinary Breathing and to reduce its rate;

5. to stimulate the Circulation, closely associated as it is with plentiful Breathing, and so to stimulate all the processes of Change in the body.

The following measures help to achieve these ends.

I. The exercising and strengthening of the muscles of the body, especially those of the chest, arms, shoulders, and back. By this means the muscles of 'forced' In-Breathing become stronger; a graceful carriage is attained and this is of great service to free Breathing, since it helps the upper parts of the Lungs to expand better; and, above all, the increased stretching of the muscles of the chest and shoulder lift up the Thorax and the Sternum.

On the other hand, *an excessive (athletic) development* of the muscles of the chest, arm, and shoulder may lift the Thorax and fix it in the In-Breathing position, and so *may impede Breathing* in another manner. It may be added that such an 'athletic' development of the chest can only be attained by Exercises of strength which demand frequent straining or pressure. As it has already been observed, this process, if constantly called into play, not only injures the action of the Heart, but is also apt to produce excessive stretching of the Lungs.

II. *Intentional or Voluntary Breathing-Exercises.*

(A) Simple Breathing-Exercises. These are done in the First Position, the upper arm lightly laid at the side of the chest, the lower arm bent at a right angle at the elbow, and the hands clenched. Such Exercises are;

(a) voluntary deep Breathing, quick or slow, and with an even rhythm of In-Breathing and Out-Breathing;

(b) the same with the In-Breathing prolonged and the Out-Breathing shortened and quickened, or *vice-versâ;*

(c) occasional holding of the breath for as long as possible —intermittent In-Breathing;

(d) *staccato* Out-Breathing;

(e) Breathing with certain parts of the Lungs, such as upper-chest Breathing, flank-breathing, or abdominal Breathing.

The employment of this kind of exercise is of remote antiquity. It is said to have been cultivated in a complicated fashion by the Chinese long before our era. Being Intentional or Voluntary, however, it is more tiring than 'Unintentional' Lung-Exercises, especially Games, in which we forget that the Lungs are being exercised.

For its value, see below.

These and the following Breathing-Exercises form an important part of every course of teaching for stammerers.

(B) *Breathing Exercises together with various Positions and Movements which help them or hinder them.*

($\alpha$) *To make the In-Breathing harder* there are certain Obstacle-Exercises for the Breathing-muscles. Under this head come: drawing the breath through a thin tube (a straw, a glass-tube, etc.), drawing the breath through one nostril only, the other being closed with the finger; the attempt to breathe with mouth and nostrils closed; the In-Breathing of rarefied air, and so on.

($\beta$) *To make the In-Breathing easier.* During the above Exercises, which, by the way, are but seldom employed, the Breathing-muscles are forced to a more violent exertion and the filling of the Lungs is impeded, while here the reverse will be the case.

Together with the In-Breathing should come certain Exercises that lift and expand the chest-cavity or Thorax. Of such are the stretching and backward-bending of the trunk, when you forcibly throw the arms back, or lift them high in the air. The important upper parts of the chest are expanded when you lift your shoulders, and when you move your arms from a straight-upward position to the back of the head, meanwhile turning the palm upwards. You may also lift up a stick and bring it down behind the shoulder-blades.

($\gamma$) To make the Out-Breathing difficult. This also mechanically inflates the Grape-like Vesicles in the Lungs, and strengthens the muscles of Out-Breathing, which undergo a kind of Obstacle-Exercise.

The Principle of this Exercise is seen when we breathe out very forcibly, but when there is something to prevent the air coming quickly from the Lungs,—as in loud and prolonged singing and speaking,—this must be preceded by a deep In-Breathing. Professional singers and actors usually have well-developed Lungs.

Under this heading comes the playing of wind-instruments, such as the trumpet, trombone, horn, oboe, bassoon, flute, etc. The air in the chest is violently compressed by the action of the muscles of Out-Breathing, and can only escape slowly under high pressure through the narrow opening of the lips or the narrow mouth-piece of the instrument. This produces high pressure of the air in the Lung against the Lung tissue, like that which is produced by straining.

($\delta$) *To make Out-Breathing Easy*, so as to empty the Lung more thoroughly. For this purpose it is useful to breathe out in rarefied air. Some instruments enable people to inhale compressed air and to breathe-out in rarefied air.

The apparatus of Geigel and Mayer, or that of Waldenburg, or of Finkler and Kochs, etc., might be mentioned. There is also a special Breathing-Chair invented by Zoberbier and Rossbach.

If is of more importance, for exercises at home, to perform, together with the Breathing-out, such movements as promote it. Among these are the lowering of the lifted arms, the bending forwards of the trunk, low bending of the knees, etc.

(C) *Exercises which help deep Breathing unintentionally.*

As has already been explained, Exercises of speed and endurance cause a spontaneous and involuntary increase in the volume of Breath in every part of the Lungs. This increase quickly reaches the utmost limit of Lung-capacity, multiplying the volume to many times the original amount. *No voluntary Breathing-Exercise can effect an equal increase* as regards either extent or duration. Exercises and movements which come under this head are quick walking, running, mountaineering, jumping, rope-jumping, swimming, rowing, cycling, wood-sawing, working at an Obstacle-apparatus, as at the apparatus for mountaineering, Gartner's Ergostaten (winch-turning), the artificial rowing-boat, and other mechanical contrivances which set great masses of muscle working rhythmically.

Most Games will come under this heading, especially Football, Cricket (at times!), and most Ball-Games. See below.

Here, again, we must distinguish between brief and long-sustained quickening or deepening of the Breathing-power.

### FURTHER IMPORTANCE OF 'EDUCATING' THE LUNGS.

Of all the aims of Physical Culture, one of the most imporant is the sound and the complete development of the mechanism of Breathing. *What is neglected in this respect during the years of growth and development can, at the very best, be only partly made up in later life.* So close are the relations between Breathing, the Circulation of the blood, the formation of blood, the expulsion of Waste-products etc., and other Changes which go on in the body, that its correctness and its proper development in the very early years of life up to the very latest cannot be too often insisted on.

It is true that without proper Breathing life may still continue: but it is really rather existence than life. No human being, no part of a human being, neither his 'physique' nor his brain, can develop as God intended, unless the Breathing be right. It is not enough merely not to die, or merely to keep up a moderate level of Health.

On the contrary, the powers of our young should be so practised and trained that they may be capable of dealing with *any* conditions of life, even the most exceptional. A youthful generation, brought up on sound principles of Health, should enter upon the world with a body as hardy as it is elastic; should have the power of directing this body with perfect skill; and should of course be endowed with the moral qualities of determination, self-confidence, and courage; but these without

Health cannot do themselves justice, and proper Health without proper Breathing is a physical impossibility.

It is necessary that those portions of the Lungs which do not take part in ordinary Breathing, and which would 'atrophy' from lack of use, should be fully developed and kept ready for action by suitable Exercises from time to time. *The best-developed Leg-muscles are worthless for rapid or prolonged running if the Lungs are in ill condition for exertion; for we run as much with our Lungs (and our Hearts) as with our Legs.* As soon as the Lungs grow weary and the power of Breathing is exhausted, the most powerful muscles of the body give way. The pleasure of vigorous walking, especially in mountainous places, is for him alone who can respond easily and without inconvenience to the enormously increased demands on the power of respiration.

Moreover, a complete development of the Lungs is, as we have seen, essential to the power of resisting Lung disease. If such *should* set in, it is much sooner and more thoroughly overcome by Lungs of sound capacity. Portions of the Lung which take no part in the process of Breathing, will lose their elasticity and become bloodless. In such parts the germs of Tuberculosis are readily implanted. This may be seen in the melancholy prevalence of Tubercular disease in Germany; no common malady is so deadly.

And, to repeat, when once the Lungs have been well-developed, it is a grand error to give up Exercise suddenly, and thus let the extra parts no longer have 'play'. This is a common source of illness with old Rowing and Athletic men.

Another point must be noticed as well.

We have already seen that our volume of Breath while we are in a sitting posture is small, very little above that in a recumbent posture: if we set it in the latter at 1, in the former it will be 1.18. At his desk, therefore, or on his form, the child breathes with only a small portion of the Lung-surface. *The upper parts*, more especially, are hardly ventilated at all; and *this is the case particularly in the posture assumed in writing*. Hence the obligation of sitting in School forces the growing child, with his exceptionally great need of active changes in the body, to breathe inadequately for many hours together.

Axel Key found that, in some Preparatory Schools for boys, the first year (beginning when the pupils reached the age of 7) brought about a terrible increase of anæmia. After one year of school every thirteenth boy was anæmic, after two years every sixth or seventh, after three years every fifth. The figures in the girls' school were higher still.

And business-men, who do so much sitting, might well bear this in mind: they are wont to go home and sit still more, and at night to lie. If they insisted on Exercise (or special Exercises) in the early morning, in the evening, and perhaps at mid-day too, their work as well as their Health would be twice as good as it is.

*If, after these considerations, we ask what form of Lung-Exercise is best and most natural for growing children, we find that it is unquestionably the Exercise of speed in the open air.* No kind of Voluntary Breathing-Exercise produces anything like the increase of volume brought about by the 'involuntary' Breathing in exercises of speed and endurance. The Chest-Cavity is enlarged in every direction, every part of the Lungs comes in to play, the gases are freely interchanged, and the Heart's action and the Circulation of the blood are greatly helped.

If actual exercises of endurance, such as long walks, cycle-tours, etc., are more suitable for the years of maturity and for grown-up people, for the years of growth before maturity the most beneficial of all Exercises are those of speed pure and simple, and above all, Exercises involving running. At no age is it so easy: a grown man is not so capable of running so much and so constantly, of racing about till he brings himself to the verge of breathlessness and the next moment being ready for renewed exertion. It has already been explained that the relative size of the Heart and Arteries in a growing child largely accounts for his easy endurance of quick running.

And of all Exercises which involve Running none are equal to Games: the pleasure, the healthy emulation, the pauses, the variety, the chance for independence, the feeling of playing for a side, and other advantages (see below), are not to be found anywhere else.

With regard to those who are weak, there is imminent danger that Lung disease may establish itself in the apex of the Lung, which is little or not at all used in the work of Breathing. To set the weak to work at once on Exercises of Speed would profit them nothing. For, because of muscular weakness, the power of drawing a deep breath does not yet exist; it must first be developed by proper Exercise. Here, therefore, the object must be to lift the chest or Thorax and make it moveable, by strengthening the muscles of the Neck, Chest, Shoulders, and Back.

For this purpose, first of all, those Exercises must be used which we have already mentioned as good in correcting an awkward and defective carriage, viz., suitable Exercises without apparatus, either by themselves or with walking Exercises. As the carriage improves and the head is better held, as the Arms and Shoulder-blades are drawn back, the front wall of the Chest lifts of itself, and comes more freely forward.

Particularly effective in almost every case is *Voluntary deep breathing with positions and movements favourable to In-Breathing or Breathing-out.* Of these we add a brief Summary.

| While Breathing-in. | While Breathing-out. |
|---|---|
| Military carriage, head back. | Head bent on chest. |
| Trunk stretched backwards. | Trunk bent forwards. |
| Shoulders raised. | Shoulders lowered. |
| Shoulders set back. | Shoulders drawn forwards. |
| Arms akimbo, elbows set back. | Arms akimbo, elbows drawn forwards. |
| Arms horizontally stretched out sideways, palms upwards. | Arms horizontally stretched out forwards, palms together. |
| Arms stretched out sideways and then raised. | Arms depressed. |
| Lifted arm brought to back of head, palm turned upwards. | Arms brought down in front and pressed to the Chest; the trunk slightly bent. |
| Stick raised high with both arms and brought down behind the shoulder-blades. | Arms lifted over the head and brought down in front. |
| Rising from bent knees. | Bending the knees low. |

These Exercises, singly or (when possible) combined, should be carried out in time and 'at the word of command', first without weights, and then with dumb-bells, sticks, or clubs, and accompanied by deep In-Breathings and Breathings-out. They might at first be done by the young under the supervision of an expert. At the beginning they are apt to be very tiring.

The duration and the difficulty should therefore be very gradually increased. It may further be observed that these Exercises are best practised in the open air, under cover from the wind; if in a room, they should be practised by the open window. The clothing worn must be loose enough to give free play to the Organs of Breathing: no tight belt or corset can be allowed.

These Exercises must at first be done singly, and again and again, till each by itself becomes easy: not till then should they be combined: see Part I.

Very slow mountain-climbing, in which one Breath in or one Breath out is given to every step upwards, is also useful where it can be obtained.

Not till there is a sufficient improvement in strength should Exercises in running be undertaken by the weak.

**In Ball-Games especially it is of the very greatest importance to see that the In-Breathing and Out-Breathing are done at the right time.** I have never seen attention called to this, but it is obvious that the In-Breathing should usually come when, for instance, the shoulder is being lifted, and the Out-Breathing when the downward movement is being made. This is only a general statement, but it would be well worth careful examination. On the principle laid down, this In-Breathing and Out-Breathing must be practised with each separate movement and Exercise *per se*. When once the Game itself has begun, these is no time to think of such things. The difference in lasting power, during a long Game, would be very considerable. Many movements would help the Breathing, and the Breathing would help many movements. Already we often see to this unconsciously, but if we devote careful and conscious thought to it beforehand, while we are practising on the Part-by-Part plan, the correct method will soon become an exceptionally valuable habit. I believe that a good deal of the power of a hard 'Drive' at any Game is due to a correct timing of the Out-Breathing as well as to a correct timing of the Stroke itself.

This matter is recommended to the notice of every Athlete.

## THE SKIN, TEMPERATURE, CLOTHING, WATER.

Figure 182 shows that the skin is by no means merely a protective outer covering for the body; important functions go on in the skin. Above all, it is a valuable Organ for getting rid of gases, Waste-matter etc. It throws off from the body a small amount of Carbonic Acid (it has been estimated at only a one to two-hundredth part of what is got rid of by the Lungs), of watery vapour, of sebum, of sweat, and, in the sweat, of a number of injurious materials which we have already learnt to know as Waste-products (see § 72).

The skin is constantly being renewed. It therefore plays an important part in the process of changes in the body.

But this is not all. The skin contains blood-vessels, and by the varying fulness of these, as well as by the sweat which is

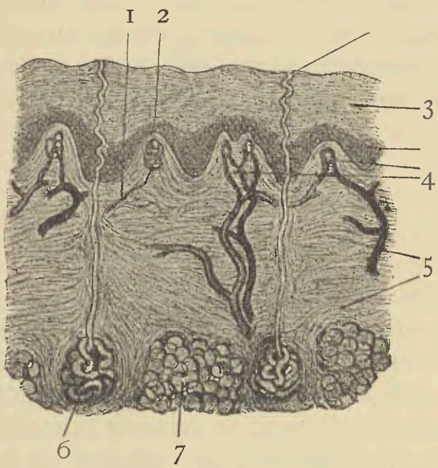



Fig. 182. Section of the skin magnified about 50-fold.
1. Nerve; 3. Horny layer and Mucous layer; 6. Sweat Gland; 7. Fat-cells.

expelled, the skin increases or lessens the loss of heat by the body, according to the temperature of the air outside.

Besides this, the skin may be said to 'feel': in its nerves lies an important part of the sense of touch.

The action of the skin is of the highest importance for the healthy discharge of all Organic functions, nor will anything atone for the lack of it. If it is interrupted over large areas, e.g., by surface-burns or scalds, or when the skin is covered with some substance that excludes the air (such as macintosh or varnish), death is very apt to ensue.

The skin varies in colour according to the race, the time of year, the manner of life, the food, and so on.

Even in white people the cells of the mucous layer take a deeper colour in unprotected parts of the body (face, neck, arms, hands) from exposure to the rays of the sun. This, combined with a livelier circulation of the blood, gives a warm, brownish-red tint to the skin of these parts. This tint contrasts strongly with the whiteness of the parts which are always covered (e.g., of the nape of the neck). Since this 'sunburnt' appearance can only be produced to any marked extent by brisk movement in the open air, it is rightly taken as a sign of vigorous Health.

But the red skin which may arise from an excessive use of Alcohol etc. must not be confused with this. It is a great fallacy to assume that a red-faced man must be healthy and strong. More especially is the red on the nose or just by the cheek-bone by no means a sign of good Health—it is quite the reverse.

## FAT.

A certain amount of Fat may be good: so long as the Circulation is free and the blood is pure, so long as active Exercise is not handicapped, so long as the Breathing is easy and regular, and so on, little harm may be done. But, when once the skin feels soft and spongy, and the Circulation and Breathing are slow, then it is time to remedy the evil—for an evil it is. No amount of reputation for 'jolliness' or a 'jolly' appearance can hide the truth. And the evil is best combated at once: for fat people do not avoid fattening things—look at the habitual beer-drinker, for example, or the regular City Banquet eater. Among the best helps, apart from Exercise, is the avoidance of Fattening or Heating Foods and of Excessive liquid.

Of the effect of fatness on the Heart, in particular, we have already spoken.

## SWEAT.

More sweat is got rid of owing to (1) higher temperature around (great heat of the air, Turkish or hot-water baths, etc.); (2) a large amount of water in the blood, especially after a large quantity of hot liquid has been drunk (hot tea will produce perspiration); (3) Increased activity of the Heart, as in severe muscular exertion.

The amount varies considerably in different persons. Fat persons whose tissues contain a large amount of water easily get into a perspiration.

With regard to Heat and Cold, it is worth while to remember that the warmth of the surrounding air has practically no effect on the temperature of the body. A man may dwell in the tropical heat of the African sun, or may go to the Arctic Sea near the North Pole; here his temperature is about the same as there.

Therefore, when the surrounding air is cold, we are apt to need more heat to keep up our own temperature inside: we use up more heat, and get rid of some of our store of fat and of Heat. But when the air is very cold our loss of heat is prevented as far as possible; when the air is very hot our loss of heat is increased as far as possible, lest our temperature should rise too high. So careful is Nature to keep it constant, while we ourselves are for the most part unconscious of her work.

### SKIN-BREATHING.

We breathe in and we breathe out through the skin: through it we breathe in Oxygen, and we breathe out Carbonic Acid gas and other gases, but not in large quantities.

Nevertheless, the effect of bare feet and legs is found to be quite appreciable, and Air-baths for the whole body are esteemed of great value in the German Nature-Cure System. Light-Baths also effect the skin considerably, and Sun-Baths as well. The exact effect of Electric *Light* on the skin has not yet been estimated. It would be well worth while for the reader to study closely the whole of the German Nature-Cure System, apart from Swedish Gymnastics.

### NATURAL REGULATION OF THE TEMPERATURE OF THE BODY.

We know well how the colour of the Skin brightens with joy, how it reddens with the blush of shame, how it grows pale with terror. These affects are produced by the nerves, which act on the blood-vessels.

Certain colour-changes (due to the blood) can be produced in other ways also.

As is shown by the large amount of Carbonic Acid thrown off in cold weather, and its decrease in hot weather, external cold quickens the changes in the body and with them the production of heat. In cold, moreover, the body involuntarily tries to produce more heat by movement, as is seen when we shiver. In the same way we try to produce more heat by voluntary movement in cold weather, by flapping the arms, by stamping the feet, and so on. In the cold weather we are particularly inclined for violent muscular exertion: it is felt to be warming and cheering. During brisk continuous movement a higher degree of cold can be endured easily and without harm.

And not only will hot and cold weather alter the blood, and drive it to the surface or from the surface; not only will exercise or the want of exercise do this; hot and cold water will do it also. For our Health this knowledge is of the greatest value, for it is so much easier to obtain hot or cold water at will, than to obtain hot or cold air. The use of hot and cold water on the surface of the skin is another feature of the German Nature-Cure System. Nothing is so excellent and so safe and so easy, e.g., for very cold feet or hands, very hot feet or head, etc.

With regard to excessively hot weather, a few words of advice may be helpful, especially for those who intend taking hard exercise.

The clothing should nowhere pinch or fit tightly, and it should be very loose round the neck; plenty of water should be drunk at short intervals, while Alcohol should be avoided.

Water should never be gulped, though gulping gives a delightful sensation: neither should much more be drunk than is needed to quench the thirst. The more you drink, the more you will want. There are occasions, however, when a good deal of pure drink (taken in slowly) will be a very great help. A cool bath (or sponging or wet-towelling), and a good gargle with water which is not too cold, may prove the best thirst-quenchers.

To prevent sunstroke, a well-ventilated, light, and non-conducting hat should be worn, e.g., a white pith-helmet or a light straw hat; or the head and back of the neck should be protected by a white cloth or damp leaves in the hat itself.

## EXERCISE IN THE OPEN AIR AT DIFFERENT TIMES.

The fitness of Exercise in the open air must depend, among many other things, on the warmth of the air, on the moisture of the air, and on the force of the wind.

As to the warmth of the air, the warmer it is, the less inclined we feel for exertion, as a general rule, though much depends on the state of Health and training, and on habit, and on the clothes. In light clothes hard exercise becomes far easier. Even in England we have not yet reached the perfection of clothing for Games in summer.

Secondly, as to the moisture of the air. Hot air when it is saturated with moisture and makes itself felt in a relaxing sultriness, hinders the proper regulation of temperature, and is unsuited for violent exercise. Hot dry air, on the contrary, quickly carries off the perspiration, and so gives a degree of refreshment which permits of moderate exercise.

A breeze may often be a great help to Exercise: it was the sea-breeze that did much to make the ancient Athenians so energetic.

We can best prevent overheating on the one hand, and colds and chills on the other, by taking the easier forms of Exercise on a hot day, exerting ourselves more in cooler weather, and putting forth the utmost amount of exertion or perseverance when it is really cold.

In England on the whole we manage this excellently: Cricket, it is true, is hard work, but it has its long intervals for most players (as they know to their cost). Lawn Tennis also is not wont to be too exhausting. Golf and Croquet etc. are also suitable for hot weather. In colder weather Football is *the* Game: Rackets, Fives, Running, etc., are also good. But we make *some* mistakes.

## CLOTHING.

Considerations of health, decency, and beauty, require a great part of the human race to envelop their bodies with more or less clothing.

The satisfaction of the sense of beauty by the shape, colour, and material of the clothes and other ornaments may well be given the lowest place. As for decency, that is a question with which the greater or less completeness of the covering has nothing to do: the only criterion is in the ideas and opinions of the various races. A young savage with nothing on except a narrow apron may seem perfectly decent, while a strikingly 'dressed' woman may seem the very reverse.

It was chiefly the desire for Health, perhaps, that led man to adopt clothing: for man is not clothed with natural hair. And this clothing, when it is rightly chosen, helps the skin to regulate the temperature of the body.

When we are well clothed we need less warmth to keep up the heat in our bodies, and we therefore need less food to keep up that warmth. Thus clothing may have its economical value: it may save food.

One layer of clothing may prevent the body from giving off too much heat; but two or three layers may do still more in this direction, for Air is a bad conductor of heat: it is a far worse conductor than Water.

From this it is sufficiently evident that several layers of thin material, with a layer of air beneath each one, will be likely to 'conduct' worse, and therefore to keep you warmer, than a single garment, however thick, worn over the bare skin.

The warmest materials are those which conduct heat least, as containing most air in their texture, e.g., sheep's wool. Cotton and twisted silk are better 'conductors' and therefore less warm. This of course assumes that the materials are dry. For wet material, if it is porous, is a good 'conductor' of heat.

A macintosh or a newspaper, however, are among the most warming things that we can get: the warmth may not be healthy, but it *is* warmth, as the poor of London know.

A point of special importance with regard to the choice of material is its capacity for absorbing moisture. A woollen material will absorb twice as much moisture (perspiration from the skin) as the same weight of linen; the linen gives off the moisture it has absorbed twice as fast, and dries in half the time. A wet handkerchief dries quickly on exposure to the air, whereas a wet sock or stocking may remain damp for a long time.

Linen, owing to this evaporation, will give a pleasant feeling of coolness to the skin, in the open air and in summer, to those who are wont to wear it; but in winter, and to those who are not wont to wear it, the feeling will rather be one of chilliness. Wool will not give this feeling of chilliness: the moisture from it will not evaporate so quickly.

But even the best woollen underclothing may be more or less irritating to the skin, even to the point of producing an itching rash; it may keep the skin in a constant state of perspiration, and makes it very sensitive to chill, i.e. it may be enervating. Thus both linen and wool have their advantages and disadvantages.

Cotton excels linen in its capacity for absorbing moisture: it does not cool so rapidly by evaporation, and, again, it has not the irritating effect of wool, and does not take so long to dry; and for these reasons under-clothing of porous cotton material is by far the most commonly used. Habit, power of resistance, and suitability to the particular occupation, make one or other material the pleasanter and more healthy to wear.

A good mixed material, not purely wool nor yet purely cotton, is to be had in Germany and elsewhere.

Advice about the best clothing for exercise is less needed in England and America than in Germany: here 'Flannels' are the rule, whereas any one who looks at illustrations of Germans at exercise (e.g., at those in this book) will see that ordinary clothes are very commonly worn. Few athletes or even average people, especially if they have been to an English School or University, would tolerate this. Germany has much to learn from England in this respect and in Games, just as England has much to learn from Germany with regard to special Health-Exercises.

For Exercise the many kinds of porous and light material that can be bought nowadays, of woven or knitted cotton or wool, have become very popular. Flannel and the various kinds of stockinette fabrics are deservedly preferred. As for the cut of garments for Games or Gymnastics, *everything should be avoided which hampers absolute freedom of movement:* the clothes should nowhere be tight, nor interfere with the breathing or with the Circulation in the surface Veins, as tight collars may do, or garters below the knee. The shirt should be loose round the neck, with short sleeves; or, if the sleeves must be long, they should not fit closely round the wrist. Tight belts should be discarded, as they impede abdominal Breathing. In Exercises requiring free movement of the legs, such as Running, Boxing, Football, Cycling, Rowing, etc., short knickerbockers, loose even at the knee, are the most practical. The stockings are then worn quite long, covering the knee, or short, only coming to the bottom of the calf, and leaving the upper part and the knee bare. The long trousers (now chiefly worn in some German Gymnastic clubs), which reach to the ankle, or are even stretched and fastened under the sole of the foot with a strap, offer resistance at every bending or forward-stretching of the Leg.

As to this tightness, small as its effect may be at any one single movement, yet in the constant repetition of movements the sum total of its effects may be very considerable. If anything, therefore, must be worn round the waist, let it not be too tight. Moreover, if a belt is worn, it should be wide rather than narrow and cutting. A sash is 'too pretty and showy to be good'.

For ladies, petticoats fastened tightly above the hips should be discarded altogether. A healthy corset of porous material may be recommended to prevent over-fatigue of the Back-muscles; a loose blouse; a short skirt of some woollen material; and (possibly) full knickerbockers, for some of those who have not short broad figures.

Hats should not have a leather lining. Of boots and shoes we speak elsewhere.

## CHILLS AND COLDS, AND HARDENING.

Nothing is commoner than to refer many kinds of illnesses (whether slight or severe) to a cold as their origin. The sufferer often knows with absolute certainty the day and the hour when he or she stood in a draught here or there, after having become very hot. Little as it can be contested that rheumatic pains in the muscles and joints, and catarrh of certain parts of the mucous membrane (in the nose, throat, and bowel), can have, as their immediate cause, a great and sudden change of temperature, with much loss of heat from some part of the skin, it is none the less true that the fear of taking cold is indirectly responsible for many of the diseases which result from cold, by helping to make a person liable to such diseases. *The widespread dread of fresh air, the fear of draughts, the excess of thick warm clothing, the use of thick feather-beds, the heating of bedrooms,* and everything else that is habitually done to *enervate the skin,* to destroy its splendid natural capacity for regulating the temperature, and to make it sensitive to every change and every breath of air, lay us open, at the slightest provocation, to colds, coughs, and rheumatic twinges. *In the mountains of Bavaria the peasants say 'he has over-heated himself'* exactly where we should say 'he has caught cold.' Who knows whether it might not be better for the health and vigour of whole classes of the population if, instead of being afraid of catching cold, they began to be *afraid of overheating themselves?*

In cool weather we go into a full railway carriage, where people have already been sitting for hours. What pestilential air do we often find there! And what furious objections are raised if we attempt to open the window ever so little, to freshen the suffocating air to some extent! The air in parlours, and in rooms of Hotels etc., in which so much time is spent, may reek with smoke, or may be as stifling as you please; but woe to him who would open a window to save his Lungs from inhaling such foulness!

And yet we know that large masses of persons who live much of their life in storm and shower at all times of the year, the many labourers and officials who are forced to expose themselves daily to keen draughts and sudden changes of temperature, do so without suffering in health, and are actually less subject to the diseases which come from cold than the indoor worker who is always careful to keep comfortably warm and who goes about in fear of the least draught.

It is therefore possible so to train oneself, that the skin may easily endure occasional cooling by sudden changes of temperature, and that the fear of draughts, of rapid chilling after heat, etc., may become a mere nurse's story to frighten children.

This hardening and indifference to weather is unquestionably a worthy aim of Physical Culture. *The training of the skin is a part of the harmonious development of the body.*

Much can be done by Clothing: would that every School and University, and many other Institutions besides, would follow the splendid example set by Loretto School. The Head Master has realised the primary conditions of *Hardening* the body. The system of healthy Clothing is a great success, from all that can be gathered.

Much also can be done by outdoor Exercises and Games, *during* which the chance of taking cold is small; *after* them, however, one should not sit about. Hot or tepid water, followed by cool or cold water, should be applied.

Much, again, can be done by the proper ventilation of *every* kind of room. It is here that we suffer much in England, and still more in America (during the winter): our colds may be caught outside, but in our rooms we may look for one of the more real causes.

Heated bedrooms are extremely enervating, and so are houses warmed by a central furnace, in which the staircases and passages are kept at an even temperature. A third part of our lives is spent in our bedrooms, and it is an important matter for the general health whether we there inhale impure and overheated air or such as is fresh and constantly renewed. The windows should be open at the top, and a little at the bottom also. If the coverings on the bed are warm enough there can be no fear of 'catching cold'.

But the most essential part of hardening is the regular treatment of the skin by Cold Water, including Baths.

### TREATMENT OF THE SKIN BY BATHS.

The skin, merely by its own action, gathers a layer of fats, 'salts', and horny scales, which stop up the pores by which refuse etc. should be set free. To this we must add the dust and dirt from outside. These must be removed by warm water. This is one of the primary requirements of Health as well as of Cleanliness. How far the Germans, and other Continental Nations, have fallen short of the ideal, is notorious.

Good pure soap is also of great importance: it helps to break up some of the material and to carry it off. In the German Nature-Cure System I was struck more than anything else with the excellent and free use of water, and the almost utter absence of soap. Soap should not be used on the skin directly: the skin should be wetted first.

The movement (most vigorous during the last 15 years) for providing cheap Public Baths, and conveniences for bathing in connexion with Barracks, National Schools, and Manufactories, bears witness to the greatness of the need, as well as to the keenness with which it is felt. The most useful form of these Cleansing Baths, the warm tub, has recently been supplemented by the Douche-bath. This is extremely cheap to fix up and keep in order, is very cleansing, and can be taken very quickly.

Full length baths of rather warm water are enervating to the nervous system if used for any length of time. Curiously enough, the effect of one kind of very Hot Bath, the Japanese (mid-day) Hot-Bath, is the exact reverse of this. It is very invigorating.

The general effect of a Cold Bath is as follows. At first the skin suddenly becomes cold, for it has already been mentioned that water, being a good 'conductor' of heat, draws out the heat from the body more quickly and to a greater extent than air: the small muscles near the surface of the skin contract strongly, and so do those of the blood-vessels; this contraction, however, is quickly followed by a corresponding relaxation, and by the flow of a large amount of blood to the skin; this produces a pleasant sensation of warmth. The redness of the skin (due to the blood flowing to the surface) is particularly noticeable after sea-bathing, or a bath in a rapid stream. We need only refer to the fact that to rub numbed limbs with snow produces a warm and invigorating flow of blood, and that the best thing for cold feet is to chafe them with cold water.

Cold Baths are thus a fine exercise for the Skin-muscles and vessels; they are 'Gymnastics of the cutaneous muscles', as the Physiologist Du Bois-Reymond called them.

Thanks to them, the Skin becomes *trained* to endure a sudden loss of heat: it becomes hardy; to the touch it will now be firm and elastic. Its 'complexion' will be improved. This will recommend its use to many ladies.

The sudden contraction of the blood-vessels all through the skin causes a great increase of *Blood-pressure*, so that the *Heart* is made to contract to its utmost power and the Breathing is deepened and quickened. Thus Cold Baths serve to strengthen and exercise the Heart and the Lungs.

To this we must add the stimulus of the sudden chill on all the sensory nerves of the skin. This stimulus induces a feeling of freshness and vigour, and awakens the delight in exertion and movement after the Bath.

The total result of all these processes, viz., loss of heat, stimulation of the Heart's action, deep Breathing, and stimulation of the nervous activity, causes very active changes in the body. And, with this, the need of food, i.e. the appetite, also increases.

Much of the effect of Cold Baths may therefore be summed up in the words '*hardening and invigorating*'.

The Cold Bath is, in fact, one of the most powerful *tonics* that we know of: and, *if* it is taken under the right conditions, it is certainly one of the very safest and least injurious. But it is not good or even safe for every one.

A few very necessary remarks may be added to the above account.

1. Do not take a Cold Bath when you are *yourself* cold: get warm first, either by warm water or by Exercise or by warm air (e.g., a Turkish Bath).

2. Do not take a Cold Bath when you are out of breath or tired. In this case a tepid (or, in some conditions, a very Hot) Bath will be better, at least to begin with.

3. Do not begin at once with the plunge, if you are at all weak: you can lead up to it by weeks of wet-towelling or (better still) by this together with *partial* Cold Baths; e.g., for the Feet, Hips, etc.

4. The Cold Jet of Water (tubing can be fixed to a Bathroom tap) is most excellent for local applications.

5. Alternate Hot and Cold, or (if you are weak) Warm and Cool, Water-Baths are worth trying.

6. Bare-foot walking in wet grass is also worth trying, if you *dare* do it, in the very early morning or late at night.

7. After Cold Water, *always* take Exercise of some kind. It is not necessary to dry the body first, though personally I generally prefer to dry once, and then to get wet again before putting on my clothes.

The cold Bath should not last too long. If it does the skin remains pale and the lips are bluish, a sign that the supply of Oxygen in the blood is insufficient. Use and habit can do much to decide what is beneficial. A good general rule is this: *the colder the bath is, the less time you should stay in it.*

Turning to the composition of the bath-water, we may observe that cold is less felt if it contains substances which irritate the skin, such as salts. *Cold sea-bathing* is consequently well borne by sensitive people, far better than fresh-water Baths of the same temperature, especially if taken in a river.

As to the Douche-Bath, its value is not the same for all. Irritable nerves may be only rendered more irritable by it, restlessness and insomnia may be promoted. We must further remember that the blood-pressure may be increased even more suddenly by the Douche than by the regular bath.

Far more suitable, and easy to use at all times and under all circumstances, is friction of the whole body with cold wet towels. This is best applied in the morning, immediately one gets out of the warm bed. It is valuable to remember this when one is travelling (as, alas, one often is) in places where baths are hard or impossible to get. For, *wherever* one goes, one is always *liberally* provided with towels!

# PART IV.

## III.

### FEEDING, DIGESTION, AND NOURISHMENT. TRAINING.

*Note.*—It sounds a commonplace, but the fact is frequently forgotten or ignored, that Food is not the same thing as Digested Food or as Nourishing Food, and that Digested Food is not the same thing as Nourishing Food.

A Nut is Food: it may be highly Nourishing, but, if swallowed whole, it is not Digested—it does not Nourish. Again, even if you Digested twice as much Food as you wanted, it would not all go to Nourish you.

As we shall see below, again, Nourishing has two senses: you might eat quite enough Nourishing Food, in the sense of Heating and Fattening Food, and yet die. Such Food would fail to build up your tissues.

## SOURCES OF PHYSICAL STRENGTH.

In all kinds of Nature-worship, the bearer of the light of heaven, the sun, exalted to a personality, takes the highest rank; and rightly so. For the vital force of the sun's warmth is probably one of the original sources of all forces of 'physical' life on earth.

The sun's rays help the plant to change materials taken from the air and soil (such as Carbonic Acid, Water, Ammonia, and Nitrogen) into elaborate substances some of which *we* cannot produce at all. For instance, plants produce Proteid or Albumen, and we can almost analyse it into its simpler parts, but we cannot produce it by mixing these parts together. In the process the plant throws out Oxygen.

Thus the vital force of the sun's heat is changed into what we may call chemical energy, which will take the form, e.g., of Proteid or Albuminous substances, or of fatty substances, etc.

These Proteids or Albumens, Fats, Carbo-Hydrates like Starch, etc., can be taken into our bodies either directly (as when we eat a pea), or indirectly (as when we eat part of a pig that has eaten a pea). In our bodies these substances change again.

When we take in Oxygen, they are partly consumed and resolved into Carbonic Acid, Water, and Urea, which last, when expelled from the body, soon dissolves partly into Carbonic Acid and Ammonia.

It was out of such elements as well as others that the plant had made that very pea which we ate. We have liberated some of the energy of the food as it were. The plants are among other things, a reservoir for preserving the otherwise fleeting rays of the sun.

Let us see what our body does to these substances: the exact processes are little known, but a vague outline is better than nothing.

## DIGESTION.

The body is made up, so far as Chemical Analysis can tell us, of Proteid or Albumen, Fat, Sugary and Starchy substances, Water, and what are called 'Salts' (especially Potash, Soda, Calcium, Phosphoric Acid, Sulphur, and Chlorine).

All these are in the blood, and so is the Oxygen which we need in order to consume, e.g., the Proteid.

The following couplet might be worth learning:

Proteids, Fatty-Heating Matter, Fibre, certain 'Salts', and Water.

We have seen that it is the blood which not only carries off waste from the tissues, but also brings them fresh materials. The blood, however, does not find these materials ready for use in just the right forms: and it also is wont to receive a great deal that it cannot put to any serviceable purpose.

It is the office of the Digestive Organs mechanically to break up and liquefy the Nourishment which reaches it (more or less prepared beforehand), and by the action of the Digestive juices so to change it that the nourishing substances, dissolved in water, may, in the form of chyle, mix with the Circulating blood.

## THE DIGESTIVE ORGANS.

The Organs of Digestion form piping of varying thickness, and this piping extends from the mouth to the other opening. The wall of this piping has *muscle-fibres which force the contents along*.

The several parts of the digestive canal are:—

1. The Mouth, with its Glands for Saliva.
2. The Pharynx and Œsophagus.
3. The Stomach.
4. The Intestinal Canal.
5. Other Organs, viz., the Pancreas and Liver.

The *Saliva* helps digestion, firstly, by moistening the food in the mouth, and by making it adhesive and slippery; secondly, by dissolving the soluble portions of it, so that they act upon the taste-nerves of the tongue, and are tasted; and, thirdly, by resolving the Starch contained in it into the more soluble substances of dextrin and sugar. The last-named function, important to the digestion of starchy food, is carried out by the action (fermentation) of a peculiar substance in the Saliva: it is known as Ptyyalin.

Thus we should masticate Starchy Food with especial care. The 'champing of the jaws' will pump the Saliva into the mouth, and, as we break up the Food, we shall also 'realise' its taste better. Not only shall we be less liable to suffer from Starchy Indigestion (which is only *one* kind of Indigestion), but we shall also need less Food, if we eat slowly. The Saliva is actually brought into the mouth by certain tastes, and even by certain thoughts, e.g., by the thought of licking the edge of a razor which has been cutting a lemon!

## THE STOMACH.

The purpose of the movements of the Stomach is (1) to bring the Food within it in contact everywhere with the Gastric Juice, which is secreted by the walls of the Stomach. To do this the walls of the Stomach perform a circular rubbing movement, one against the other, as when we roll a soft tough mass into a ball between the palms of our hands. In the Stomachs of birds which live upon grain, the hard husks are crushed in this way: it has even been observed that the same thing happens to hollow glass balls which have been swallowed. It is certain that the walls of the Stomach are enormously thick in such birds, in proportion to the birds' size. With soft and easily-digested Foods only a slight amount of this movement is required; the movement must be more forcible in proportion as the food to be digested is harder and less permeable by the Gastric Juice (e.g., in the case of Coarse Bread, hard Vegetables, Salad, etc.). Such Foods can therefore serve to exercise and strengthen the muscles of the Stomach.

The Stomach also has to move its contents to the Intestinal Canal by a series of pushes, as when we push something along within an india-rubber pipe.

Massage and other means may be made to help certain movements of this kind.

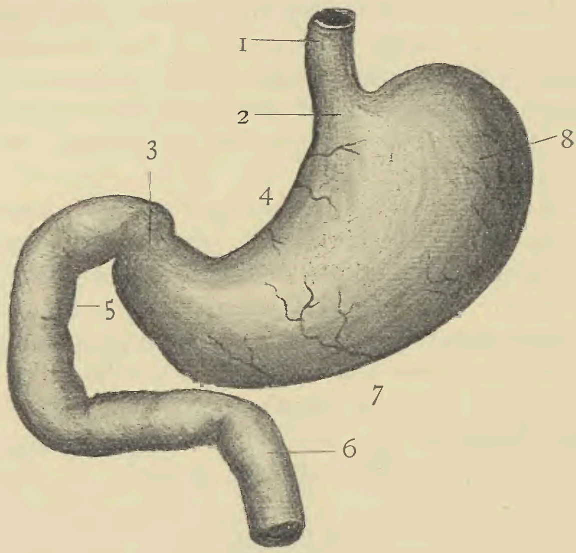



Fig. 183. The Stomach and Duodenum.

1. Œsophagus. 2. Orifice of Stomach. 3. Pylorus. 4. Lesser Curvature. 5. Duodenum. 6. Beginning of Small Intestine. 7. Greater Curvature. 8. Base of the Stomach.

The Gastric Juice contains two very active constituents: Pepsin, with Muriatic Acid, is able to change Proteid or Albumen into 'Peptones', i.e. into a soluble form, in which it can pass into the blood and can replace that which is lost by being used.

The Stomach thus has the power of digesting the Proteids or albuminous elements of both animal and vegetable Food. These various substances are digested more or less quickly, according to the way in which they have been prepared, etc.

Starchy substances and fats are hardly affected by the action of the Gastric Juice. They are not completely digested, therefore, until they reach the Intestinal Canal.

### THE INTESTINAL CANAL.

The Intestinal Canal is a pipe which (in the adult) is about five times the length of the body. The small Intestine takes up most of this length.

Into the beginning of the Canal (called the Duodenum) the Liver and Spleen pour their contents: the Liver supplies gall, the Pancreas supplies the valuable Pancreatic Juice.

Lower down, after passing through the small Intestines etc., we come to the Colon, which eventually leads to the back-opening. An enema of more than a certain amount of water will help to flush this Colon.

### DIGESTIVE JUICES.

We have already seen that the Gastric Juice helps to digest Proteids; other juices are the Pancreatic Juice, the Gall, and the Juice of the Intestine.

*The Pancreatic Juice* possesses, but in a far higher degree, the same faculty as the Saliva, namely, that of changing Starch into Dextrin and Sugar, and thus making it soluble. It is further able to change Proteid or Albumen into Peptones, like the Gastric Juice; and, finally, to break up the Fatty parts of food into the finest possible particles (this is called Emulsion) and to resolve the latter into Fatty Acids and Glycerin.

The Gall (among other things) distributes the Fat (in the chyme) in very tiny particles, so that the Intestines may absorb it.

The third Juice helps to digest Proteids and Starchy materials.

A Flesh and Proteid Diet leaves the smallest solid residuum, and a Vegetable Diet the largest. It is generally held that *some* residuum is necessary so as to give bulk to the motions of the bowels.

### ABSORBING BY THE DIGESTIVE ORGANS.

The Mucous Membrane of the Digestive Organs is not only able to form Juices from its whole surface and to mix them with the passing stream of chyle, but is also able to absorb from the chyle the digested substances it contains.

This absorption takes place by means of the thread-like Capillaries and the little vessels of the mucous membrane. In the Stomach, solutions of salt, sugar, alcohol, poisons, and drugs, can be absorbed.

It may be noticed that the Breathing-movements effect the flow of the Lymph-stream.

## THE SPLEEN.

The Spleen has something to do with the formation of blood, especially of the white Corpuscles. There are some who suppose 'Stitch' is caused by too much blood in the Spleen. It is said that some Eastern despots used to cut out the Spleens of their runners.

## ELEMENTS OF NOURISHMENT.

Material is constantly being consumed in the body, and Food has to make up for a good deal of this consumption. The elements of Food we have already noticed, viz.,

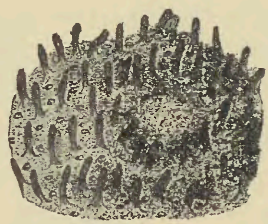


Fig. 184. A piece of mucous membrane from the wall of the intestine (strongly magnified). Notice the little Villi sticking up and the lymph-gland in the middle.

1. Proteid or Albumen, in Animal or Vegetable form. It abounds richly also in Pulses and Milk-products, and fairly richly in Grains and Nuts.
2. Fats and Carbohydrates (Starch etc.).
3. Water.
4. 'Salts' (such as common salt) to replace the 'Salts' used up in the blood; also Iron, etc.

## LUXURIES.

By 'Luxuries' we here mean Foods etc. in which the object sought after is not nourishment, (which in some of them is nil) so much as a pleasant and stimulating effect on the organs of taste and on the whole nervous system.

*Tobacco* is one of the commonest. Nearly all those who use it tell me that it effects both their eye and their 'wind' at Games and Exercises. The *immediate* effect is undoubtedly soothing, but the sum-total of effects on the Heart and Blood and Stomach and Lungs and Nerves cannot be properly estimated. Careful experiments made in America and elsewhere are dead against its use. But worst of all is its hold over the individual: to give it up for a year is a frightful struggle. It is bad to have any such habit, for it affects others as well as the person himself (or herself).

To many who do not smoke, the infection of the air indoors by the fumes of tobacco is disagreeable, and hurtful to the Breathing.

Smoking is usually forbidden in training. Some Rowing and Athletic Clubs even make the regulation that when members of the club are in training, no one at all may smoke in certain of the Club-rooms. With regard to Brain-work, to rely on smoking for power to work is a grand error: for, among other things, in very few Examinations is smoking allowed. Thus where the Tobacco is needed most it is least possible to use it.

About *Alcohol* only a few words can be said here.

(1) American and other experiments show its bad *immediate* effects, even in quite small quantities, upon the Digestion of Food, the tissues of the Stomach etc., and the Heart. We cannot yet safely assert that these effects are universal. But the expensiveness of Alcohol cannot be disputed.

(2) The *ultimate effects* of Alcohol are almost incalculable: but among them we notice that the drinking of Alcohol, so far from satisfying the desire for a long time, often actually increases the desire. The results of drunkenness, and especially of habitual drunkenness, are an extreme instance of immediate effects; but the sum-total of the effects of the regular drinking of a large amount of Alcohol, both upon the physical powers and upon the Brain, and upon morals and upon happiness also, can only be guessed.

(3) *Alcohol contains no 'Proteid'*. Some say that Beer 'has a certain nutritive value'; but as a matter of fact this is Fatty and Heating substance and not Proteid. *

* When in the best Training, and perhaps doing 10 hours' Brain-work a day, as well as hard Exercise at Rackets or Tennis, I often found that even a glass of Alcohol put me off: my powers went down with a rush. In fact, I believe that Alcohol has its best (immediate) effects when the health is worst and the blood most feeble or impure, but that for well-nourished and really pure blood its (immediate) effect would be depressing. (E. H. M.)

The following Table gives the volumes of Alcohol per cent. in many Liquors. But it must be remembered that effects do not depend on the amount alone. For example, Beer often has an aperient effect: Germans who take Beer and Coffee suffer from Constipation less than English people do who take Wine, Spirits, and Tea. Brandy is apt to be constipating. Moreover, one can drink more German Beer (which is brewed cold) than English Beer (which is brewed hot), though the amount of Alcohol is not correspondingly different. Some new wines which have very little Alcohol are highly intoxicating. Cyprus has such a wine.

TABLE OF VOLUMES OF ALCOHOL PER CENT.

| | | |
|---|---|---|
| 1. | Bavarian Beer | 3—4 |
| 2. | Beer for export | 4—5 |
| 3. | Cider | 4—5 |
| 4. | Ale and Porter | 7—8 |
| 5. | Common Moselle | 7—9 |
| 6. | Rhine wine | 8—10 |
| 7. | Madeira | 15—17 |
| 8. | Sherry | 17—19 |
| 9. | Common Brandy | 30—40 |
| 10. | Cognac | 55—65 |
| 11. | Rum | 75 |

In the following observations we need not consider the intoxicating effects of excessive indulgence in Alcohol. It is well known that, when habitual, it permanently destroys body and mind, and that drunkards bequeath to their posterity an enfeebled physique, mental weakness, and even a tendency to epilepsy and madness.

Alcohol, when absorbed into the body, is apparently not got rid of without alteration, but passes into the changes of matter, and, by being consumed, is resolved into Carbonic Acid and Water. One gramme of Alcohol yields on consumption about as much heat as the same amount of Fat. So far as it thus produces heat in the body, heat which might otherwise be supplied by a corresponding amount of Food-stuff (e.g., Fat or Carbohydrates), it saves these and itself becomes almost a Food-stuff. But it becomes a very bad one. *The heat produced is of little advan-*

*tage in the economy of the body, since it goes hand in hand with an increased loss of heat.* Alcohol relaxes the blood-vessels of the skin, making it red; it quickens Breathing and increases the blood-pressure shortly after it has been taken. Owing to this, more heat is lost and that to such an extent that the temperature of the body goes down. The sensation of warmth which follows upon drinking Alcohol is therefore deceptive. Alcohol ultimately reduces the temperature, a circumstance of which advantage has been taken in the treatment of fever.

Only so far, therefore, as the warmth it produces is not wasted by more rapid loss of heat, can Alcohol promote the heat and making of heat; Carbohydrates in the body also form Fat. On the other hand, *Alcohol is incapable of replacing* the least part of the most important nutritive and tissue-forming substance, *Proteid* or Albumen, and so of saving the Proteid of the body. *On the contrary, it decomposes and uses up the Proteid in the body. Now for the work of the muscles Proteid is of great importance.* In consequence, the habitual use of spirits does not render a man fitter for muscular exertion, but has rather an enervating effect, which makes itself felt more particularly in *prolonged* exertion. In habitual drinkers impoverishment of Proteids, loss of strength, and torpidity, soon set in. Only those who are able to combine with it a strengthening Diet rich in Proteids show less the enervating effects of the Alcohol.

Besides this, it must be remembered that the increase of fat, which is already promoted by the Alcohol, is very seriously abetted. We must further consider that the great amount of liquid taken into the blood in Beer etc. impedes the action of the (perhaps) fatty and enfeebled Heart; which explains the frequent occurrence of weak Heart in beer-drinkers. The evil effects of Alcohol are most evidently shown in constant indulgence in brandy. Nutrition, in any case reduced (as we have seen) by Alcohol, may be checked in these cases more particularly by the strong irritant effect of Brandy, which may induce catarrh of the coating of the Digestive Canal, and may seriously impair the actual digestion.

The moderate use of Alcohol excites the nervous system. The Pulse and the Breathing are quickened, the Blood-pressure is increased, because the Heart-nerves are quickened. The

Blood-vessels (especially of the head and neck) are dilated, the skin sweats and breathes more freely, the brain is excited. There is a general feeling of well-being which lifts the subject above the cares of life. His ideas flow more readily. Noble and ignoble feelings and impulses are alike quickened.*

## TRAINING.

No Training should be recommended if it renders the Brain unfit for a reasonable amount of work: the ordinary Rowing-man's and even (sometimes) the Athlete's Training is on this account to be condemned. If Training makes a man restless and fidgety and incapable of good Brain-work, then there is something wrong with it. The higher nature should be well served by proper Training; whatever serves it ill is improper Training.

Training should not be undertaken only for special feats of physical strength. After such a course of Training hundreds rush off and 'do a bust': a huge dinner, with all the etceteras, is followed by still further drinks, and so on. No Training should have this among its effects. After Rowing-Training this is, in England, the rule and not the exception.

Training should have a wider sense: it should

(a) train the body in such a way that *the mind also* may become fitter for work, and may do better work;

(b) get the body into a *Habit* that will last through life, so that the Training, which may begin perhaps somewhat under compulsion and as a hardship, shall be voluntarily and cheerfully *continued in after-life*.

It need not be continued in its utmost severity, but it should be continued if its effects are good for the person *all round*. If these are *not*, then the Training itself is somehow wrong. It may be better than ordinary living, it may produce success on a special occasion, but it is not the best.

* But it is not certain that these would be the effects upon a person whose blood was comparatively free from Fatigue-products (Uric Acid etc.). Nor does the above take into account the *ultimate* effects, which, after all, we have no right to neglect.

Dr. Schmidt, on the other hand, quite rightly says that, *during prolonged exertion* of all sorts, walking, mountaineering, cycling, rowing, etc., it is best to refrain strictly from Alcohol. He recommends Tea or Coffee, which for the time being removes the feeling of tiredness; but here again he does not mention the full effects. (E. H. M.)

By Training we understand generally the preparation for feats of physical strength. In order to attain the greatest capacity of the body for exertion, it is necessary: (1) to develop muscular energy [nearly] to the maximum, and (2) to reduce the fatigue, or the liability to fatigue, to the minimum. The method of doing this, apart from plenty of regular exercise, is to arrange the mode of life carefully. Of prime importance is proper Diet, and attention to the Lungs and skin. This brings the body into the condition of Training, i.e. into the best possible condition for performing feats, and enduring the fatigue from them, without injury.

To undertake severe Exercise without Training is apt to be dangerous in several ways.

It may here be remarked that, with a proper amount of the Simpler Foods, even a week of hard Brain-work, without any appreciable Exercise, does not appear to appreciably affect one's standard of play or quickness and endurance even in Tennis, which is one of the most exhausting and complicated of Games. *

After Training, it is a great mistake for most people to give up severe exercise with a jerk and to indulge in more luxuries even than before.

The various kinds of Training may be distinguished by their *Aims*.

1. *Health Training*. The object of this is to make the body as apt as possible for any kind of physical exercise, that is, to develop the body all round. It therefore will aim at a *tolerable* amount of excellence in Exercises of strength and skill, of speed and endurance. This is the kind of development which was brought to perfection in the old Greek contests, in the Olympic and other Games, where they had running, jumping, throwing the spear, quoit-throwing, and wrestling.

To develop *an all-round capacity for exertion* is one of the highest aims of Physical Education for the young; it is also one of the highest aims of the Exercises of the adult, though of course a preference may be given to this or that form of Exercise.

2. *Training for special Games, Athletic Sports, etc.* Such

* It is impossible to say how far this would be a *general* rule with the Simpler Diet, because so few athletes employ it. But in my case I seem to go on again just where I left off a week ago. (E. H. M.)

Training is apt to be guilty of absurd exaggerations: a special Training for heavy weight-lifting may produce strong muscles in the arms and shoulders etc., but a miserably weak development of other parts. Scientifically, however, the interest is that this may produce a 'Record'.

It might well be laid down as a rule that, side by side with a special Training, there should always be *some* Exercise for the other parts of the body. For example, the Rower should practise all sorts of Exercises to make his arms and wrists lissom and active. Already it is usual for Rowing men to walk and run as well. Weight-lifters should go in for *some* Exercises of Speed. Ball-Games players should use left-side Exercises; and so on.

But there are certain Games (e.g., Fives) for which the Training is well-nigh a sufficient all-round Exercise in itself, without supplement.

3. *Military* training. Military service aims at being a continuous training of all the physical and mental faculties required in war. Physically, the most important of these is the power of enduring the long marches when hampered with a complete equipment.

4. One particular kind of Training aims at *Reducing the Weight* to a minimum, without involving skill in any particular Exercise. Of this sort is the training undergone by jockeys. Their extraordinary and hazardous treatment of their bodies is only mentioned in this place, because the ignorant have often quoted it in proof of the danger to Health which 'Training' is thought to involve.

For the reduction of weight by the avoidance of Fatty and Heating Foods, etc., see below. To reduce weight is certainly a fine object. Many Germans would do well to train in this way.

5. To go into Training *for Brain-Work* is not usual. But the best Training for Games and Exercise often is (with very slight modifications) the best Training for Brain-work also. Hard Exercise need not be stopped when we want to do—say ten hours of hard Brain-work; nor need hard Brain-work be stopped when we are going to play, or after we have played, a very hard match.

RULES FOR TRAINING.

1. The *age* should be considered. No one should train severely while growing: Dr. Schmidt considers the 18th year as the earliest. The strain of Training is most easily borne between 19 and 30. After 30, not everyone can stand it. After 40 and 50 the Heart often forbids severe Training.

But, in so far as 'severe Training' means the abstaining from excess of all kinds and especially from Stimulants and Luxuries, no age is too early, no age too late.

2. Any person who desires to go into regular Training should first be examined by a Doctor, so that he may know whether his Heart and Lungs are sound. Inconsiderable defects in the Heart may remain undiscovered until it is too late. But with the increased demand for exertion, which comes with Training, the case is changed. The first results of Training, the lessening of the amount of Water and Fat in the body, the increase of red Corpuscles, etc., is to relieve the Heart and ease its action; this must be a gain, especially where this action is carried on under unfavourable conditions. Yet the demands made on muscular exertion by Training are so great that the power which is just enough for less strenuous efforts and which makes up for the defect in the Heart's action, may at length give way under the strain; the power of exertion is arrested at an unexpectedly low level, and the Circulation is disturbed. The same kind of thing happens with disease of the Lungs.

In cases of pronounced Anæmia, and weak and irritable Nerves, severe Training is also more than hazardous.

3. *Severe Training (esp. Muscular Training) should not be begun at once.* There should be a gradual leading up to the final Training: from a slower and gentler beginning, with many intervals of rest, progress should be made by degrees: the pace, strength, number of times, variety, etc. should be almost imperceptibly increased. This means that preparation should begin long beforehand.

Military Training in many countries, however, is wont to impose the strictest Training at once: this is a mistake.

4. Nor should severe Training be given up suddenly. If the members of Clubs would practise Games or Physical Exer-

cises as well as unite for social gatherings, they would not only retain a certain amount of their early activity, and so be better men all round, but they would also promote their personal energy and health to their own very great advantage.

5. With regard to *the best General Exercises*, Running, the exercise which more than all others strengthens the Heart and Breathing, plays an important part in almost every form of Training. For, after securing the right carriage and the right positions, or while securing these, the Blood-Circulation and the Breathing should be cared for—otherwise the Training will rest on an insecure foundation.

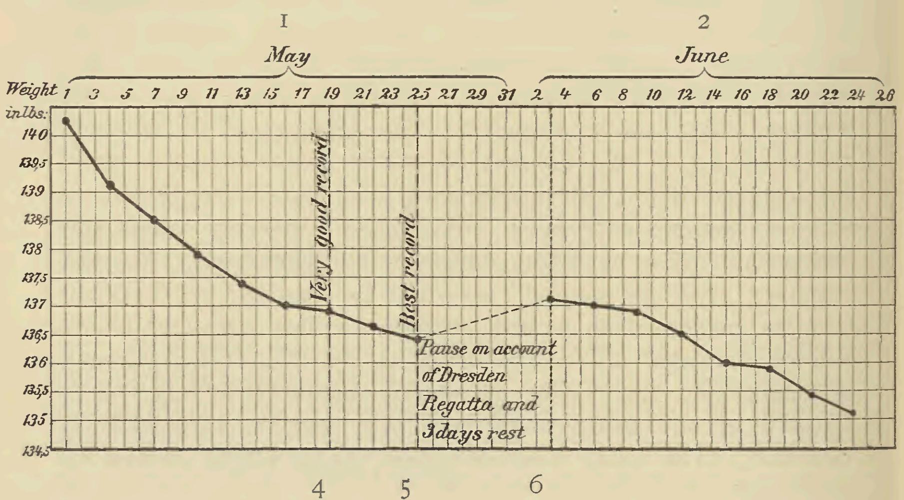



Fig. 185.

6. Training should aim at getting rid of *excessive* stores, especially of Fat and Liquid. Of Fat we have already spoken. Running is of great value here, and especially Running in the cold air.

Lagrange estimated the loss of weight in a runner, during Training, as follows:—

| | | |
|---|---|---|
| first | week . . . . . | 8 lbs. |
| second | ,, . . . . . | 3 ,, |
| third | ,, . . . . . | 0 ,, |

But much will depend on the Diet also, and at the end of Training the increase of Muscle may produce an increase of weight.

The Table (Fig. 185) will show a sample instance.

In training the object is not only to increase Muscle, but also to get rid of the superfluous Fat and Moisture.

The loss of masses of Fat round the Heart will free its action; similar masses among the Digestive Organs etc. free the action of those Organs as well as that of the Breathing apparatus.

To take the excess of water out of the body, to condense the blood, and so ease the action of the Heart, the supply of liquid should be considerably reduced.

A good deal of what is commonly called 'Fat' is really liquid.

The lessening of the water in the body is of importance because it eases the action of the Heart: it causes each beat of the Heart to force into the Arteries, and so to carry to the Muscles in action, as many red Corpuscles as possible in a given volume of blood. See above. Thus the supply of Oxygen is more easily brought about, and the Heart need not so soon be taxed to the uttermost.

This Dehydration, as it is called, can be helped, e.g., by Exercises, and by Hot Air- or Steam- or Water-Baths: the best Hot Air- or Steam-Baths are those in which the head is free, and in which the heat is given by the sun or by electricity.

The importance of the Skin as an 'excretory' Organ, not for the sweat alone, but also for other Waste-products when matter has been changed, renders a constant and appropriate treatment of it quite indispensable in training. Daily friction with cold water, e.g., with wet towels (see above), is the best possible means to this end; alternate warm and cool or cold Douches or Partial Baths are also to be recommended.

8. The influence of *Light and Air* on the formation of the red blood Corpuscles should be constantly remembered; for blood which is rich in red Corpuscles, i.e. in those Corpuscles which carry Oxygen, saves up the power of the Heart, and renders violent muscular exercise possible without rapid exhaustion of the Heart or Lungs. This and other reasons have led to Tobacco being strictly forbidden during Training.

9. With regard to *Diet* see elsewhere. *

* Personally I avoid *all* Flesh-foods (Fish, Flesh, Fowl) *and Eggs*. I get my Proteids chiefly from Protene and Cheese and other Milk Products, from Hovis Bread, Gluten, and other Grain-Products, and from Peas and Lentils. I eat a

10. Daily *Massage* may be of great value. Much of it can be done by the person himself. Massage has many valuable uses, which cannot be entered into here.

11. Constipation is one of the greatest hindrances to Health. It can be largely obviated by

(a) the avoidance of costive substances (e.g., Brandy, Tea, and probably Flesh-foods);

(b) Exercise in general, and special Exercises also;

(c) Massage of the right kind;

(d) Fruits, Vegetables, etc.

See further below.

12. Obviously Excesses of various kinds are bad for Training.

In conclusion, let us ask the reader to register carefully his *personal* experiences during long stretches of time: they will be interesting and useful not only to himself, but to mankind in general.

## THE VALUE OF CORRECT TRAINING.

Training, as we have seen, includes

(i) the greatest possible amount of regular Muscular Exercise: this should aim chiefly at strengthening and developing the Organs of Breathing and of Circulation;

(ii) a proper way of living, which shall (among other things) reduce the excess of Water and Fat in the tissues, enlarge the muscles, increase the red Corpuscles in the blood, and quicken the action of the Skin and Lungs. Luxuries and Stimulants, which lead to various evils, are also to be given up;

(iii) the getting rid of various poisons and Waste-products; which actually injure the Organs if they remain;

(iv) the improvement of the mental condition, e.g., its powers of memory, endurance, activity, versatility, etc.

*The Physical value* of Training shows as follows:

1. The Muscles become stronger and less liable to fatigue: i.e. they become capable of more endurance, and also

2. fewer Waste-products etc. are to be found in the body,

great deal of Fruit (fresh or stewed), and a certain amount of Vegetables. I avoid Stimulants and Irritating Sauces as much as is possible. I also avoid Sugar; its immediate effect may be stimulating, but I cannot accept Kolb's account of it, for the ultimate and full effect is not considered. (E. H. M.)

owing to the muscular exertion being easier; fewer have to be got rid, e.g., by the skin (in the sweat) or by the kidneys (in the urine);

3. less Carbonic Acid is produced in the body owing to the same reason; less, therefore, has to be got rid of by the Lungs; Fatigue and Breathlessness do not come so quickly; and so

4. the Breathing becomes slow and deep and quiet; the rate in repose falls from 16 to 13 or 12; the volume of Breath increases, and with it the capacity of the Lungs (as registered by the Spirometer).

5. The Heart becomes stronger also, as we see by the less frequent beat of the Pulse, which may fall from (an average of) 69 in the morning to (an average of) 63. Volle has observed 58 or even 42 beats a minute. An irregular Pulse may gradually become regular through Training.

6. With the feeling of increased capacity comes a pleasant sense of strength, a pleasant self-confidence.

For various advantages besides these, see below.

Other *Moral* effects of (correct) Training come from the discipline and self-control, the perseverance, the feeling of contending for a side and not merely for oneself, and so on.

For many Moral effects besides, see the beginning of this work.

As compared with the self-indulgent 'pleasure'-seeker, the lover of Music-Halls, late hours, huge Dinners, Bars, etc., the man in Training shows to great advantage. The amount of determination, and of severe but self-imposed discipline of the mind and body, which people are wont to display in Training, must command respect even from those who have little sympathy with many of the characteristics of 'Sport' and Games at the present day.

As to how many of these effects are *lasting gain*, that depends largely on the individual. So far as can be seen, Training in England does not do what it should; the fact that its effects are so small in leading to a regular frugal and healthy life seems to tell against the system as it generally is practised to-day. If the Simpler Foods were adopted, and if the right amount of Proteid were insured, then the good effects would probably be permanent.*

* For my own part I can certainly say that nothing shall ever induce me to go out of Training if I can possibly help it. I wonder how many others could say the same. (E. H. M.)

## OVER-TRAINING.

After a certain point in Training it is often found that the person ceases to improve, and becomes what is called 'stale'. At this stage some recommend a rest, others a change of Exercise, others an increase of Stimulants and Luxuries for the time. Anyhow the capacity for exertion, and the skill, become less and less.

What are the chief *causes* of this?

(i). The *Food* may be to blame. The Food itself may not be appetising or well-cooked, there may be too little Proteid, or there may be enough in the food, but it may not all be used.

Very often there is too much of everything, and especially too much Stimulant: for Flesh-foods *do* contain a very powerful Stimulant. A rest from Food, a morning's 'starving' on dry bread and cold water, would sometimes be the very best thing. For it must be remembered that energy does not simply depend on the amount of Food inside us, but on the amount inside us which is *ready for use*.

(ii). 'Nervous irritability' may also do a great deal of harm: for example, it will hinder digestion. This again probably depends largely on Diet.

(iii). *Over-Exertion* may be another cause. If the Muscles are used more than a certain amount, they may grow bulky and slow; they may expand and keep expanded, and thus cease to be elastic. There are other causes as well, e.g., Special Diseases.

## THE KIDNEYS AND THE URINE.

The Urine, as well as the Sweat, is thrown off from the blood; but the Urine passes off through the Kidneys, the Sweat through the Skin. Less Urine is thrown off, and thus the Kidneys are to some extent relieved, if we sweat freely, or if we have Diarrhœa. But, on the other hand, the Urine may become too poor in water, and therefore thick, if we perspire too freely and do not drink enough.

It is vital to keep the Kidneys free, as well as the Bowels. There are some who imagine that swallowing huge quantities of Water must always 'flush' the Kidneys. It is not necessarily so. Salt and Water, however, and Salicylate of Soda and Water, do help to carry out certain Waste-products etc. with the water, that is to say, if they are not taken too soon before or after a meal.

The Urine is of great value as a test of Health: it helps to reveal Diabetes and Bright's Disease. But it can be made to show more than this—the Urea in it can be made to show (to some extent at least) how far we have used up the Proteid-supplies in our body. If the Proteid-substances are imperfectly consumed in the body, Uric Acid appears in the Urine, as well as small quantities of other nitrogenous bodies. Uric Acid in the Urine is particularly common in Gout.

Uric Acid can probably be introduced into the body directly by means of Flesh-foods, Meat-juices, Tea, Coffee, etc. In its *immediate effects* it is generally *Stimulating*, that is to say if the blood is already impure. The more impure the blood is, the more Stimulating is the immediate effect of the Uric Acid. Dr. Haig and many others believe, however, that *ultimately* this Uric Acid adds to the impurity of the blood.

# PART IV.

## IV.

## THE NERVES, RAPIDITY OF ACTION, PROMPTITUDE; FATIGUE.

THE NERVES, RAPIDITY OF ACTION, PROMPTITUDE; FATIGUE.

Diagram 186 gives some idea of the Nervous System within our bodies.

The Nervous System is mostly made up of Cells (Nerve-Cells) and Fibres.

The Nerve-Cells are chiefly collected in the 'grey' substance of the great Nerve-Organs, the Brain and the Spinal Cord; but there are Nerve-Cells elsewhere also.

The Fibres branch out all over the body: they are like coarse or fine or very tiny threads.

The Nerve-Fibres are like Telegraph-wires: they communicate to the central Organs news from the outer stations (the Organs of touch, sight, hearing, smell, taste) concerning the condition of things in the outer world, and in the body itself. If the Central Court, which holds its sittings in certain Nerve-Cells, is of opinion, owing to this news, that certain measures should be taken, that the body or any parts of it should move, then the necessary commands or stimuli (or, as they are called, excitations) are sent along the nerves to the muscles, which are the Organs designed to carry out the commands.

The Nerves, therefore, either tell news or else give commands: these Nerves are called, respectively, Sensory or Feeling Nerves and Motor or Moving Nerves.

With all sorts of Mental activity go certain material changes in the Cells of the 'grey' matter of the Brain; during active Mental exertion the Brain becomes more full of blood, and the changes of matter in the Brain are more active. Just as the Muscle is made less capable of action by the Waste-products, which gather together in it, so the mental 'muscle', the capacity for exertion, is weakened by Waste-products which gather together in the Brain.

Some substances excite activity (thus Uric Acid often does for the time being), others lull it to sleep (e.g., Morphia, sometimes Alcohol, etc.).

But these functions form by no means the whole of the work of the Nerves. We have already seen that Breathing and the

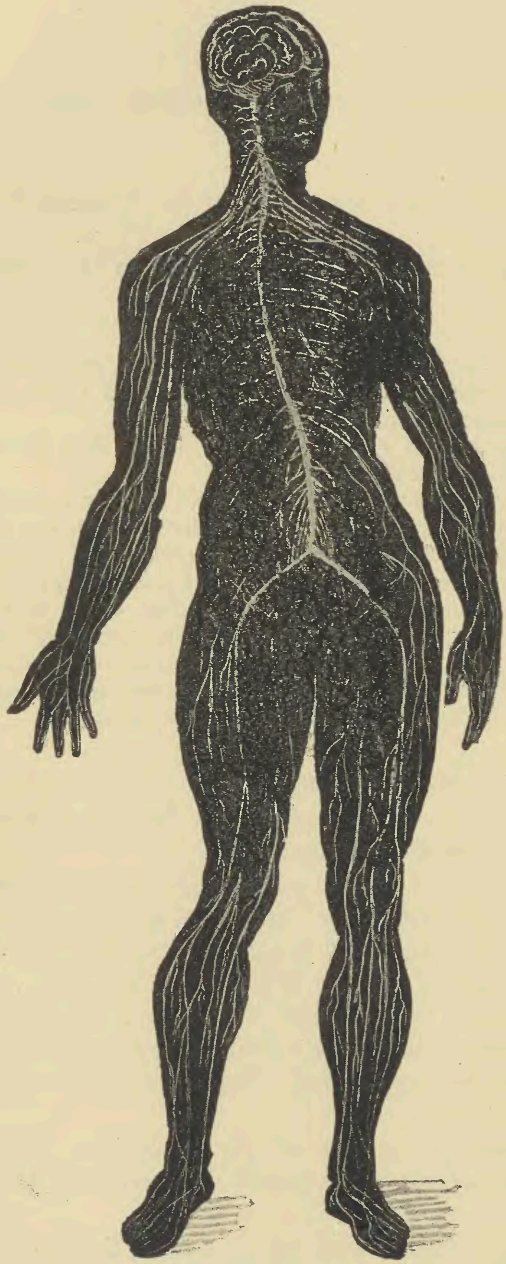


Fig. 186. The Nervous System.

beating of the Heart consist of rhythmic muscular motions in constant succession, the Breathing being usually involuntary, and the Heart-beats being quite involuntary, except in so far as we affect them by Exercise, etc. Now these motions cannot go on without Nerves.

The work of the Blood-vessels, the Digestive Organs, the 'excreting' Organs, and so on, cannot go on without Nerves. In so far as these motions are involuntary (i.e. uncontrolled by our wills), they are chiefly controlled, not from the Brain, but from the Spinal Cord, which runs down the Spinal Column.

Hence the importance of Cold Water on this Column, as a tonic, etc.

A border-land between movements purely Voluntary or purely Involuntary is formed by the semi-automatic movements. Originally dependent on the will, and Voluntary, and for the most part done rhythmically and in a certain order, they have become so familiar to the mechanism of movement, owing to constant repetition, that they are now performed almost Involuntarily on the slightest impulse of the will, i.e. they are semi-automatic. Walking is an example of this movement. When once we have started it and set the pace, most of the rest of the work can be done almost or quite without conscious thought.

The Sensory Nerves end in various ways: in the Skin, especially in the Corpuscles of Touch; in the retina of the eye; in the labyrinth of the ear; in the mucous membrane of the nose; in the taste-buds of the tongue.

## THE BRAIN.

The Brain completely fills the hollow of the skull, and is, roughly speaking, like a Hemisphere in shape. At the base of the skull it passes directly into the Spine: the Spine is thus a cord-like prolongation of the Brain.

It is interesting to notice that many of the Fibres from one side of the body cross over to the other side of the Brain. Thus Hæmorrhage (following on Apoplexy) in the left Hemisphere of the Brain may produce paralysis of the right arm and leg.

Thus Exercises for one side of the body often help to develop the other side of the Brain.

The proportion of the Great Brain, as the seat of intelligence, to the parts which act automatically, is what gives the Brain of Man its peculiar character as compared with the Brains of other Animals, even of Anthropoid Apes. It is also interesting to know that the functions of Voluntary movement, determination, conscious sensation, and mental perception, have their seat in the 'grey' matter which covers the surface of the Great Brain.

An exact map of the surface of the Great Brain has thus been made, showing the points of origin of the moving or Motor-nerves for the various muscle-areas of the body. Of these central points the earliest known was the speech-centre ('in the region of the 3rd frontal convolution on the left'!). The destruction of this part, as by Hæmorrhage in Apoplexy, causes loss of the power of speech.

The Science of Phrenology takes advantage of this knowledge, and Kuhne, a learned German, has done excellent (but very little known) work with regard to the effect of certain bodily disorders upon the Brain itself and even the shape of the skull; but his conclusions are denied by many scientists.

The left half of the Brain, as we have seen, directs many of the movements of the right side of the body, and the right half many of those of the left. But *all* Motor-fibres do not cross; some remain on the same side.

### THE TIME TAKEN BY ACTION AND 'REACTION', AND HOW IT CAN BE SHORTENED.

When you have told anyone to look at something, he does not do so immediately: he cannot. A certain process has to be gone through first.

This time of 'reaction', as it is called, is made up of (1) the time taken to excite the Feeling or Sensory-nerve (e.g., of the Ear), and to send the 'news' to the Brain; (2) the news (here an impression of the sound) must penetrate the consciousness, and (3) must be noted by the attention; (4) the will must then be 'stimulated', and (5) the stimulus is sent along by the Motor-nerves to the muscle which is to act (here it might be the muscle of the eye).

Now it must be clear that the less excitable and 'awake' the Nerves are, the longer the time of 'reaction' will be.

Whatever makes the Nerves less excitable and 'awake' will make them put forth more effort if their work is to be done quickly: for instance, Fatigue-substances (Waste-products etc.) will often make them less excitable and more torpid.

Among the influences that make the Nerves torpid will be the following:—

1. *A condition of Fatigue*, whether due to Local Fatigue, as in the Brain or Muscles, or general Fatigue and exhaustion. This condition invariably hinders the readiness in 'grasping' a command, for example, and the promptness in fulfilling it.

2. *The effects of certain substances*. Among the substances which increase or reduce the excitability of the Nerves we must place *Alcohol*. As we have shown already, when it is taken in moderate quantities it has first an exciting and then a paralysing effect. The latter is more pronounced, and the time of 'reaction' (i.e. sluggishness in 'grasping' and acting) is more strongly marked and sets in more quickly and completely in proportion to the amount of Alcohol taken and the rapidity of its assimilation.

Small doses of Morphia act in a similar way.

Previous indulgence in Alcohol spoil to some extent the fitness for Exercises which need quick 'grasping' and quick response, e.g., Lawn Tennis, Cricket, Fencing, Boxing, etc.

3. *Sensations of uneasiness*. All uneasy sensations, discomfort, pain, disgust, boredom, sluggishness, weaken the action of the muscular energy, and make the nerves less easily excitable. Hence the period of 'reaction' is considerably lengthened and the movements are sluggishly performed.

Therefore wearisome drills and 'Set Exercises', especially when the Brain is fagged, can never produce the brisk movements which are best for the young.

In adults, however, the sense of duty and discipline, and the strength of the will, are sooner able to overcome the hampering effects of such uneasy sensations.

4. *Complicated movements* of course take longer. We realise very little indeed how complicated certain movements really are.

A stroke at Lawn Tennis, if it is to be correct, is a most intricate process. It means the perfect adjustment of many perfect parts.

5. *Unpractised* movements also take longer than those which have been practised.

6. Certain bodies have a natural aptitude for nearly all movements, others for some movements in particular. There are many who play Games well almost directly they begin them. In such cases the time of 'reaction' is very small. But Practice of the right kind can make up a good deal for natural slowness.

7. *Inattention* of course lengthens the time of 'reaction'. When you are thinking of something else, when your mind is distracted, your nerves cannot act so quickly as when you are alert and attending to the one thing in particular. *Hoc age* was a grand old Roman motto—'Attend to the matter in hand.'

We may now consider *under what conditions the time of reaction can be shortened:* for we should like to have many of our movements as 'instantaneous' as possible.

They would especially be—as answering to the above divisions—(1) Freshness, (2) Absence of certain Substances in the blood, (3) Ease and a feeling of Pleasure, (4) Simplicity of the Movement, (5) Previous Practice, (6) Natural Ability, (7) Concentrated Attention.

(1) *Freshness* is important, but it cannot always be ensured. Of the frequent want of Freshness after a heavy meal or after hard Brain-work, we speak elsewhere.

It may be mentioned that, if *certain* Exercises (such as kicking up the legs, and a short brisk walk) be interpersed amidst Brain-work, the latter will not be so fatiguing, and hence the Freshness for Exercise afterwards will be greater.

It is necessary also to change the actual Exercises, or even to rest, at intervals. A long stretch of Exercise is good at times, indeed it is essential in practice, but many short spells, and changes of pace, etc., are no less essential, and are great helps to the maintaining of Freshness.

(2) *The Absence of certain products* in our blood will be important; Kidney Disease, or Constipation, or a Closed Skin (e.g., owing to a Chill), should of course be carefully avoided, for they will tend to keep the poisons within the blood. But it is no less important to avoid adding Waste-products directly to our blood by means of certain Foods, e.g., the Flesh-foods.

Bad air will also clog the blood with Carbonic Acid etc.; and so fresh air, especially sea-side or mountain air, will help the blood to keep clear, and, indirectly, will make the movements quicker.

(3) *Pleasure.* Pleasurable sensations, such as joy, cheerfulness, emulation, enthusiasm. interest etc., strengthen the action of the Heart, make the Nerves and Muscles more readily excitable, and are favourable to ease and rapidity in the processes of 'grasping', of willing, and of performance by muscular contraction.

Pleasure quickens the action of the Heart, increases the blood-pressure in the Organs near the surface of the body, and adds to the muscular energy, especially in the young.

Pleasure, as well as anger or fear, actually alters the composition of the blood itself. Some careful American Experiments on the effects of various emotions on the blood (and perspiration) are of the very greatest interest.

When Gutsmuths says he would have Gymnastics for the young carried on as 'work clothed with youthful joy', he gives a hint which can never be too much laid to heart in in the pursuit of Exercises in Schools and elsewhere. School Gymnastics and Exercises will only have an absolute success, and will only persuade the pupils to continue Exercise when school-days are over, if they are marked by a bright and happy feeling; if the instinct of movement and the longing for action, inherent in the young, are given free scope, and if everything is avoided which could stamp Exercise as a mere lesson.

We can well remember how we used to hate Drill and Gymnastics at School; but we seldom played any Game without pleasure and therefore without profit. Let us hope that the terrible pedants who say that no education (of body or mind or morals) can be good unless it involves unpleasant discipline, will soon cease to burden our world and to disgrace it. It will be long ages before this terrible spirit ceases to rule our Brain-Education; but when it has ceased to rule our Physical-Education, as it gradually is ceasing to do, we shall have gained a great deal.

In Games, joy and pleasure usually prevail most of all. The happy movement of the play-ground or the field, under the open heaven, is, as Herbert Spencer justly observes, a valuable nerve-tonic for the young. The love which a child has for the varying changes in his Games, the emulation which fires the young to greater efforts, *actually cause the various movements to be more easily performed,* and amazingly increase the inclination as well as the capacity for movement. The amount of running a boy lightly gets through in active play would be difficult, or even impossible, for him to perform in Gymnastic or Running Exercises 'done to order.'

(4) As to the rapidity of *Simple Movements,* as opposed to Complex Movements, it is too obvious to need proof. But the lesson is that, for average people, it is generally a mistake to quicken the Complex Movement until the Simple Movement can be done not only quickly and Easily, but also correctly. See the System suggested in Part I.

(5) The time of 'reaction' is also shortened by *previous practice.* A person who has frequently practised responding by instantaneous movement to a stimulus from without, whether it be a sound (e.g., a command), or a sight (e.g., a rapid signal), will find that the time diminishes steadily. In short-distance Races, for example, one of the most important preparatory exercises is to start over and over again, i.e. to spring forward instantly at a given signal and fall at once into full swing of movement. For the right Method of Practice, e.g., beginning slowly, and part by part, see especially the beginning of the work.

(6) Of Natural Ability and the consequent quickness of action nothing need be said here, except to remind parents (or those who may be parents some day) that Alcohol and other products may not only produce slowness in themselves, but may also produce a *tendency* to slowness in their children. Their children will be formed, not independently of them, but out of their very blood. This consideration has its wider lessons also.

(7) The time of 'reaction' is conspicuously shortened by *Concentrated* and Strained (not over-strained) *Attention.* The feeling of expectancy makes a great difference to the rapidity.

The pose of the body can thus be made to help: for an alert position, e.g., the standing on tip-toe ready to start, and the right position of the hands or racket, will help very appreciably.

While we are on the alert, we seem almost to feel that we are priming our nerves with energy.

Think how the Fencer or Boxer would fail if he let his attention wander.

Eye to eye with his adversary, noting every motion with strained attention, the fencer has much of his body to defend with a little foil. He must be prepared, not for one predetermined movement, like the racer waiting for a start, but for varied measures of offence and defence.

But the effect of this strain, upon Fatigue, as opposed to the Freshness of him who is not 'straining', must also be considered.

The movements made in half an hour's Fencing, by two practised and eager opponents, reckoned as mere muscular exertion, may amount to an inconsiderable sum-total; yet the Fencers themselves may feel extremely tired and exhausted after such Exercise; sometimes they may perspire violently and lose weight to a surprising extent (a loss of as much as 1500 gr. in one fencing-lesson has been observed). *It is chiefly the severe Nerve-effort which brings these marked symptoms of Fatigue.* Fencing etc. (with foils or swords or singlesticks) is the type of an Exercise which fatigues and taxes the Nerves far more than the muscles.

The lesson is that Concentrated Attention throughout a long Match may take too much energy out of the system to be worth while. In hard Tennis Matches, for example, we do not always play up our very hardest at the first and throughout. We often sacrifice a Game, or even a Set, and keep a *reserve* of Nerve-force. The slackening of the attention for a time may bring Freshness in the end. But this slackening does not *always* pay. It is sometimes hard to 'screw up' the Nerves again.

Sandow and others advise the learner to throw his energy into the muscle which is being used, and into the movement itself, as it were. This is very sound for Practice, but when the more complicated Game etc. comes, then the attention is often wanted elsewhere. I believe it will be found that the mind *can* be thrown into the requisite muscle: the muscle can be primed and loaded with energy by sheer force of will.

One more point may be noticed.

(8) Much may depend on the pace of the stimulus etc. The signal should be sharp and striking.

'A word of command slackly given is slackly carried out. The words of command must therefore be given in the same manner and with the same decision, in every place, position, and service'. Thus says the German 'Exercier-Reglement für die Infanterie'.

In most English Games and Exercises, however, the word is not given by another. But it might be a useful plan, both in early Practice and in Practice by means of Games, etc., for the player *actually to give the word of command to himself*, in a short sharp staccato tone. It need not be spoken out loud, but the effect, even when not spoken out loud, but spoken 'in imagination', would undoubtedly be an increase in briskness and energy. The word of command, the stimulus, seems to be coming from the outside. One's more energetic self seems to dictate to one's less energetic self.

### COMBINATION AND CO-ORDINATION OF MOVEMENTS.

All bodily movements, whether simple or complicated, require *whole groups of muscles to work together,* and not one or a few to work alone. By Co-ordination of movement we mean that the will searches out all the muscles required for the movement in question, and obliges them to work in harmony and unison.

Stretch out your arm: to do this you must use certain Muscles, especially what is called the Deltoid muscle.

If you are grasping a dumb-bell in your hand, then the Muscles of the lower arm will also be used.

But to make the movement, once begun, proceed quickly or slowly, evenly or jerkily, at will, to make it stop at a certain point and not overshoot the mark, the opposing or antagonistic muscles are called into play. It is as if you were guiding a horse: in case you pulled one rein too hard, the other rein would have to correct the error.

But this is not all.

The contraction of the Deltoid Muscle would be less likely to lift the heavy hanging arm, weighted into the bargain with a dumb-bell, than to pull the movable Scapula of the shoulder out of its place, if the supporting Muscles (which hold it to the trunk of your body) did not keep it fixed in its place; they enable the Deltoid, from this steady fixed point or fulcrum at the shoulder, to move the extended arm, like a one-armed lever, in the required direction.

But again, these Muscles which hold up the Scapula of the shoulder take rise for the most part from the Spinal Column, which is movable in every joint and almost balanced like a stick upon the Pelvis. So the Spinal Column is affected. It has to keep up the balance or equilibrium.

The disturbance of balance and the necessity of keeping the body erect, by the stretching of certain Muscles, further extends to the Pelvis, which is itself balanced on the heads of the Thigh-bones; and so it extends to the Muscles which support the Pelvis.

Thus a movement so apparently simple as the extension of your arm requires the co-operation of a large number of Muscles, all exerted in varying degrees.

We find that three kinds of muscular action are implied in the 'Co-ordination' of a movement:—

1. the dynamic, which forces the limb etc. in the right direction,

2. the moderating, which guides and steers and checks, and

3. the static action of the muscles, which keeps up the balance of the body.

The efforts of the guiding and balancing Muscles (1 and 2) are often less fatiguing than those of the forcing Muscles (3). The third may be more like the 'accompaniment' of a piece on the piano, while the first and second give the 'air'.

But, to a beginner on the Bicycle, the Balance-Muscles are most easily tired.

Of different Combinations or Co-ordinations we may notice the following:

In teaching Games, least attention is usually paid to (3): the right position of the body, and its balance, are much neglected; Even (1), the right way to use force, is not properly pointed out; (2), the guiding, receives most attention.

1. The Co-ordination of certain *muscle-groups that are near one another and closely connected.* This, of all others, is capable of the highest and most *delicate* development, and in it the graduating and moderating action of the opposing or antagonistic Muscles is strongly brought into play. Chief among such movements are those of the hands, which admit of the most manifold and marvellous kinds of dexterity; also the management of the musclus which take part in Voice-production (speech and song). The training of the facial muscles to mimicry also comes under this head.

2. The Co-ordination of *Muscles which move the larger parts of the skeleton*, so that great Muscle-areas, far apart from each other, are exercised. Here would come Gymnastics, with or without apparatus.

It may be said that Training in Co-ordination comes too much into the foreground of Gymnastics as compared with other forms of Exercise, and that some important aims of Exercise (e.g., rapid adaptation) are therefore apt to be neglected. From this criticism we note in what direction Gymnastics need to be supplemented and developed. The value of Gymnastics with apparatus is none the less high for that. Only such Gymnastics are not nearly enough in themselves.

In most Games, few but the genius-players use these large Muscle-areas properly. The force which the gigantic muscles under the arms can give to a Cricket- or Lawn Tennis- or Golf-Drive is often almost or entirely neglected by the player. The player often simply uses his Wrist. It is as if a rower were to sit quite still and try to row only with his arms!

3. Another factor is *Weight*, e.g., the natural sinking of a lifted limb. Here also might be classed hanging from some Gymnastic apparatus.

This force also is much neglected in Games: the amount of energy that can be saved by a proper disposal of weight may be gathered from a Tug of War, for example. But in Cricket and other Games it should be taught at the very beginning as a separate Exercise.

Lawn Tennis Service and Bowling at Cricket acquire force from the sheer sinking of the heavy arm.

## THE TRAINING OF THE FACULTY OF CO-ORDINATION.

**See further the Chapter on Practising, especially on Practising Part-by-Part.**

When so many Muscles have to be used at once, even for an ordinary movement, how *can* we manage to harmonize them?

The possibility of doing this would be barely comprehensible but for the fact that the Motor-Centres (in Brain and Spinal Cord) are able to mechanise this complicated process for each kind of movement, *when once it has been successfully and repeatedly practised;* after tentative and incomplete attempts, and after many efforts of will, *unnecessary movements are gradually suppressed.* That is to say, the memory of a movement which has been frequently repeated fixes itself in the Central Organs in such a way that, when you merely decide that you will perform such and such a movement, that is enough: the Motor-Centres give forth, as if of their own accord, the right amount of stimulus (or motor-excitation). The shortest and best ways (or something like them) have been learnt by repeated successes and repeated failures, and the energy runs swiftly and easily and naturally along the well-trodden paths.

This power of memory is of the greatest value in Athletics: without it, improvement would be impossible. The idea of the movement is impressed on the mind. Hence the great importance of getting the whole movement quite right at the very outset, so that the habit may be right also. And this can rarely be done without practising each part of the complicated movement by itself.

Thanks to the will-effort (at the beginning), the faculty of co-ordinating movements can be acquired; the simple and primitive types of all possible movements, and the simple and primitive combinations of these, can become a sure possession. The better known a movement is, the less need is there of *conscious* co-ordination. The will is then chiefly exerted in deciding the strength, pace, and so on, rather than the movement itself.

At first, however, the learner, if left to himself, uses up a vast store of energy in experimenting and finding out the best ways by himself; in thousands of instances the best ways are never found at all. A *somewhat* less bad way is found and turned into a habit by conscious repetition. In such a case we may have a Co-ordination which is fully formed in the Memory, but prevents success beyond a certain point. For it is not the best Co-ordination.

The unpractised person, who has to co-ordinate a movement as yet unfamiliar, puts forth an amount of muscular effort, and also of nervous effort, very far in excess of that put forth by a practised person. But, when a movement is known, or the principal parts of it fall within the province of known movements, so that the co-ordination of it, or of its principal parts, is already familiar and more or less mechanical, it is performed with a very small exertion of force.

Similarly, after many laborious attempts, the young learn to stand, walk, run, jump, hop, etc.; and in short, they come to School provided with a wide range of known forms of movement with which the co-ordinating faculty of the will is already familiar. On this basis the Gymnasium and other Exercises proceed to build.

If your memory be richly stored with a comparatively small number of the commonest foundation-movements, then, when you want to make a stroke in a game, for example, you will naturally use these commonest movements if they *can* be used. Your stroke will have a firm solid foundation of correct parts: by constant practice these parts will be fused together into a complete whole, a single harmony.

**But, above all things, see that these foundation-movements are correct, each by itself.** I will suggest one here: stand with your feet 12 inches a part, both toes facing forwards; all the time keep your shoulders back, your chin back, your left hand to your side, your right hand clenched and held before your face. Now, without moving your feet, turn round your body to the right (at first slowly) till your shoulder and eyes almost turn in the opposite direction to the first position. Then come back. Do this 10 times, and gradually, day by day, increase the pace. Don't strain at first. Later on try this to the left. You will thus be using some mighty Muscles that will serve you in good stead in full many a Game—Cricket, Tennis, Lawn Tennis, Rackets, Squash Rackets, Fives, Golf—to say nothing of Boxing and other Exercises. This is only one movement out of many, but it is a Foundation-movement.

The Movements should be learnt **in the right order.**

Educationally, it is absolutely necessary to link the Exercises together in systematic succession, so that the expenditure of co-ordinating-power and strength in each succeeding Exercise shall be slightly in advance of what was required in the previous Exercise. Thus for every hour of Practice and for every kind of Apparatus there will be a connected sequence of Exercises to work upon. The will must not suddenly be confronted with a hitherto unknown and untried combination of muscular contractions. One part, the basis of the Exercise next in sequence, will be already known and familiar, so that no more is needed than to co-ordinate afresh, to recombine the old and to add something new.

The kind of co-ordination which is capable of the highest development, the co-ordination of muscle-areas which are near to one another, is seldom practised.

An instance would be wrist-movements and finger-movements. There are thousands of minutes every year when many of them could be practised—e.g., while we are *waiting* anywhere.

We have seen that Training in Exercises of skill and strength should mean primarily to attempt many kinds of movements and to master them and store up the remembrance of them in the Central Nervous System. The skilled player thus possesses a large number of types of movement already familiar to him. *He can make use of them with ease when they are wanted.*

Perhaps it might seem that these *abstract* forms of movement are such as can hardly ever be put to practical use in life. They seem dull and sterile. The acquirement of them at first seems useless. And this is a reproach which such a system as I suggest in Pt. I. will not be spared. But we hold the sound opinion that the action of the will in every direction must increase the faculty of co-ordination, and that these simpler movements are bound to help nearly every future movement, even if at present we do not know what these are likely to be.

The total sum of skill attained appears to us to be founded not only on the store of mastered forms, thoroughly practised and hoarded in the Brain, the Spinal Cord, etc., and in the organs of movement, but on the increased faculty (in the Central Organs) of finding surely and immediately the right way to the Muscles required. The School of Gymnastics should strive to master surely the body in all its various positions and movements.

In other words, we go forth with a varied stock-in-trade: we feel better fitted for grappling with *any* new form of Exercise. Moreover, the new form of Exercise will now have a far greater interest for us: the principle of Self-activity will come in. We shall have already acquired not only the Foundation-movements themselves, but the Habit of quickly finding out the right movements for any fresh exercise, and of quickly combining them together harmoniously.

*How far can a naturally clumsy person become skilful?* Much depends on Habit, but, even after the age of 30, bad Habits may be corrected and good Habits permanently acquired.

For the coarser and larger movements a Part-by-Part Practice (of the right kind) can do wonders: for the finer movements, e.g., of the fingers, possibly there is less hope; but even here the Part-by-Part System would be very likely to succeed, even with those whose improvement was altogether despaired of.

But, anyhow, previous Pràctice in Combining movements is nearly always necessary for success.

### FAMILIAR COMBINATIONS.

The more complicated a movement is, the more time it is likely to take, unless you either do it quickly by nature or else have practised it already. In the latter case, you must at first use your will-power and you must also have arranged the special movements beforehand.

Hence the saying is true: Well-combined movements must have been arranged previously, and must have been rightly practised previously.

In Drill the word of command usually does this to begin with; and the 'Goose-Step' would illustrate the previous practice of various parts of a complex movement.

If the right Exercises were chosen, the Foundation-Exercises, especially, they might be formed into a regular Drill for the young, and there might be music or even singing at the same time. Very young children often enjoy this. By degrees these movements might thus become very Familiar and Easy, and would be wonderfully useful afterwards.

In Drill, each person engaged, though a member of the whole body, must individually give the closest attention to prompt and correct movements, if the whole group is not to suffer and the movement to be a failure.

But, on the other hand, dull Regulation-Exercises and Dances etc. make so little demand on muscular effort that they are apt to have little effect on the muscles and the changes of matter in the body. They are apt to make too great demands on one Organ only, and that is the Brain, especially if they be done after hard Schoolwork, which, alas, is so often dull also, and therefore itself tiring.

But, if a few were done *very* correctly, then the drudgery would not be so great.

The Exercises which are to become familiar should be so arranged that not only shall the easier precede the harder, and lead to the harder, but that the new shall often involve *part* of the old. This part will then be attacked from two or three different points of view, as it were. The fact that the fundamental movement in each group is recurring again and again, and thus becomes familiar, leaves only the variations and successive additions to be freshly combined.

SUDDEN COMBINATIONS.

So far we have spoken of movements which can be arranged and combined at leisure. But these are not enough practice in themselves. They are well enough when we know what to expect, and for 'regular' exercises (e.g. walking) they are most useful. But in most Games with variations, for Boxing, Fencing, etc., suddenness and unexpectedness are two of the chief difficulties.

For it makes a great difference in moving whether the movement to be made can be mentally arranged at leisure or whether it must be formed suddenly and rapidly. A new movement, to be well-arranged, requires consideration and careful thought, whereas in Games, and in emergencies of life, we have no time.

This difficulty can be partly removed by sudden directions from the outside, or—if it can be managed—on a Phonograph; but such unexpected movements should not be attempted till most of the well-known movements have become familiar combinations. To begin with the sudden and unexpected in Games etc. is a grand error.

When once the few Foundation-positions and movements have become familiar, *then* sudden changes should be tried. Nothing is so fine an Exercise for these rapid adaptations and prompt responses as our great English Games.

DuBois-Reymond, in his lecture on Exercise, finds here the distinction between English and German Physical Education; the English boy makes a point of doing his new movement quickly, if awkwardly, while the German ponders and then makes his correct movement slowly. The English boy is well over long before the German has done deliberating how he may best apply his skill, how great an impetus he ought to give, or even whether, after an unsuccessful attempt, he should try again. In such cases as this, much less depends on correct form than on the practical power of overcoming the hindrance as quickly as possible. This point is deserving of special emphasis because of the importance of quickly and surely surmounting obstacles of every kind, not only in daily life, but also in war.

This kind of exercise in sudden rapid movement, the practice of priming the nerves of action in a moment, the practice of swift 'innervation', is a Nerve-exercise which is entitled to consideration, and may fairly be regarded as essential. For a harmonious Physical Education it deserves the same care as the training in deliberate and well-combined movements. The qualities thus acquired are *presence of mind and promptitude*.

The formal and somewhat dull Schools of Exercise, of which Gymnastics (German or Swedish) are a type, are devoted to the practice of exercises of strength and skill, performed at the word or after the example of the master or the previous performer; as a rule they give sufficient time for reflection; they are little training in unhesitating action. The importance of Nerve-exercises is almost left out of account. The gap should be filled by exercises in Promptitude, which must form an essential part of true education.

The promptitude and unhesitating pluck, of which the English and American peoples are so justly proud, is no doubt to a great extent the result of training in Games. Drill and Gymnastics bring discipline and uniformity, but Games alone can give the Englishman or American his nerve, his presence of mind, his lightning-like rapidity in emergencies. He may often err through rashness: but more often he does the only right thing.

## EXERCISES IN PROMPTITUDE.

Under this heading come Fencing, Wrestling, Boxing, and, above all, the more complex and elaborate *Games* involving Running, and the many Ball-Games. The peculiar qualities common to all of these as regards the will and its power to combine movements are as follow:—

1. *The movements are not directed by the order of a teacher* nor by the example of the first performer, but by free and independent choice, determined by the sudden changes and chances which arise.

2. The object is not so much to do the movement correctly and gracefully as to do it certainly and successfully; to see the chance and to use it; to defend and to attack in the most *useful* way, but still to keep within the written and unwritten Laws of the Game.

The correctness and 'grace' should have been practised outside the Game itself.

3. The position of affairs must be grasped, and decision and execution must follow, all in a single moment, at lightning speed; the movements must be suddenly arranged, suddenly carried out. No time is given for deliberation.

Hence the attention must be alert. In some forms of exercise the strain on the attention is almost persistent, as in Fencing. Here the nerves get soon exhausted.

In Games it is different. The tension and readiness for a spring or a strike are only required at certain moments. Before and after the strain come intervals of relaxation and recovery, as in changing sides at Lawn Tennis, and in intervals between Overs at Cricket. Thus excessive excitement and exhausting nervous activity are not so great in Games. But this is only speaking generally. There are many exceptions.

Hence, for the exercise of the qualities of promptitude, presence of mind, and swiftness of decision, and 'innervation', which are so important in the formation of character, and in numberless positions in life, Games are the most wholesome and suitable method, especially in early years. The more elaborate Games offer far greater variety of accidents and fresh unforeseen circumstances than Fencing and Boxing and Wrestling. Or, at any rate, the fortune of Games is more liable to vicissitudes.

It is especially the more complex Games between two 'sides' of players that give opportunities for learning and practising sharpness, observation, care, presence of mind, and promptitude; and the qualities which the young gain in Games they may be able to carry into other spheres of life: there also they will be sharper, more observing, more careful, more ready and prompt; and they will be more likely to think of their 'side' and its interests, than of themselves alone; they will also have more confidence in their own opinion and their own originality.

If some Professionals and 'Pot-hunters' have degraded Football and other Games, we need not condemn the Games themselves for that reason. They are too valuable a means to be rejected rashly.

### REFLEX MOVEMENTS.

In all the above exercises and movements, the will made the decision at the outset: when we began to walk, as little babies, we had to decide to move our legs. Some of these movements, as we shall see, can become practically Automatic, and of these we shall speak below. Here we shall consider those movements which are called Reflex.

Cross one leg over the other, and smack the upper leg above the knee, and your foot will move. Pain will also produce 'Reflex' movements, as when a red-hot iron or a pin is applied to the flesh. The movement is very quick because it does not have to be directed from the brain: the stimulus takes a short cut across country, as it were.

### AUTOMATIC MOVEMENTS.

Some movements go on of their own accord, such as the beating of the Heart. We cannot alter them directly, by our own free will. Such movements are mostly regular and rhythmical, and they are the most economical force.

Indirectly, we can influence them by emotions, foods, exercises, etc.

### SEMI-AUTOMATIC MOVEMENTS.

Any single movement, even of the more complicated kind, becomes more and more familiar to the will if it is often repeated in the same way, especially if it be repeated with much effort and concentration of will and of attention. For thus the memory-picture of it is stored up in the central nervous system, and, as some hold, in the actual muscles also; and in repeating such a movement there is, eventually, little need of laborious thought: for it follows as of itself on a slight impulse of the will. As we have already seen, it has become more or less mechanical.

Many movements of ordinary life, at first intentional and voluntary, are at length performed mechanically. A person who is accustomed to carry a stick or umbrella when he goes out, will lay hold of one quite mechanically as he leaves the house; while a person who takes out his umbrella only in rainy weather will always have to make a special act of memory as he goes out, or else he may leave the umbrella behind. A person who has changed his house will often find that he has taken the road to his old house when he has been wandering along thinking of something else. A whole series of movements may become so easy and mechanical as to cease to depend on the will at all.

Among the easiest movements to make semi-automatic are those which are most rhythmical, or which accompany rhythmical movements—for instance, Walking.

The preservation of balance, in which great demands are made on large muscle-groups (see the exercises in balance, above), is troublesome and difficult in unusual and quickly changing positions; in the common and ordinary forms of movement, however, the will is no longer conscious of it; balance has become a semi-automatic exercise.

And yet even here the combination of the muscles for balancing the body has had to be laboriously learnt. How unsteady is a child in its first attempts to stand, how often does it tumble when it has just learnt to walk, and, later, to run and jump. But the more familiar these movements themselves become, the more does the power of keeping the balance link itself to them. What difficulties, again, most beginners have in keeping their balance on a bicycle. How unsteady they feel on the tottering machine, and how convulsively their muscles work, till they are quite tired and stiff. Not until after repeated practice does the unsteadiness slowly disappear, so that the useless expenditure of force is avoided.

But the experienced rider no longer feels that the muscles of the back and pelvis must be constantly stretched so as to balance the trunk safely on the saddle.

It takes further practice to master the balance during curves (e.g., while turning corners in Bicycling or Skating); yet here also the movements may become semi-automatic.

Of greater importance than these semi-automatic movements by which balance is maintained, are the semi-automatic movements which go on in a regular rhythm, and are like the rhythmic automatic action, e.g., of the Heart. Under this head come the various movements of speed and endurance.

First among these is the movement of Walking, which will become semi-automatic, and be effected, as if spontaneously, upon the slightest impulse of the will. Since it is performed every day, *the Spinal Cord retains an exact memory-picture of the gait* with all its peculiarities, and lets loose the walking motions without taxing the will.

Not every kind of gait is so reproduced, but only the 'habitual' gait; the general rhythm, the pace, and the force employed are wont to be reproduced, *unless you make a special act of will*, and thus bring about certain changes, e.g., quicker or slower, longer or shorter steps. Each person has a particular gait of his own, according to his character, education, etc.: this forms a feature of his whole personality. In one it will be hasty and restless, in another indolent and easy; one advances with an erect, self-confident, defiant carriage; another with a limp, feeble, and sliding movement, and so on. Thus the gait becomes a sign of the character. 'From afar,' says Jäger in his 'Neue Turnschule,' 'in the Foot-fall, in the mere foot-print, the gait tells us the personality, the spirit possessed with the joy of purpose, duty, labour, battle, the person who is master of his own weight.'

Just as the gait with all its peculiarities becomes an almost automatic movement, so it is with other movements of *speed*. So it is with Running, as long it is merely a quicker form of motion from place to place (Long-distance running) and not a race. In the same way the Rower accustoms himself to a certain style of rowing, with a uniform expenditure of time and strength, and a uniform method of movement, performing it semi-automatically, so long as his powers, so long as the wind and current, demand no other than his habitual method. The same, again, is the case of Cycling, in which each person develops a certain style and speed, that become habitual and almost mechanical; and so it is with Swimming, and with many other Exercises.

It is hard to fix any limit to this power of making movements semi-automatic. To a very experienced Lawn Tennis player, at the end of a hard season's play, the mere sight of a ball is enough to start the whole apparatus for a stroke, vastly complicated as it is; there need be little or no conscious will-power exerted. And so with Mr. Jessop, for example, to see a certain ball bowled means to hit it out of the ground. The eyes must be kept open: the rest seems to come of itself!

Qualities common to these semi-automatic forms of movement are: (1) that they proceed in a regular rhythm, (2) that they imply no severe exertion, but require Division and Distribution of Labour over large Muscle-areas, so that the exertion of nerves of the will is not great.

3. Besides this, these movements have all been intentional at the outset.

Since these movements are important exercises, in which the perfect carriage of the body, the beauty and power of motion, the speed and capacity for exertion, are all points to be considered, it is necessary to do them in the most perfect way, until this way becomes a habit. *The Spinal Cord is not a critic; if a movement is invariably done with the same faults, these faults become familiar and semi-automatic.* It becomes more and more difficult to overcome such habitual faults, such semi-automatic faults, and to impress the whole movement on the Spinal Cord in a new and improved form, as a new memory-picture. If, on the contrary, the best method is strictly enforced in the first practice, the result is good habit, a good 'style', also semi-automatic, and remaining as a lasting gain, a possession for ever, an investment at Compound Interest.

Thus, for example, in the training of race-horses, very light lads are employed as riders, so that the horse may accustom itself to go at its highest speed easily. When this has become a habit, and is kept up steadily and uniformly, then this correct way of running will not be altered or spoilt when the horse is ridden by a heavier rider. For it remains a permanent characteristic of the animal.

The moral is that which has been drawn above. Begin under the easiest conditions; do not try Hard Exercises, Obstacle Exercises at first. First get each part quite correct by itself and in its simplest form.

It is easy to become used to a good method or style in forms of movement as yet untried, e.g. perhaps in swimming, for the young. And for this very reason it is vital that the first lessons in such exercises should be given by capable teachers, who will insist unconditionally on good style from the beginning, and will not imagine that perpetually recurring faults will disappear of themselves with longer practice.

As for Walking, in schoolboys we have often to deal with bad habits of long standing, with indolent carriage, round back, and ungainly crooked knees. To alter the habitual gait in such cases, and so to correct it that a good smart carriage, a free stride and lively pace may be acquired as permanent habits, a vigorous training is necessary in walking and marching exercises. The Numerous instructions are not enough; a military smartness should be aimed at. On the other hand, the following points should be remembered: that

(1) a bad carriage depends largely on errors of Diet, and

(2) should be also corrected part by part, e.g., the shoulder being kept back by special Exercises, and the head by special Neck-Exercises, and so on. To try to correct the whole at once is not enough.

One cannot begin too early; it is easier to form a good habit than to alter a bad one. The German Military-system is admirable in this respect.

We have seen that Exercises of Speed and Endurance most easily become semi-automatic. *What is the value of these exercises so far as Nerve-Exertion is concerned?*

The nervous effort is reduced to a minimum, so that the exertion of the will, the brain, is practically needless. Therefore *the tendency to Fatigue is far less* in semi-automatic movements than in those which are purely intentional. Exercises in attention, skill, and strength, are a great contrast.

It is for a similar reason that the Heart and Lungs do so much work with so little fatigue: the Brain is not needed, nor any intention or nerve-effort of will. The rhythmical automatic Exercises mean little Fatigue, the rhythmical semi-automatic need more, the rhythmical intentional need still more, and the constantly-changing intentional need most of all.

*As a rule, the will-effort in Walking and other semi-automatic Exercises is very small: it generally merely starts the series and perhaps decides the pace.* Nevertheless the will *can* be used for these exercises; and the more it *is* used at first, the quicker and sounder will the progress be. The Brain hands over the management to the Nerve-centres, e.g., in the Spinal Cord, but it can take back the management if it likes, especially if things are going wrong.

And this *partly* explains why the force exerted in Exercises of speed or endurance may be far greater than the forces exerted in purely voluntary Exercises of skill and strength. The movements of speed and endurance demand the least possible force of will and nerve power in proportion to the work done. They are therefore refreshing to the Nerves, and especially to the Brain. During a walking tour, for instance, you can quietly talk with your friends, and you can let the sights act fully and freely upon your mind. And so it is with an experienced Rower or (if the road be good and smooth) an experienced Cyclist.

This is important, especially for those who want Exercise to be a relief to the Brain after severe work. The hard-worker often finds walking a great rest, and also Running, if he is young.

It is true that sometimes the will may be called upon to act even in semi-automatic movements of speed and endurance, and this may more or less impair their refreshing effect on the Brain. Refreshing as it is to walk on a good road, it is wearisome and fatal to go far on a bad, stony road, or 'puddley' road. For then the attention is always kept on the stretch and Nature is not enjoyed. One has to seek now here, now there, for a spot where the foot can be safely set; one has to take steps now long, now short. Thus the movement of walking is robbed of its easy semi-automatic character. Hence in such cases Fatigue sets in much sooner.

Quite apart from this, Games of skill, especially Ball-Games, are so pleasant and interesting that to hundreds and thousands the Fatigue is really less.

If the thoughts cannot easily be distracted from work or worry, a ride would be better than a walk—in fact almost any exercise would be better, if it demanded attention and roused interest: for example, a race would satisfy these requirements where a mere walk or run might not do so.

If the object is to cover a certain distance in the shortest possible time, or in a given time to cover the longest possible distance, as in races in running, rowing, and cycling etc., the same energy of the will must be exerted as in the highest feats and exercises of strength.

But in too prolonged exercises, long-distance Walking or Running or Rowing, etc., even if they are taken at a moderate pace, the muscles grow weary; they become more difficult to excite, and the stimulus from the semi-automatic centres is no longer enough. Therefore an increasing, and finally a very intense, effort of the will is required to master the general feeling of fatigue and to keep on the movements, which, moreover, of themselves become more and more clumsy, slow, and indolent.

### KEEPING TIME AND RHYTHM.

As we have seen, the movements which follow one another in a fixed rhythm and in regular time are the first to become semi-automatic, and to depend least on the will. This is still more the case when we see or hear something which keeps time to the movement, whether it is beating time, or a word of command. Audible counting in time, beating time, singing, the tramp of men on the march, all carry along a Marching Division in the same step. This is even more decidedly the case with music in well-marked time, or the loud rap of the drum. Such rhythmic impressions of sound help the automatic sequence of movements to a wonderful degree: *they even provide a stimulus stronger than that of the will.* A wearied troop, each member of which is only able to march in time by an effort of will, instantly regains its steady step, and is revived, if the band strikes up a marching tune; the measured tramp becomes steadier in proportion to the sharp marking of the rhythmical time-beats. These act as genuine goads or stimuli to motion: they render unnecessary the exertion of the will.

The lesson which should be drawn from this is to use the Metronome or the Phonograph during Practice-Exercises: the latter will probably be the best; of course its pace can be very easily regulated. Some day, perhaps, a portable Phonograph will be invented, so as to keep one up to the mark wherever one may be!

This is noticeable in Dancing, i.e. in regular sequences of dance-movements, such as those of the Waltz or Polka. Here the little effort of the will, the mastery of the mind by the time-giving music, is undeniable. The familiar movements of the Dance go on mechanically to the sound of the music. In this lulling of the will, in this abandonment to the impulse of movement which the regular notes of the music awake, lies the charm of Dancing as far as the Nerves are concerned. Dancing, moreover, in its character of an Exercise of Speed, has the general effects of these exercises on the Breathing and the Beating of the Heart.

Unfortunately, however, these advantages to Health can be but imperfectly enjoyed, on account of the shocking atmosphere in most Ball-rooms, the indulgence in not very first-rate Alcohol and other unwholesome drinks in the intervals between dances, and also, with some of the ladies, the tight-lacing which hinders the Circulation and the Breathing.

But all Dances have not the same effect, of course, and those Dances will have it the best in which the movements have already been correctly practised part-by-part beforehand.

It is also to be remembered that, though the Music adds grace and smoothness and ease to the motions, yet it is apt to deprive them of their value as Will-Exercises.

## BRAIN-FATIGUE.

With Brain-exertion there always come more lively Changes of Materials in the Brain, just as in Muscle-Exercise. Waste-products at last appear in the Muscle, partly, at any rate, because of the changes of materials, and these Waste-products tire or even paralyse the Muscle, so the Waste-products accumulated in the Brain after Brain-exertion, will cause Brain-fatigue.

This first makes itself felt in a weakening of the power of attention. In listening to a Scientific Lecture, for example, or in reading a book which requires close attention, at first we may be able to follow with deep interest and full understanding, but after carefully listening or reading for a long time we feel it harder and harder to understand. At last we find ourselves listening or reading in such a way that what we take in with the ear or eye is no longer clearly grasped by the mind, but slips by unnoted and unregistered; thoughts of other things, or little chance occurrences near us, divert our attention. We 'lose the thread'. Only by an effort of will can we fix our attention on the subject in hand, and finally the faculty of thought is crippled; the Brain is weary and needs rest.

Such rest we may get by turning our attention to a fresh field of thought. We are like the Gymnast, who, after hard Exercise with his arms only, may be perfectly ready for Jumping Exercises.

This change of the field of thought, however, is no rest if prolonged Brain-exertion has already brought on general fatigue and exhaustion. In this case we cannot work successfully in any other department of thought; we seem to loathe and perhaps suffer from any occupation, and we feel irritable. There are however, extraordinary differences between different persons—some scarcely ever feel fatigue of the Brain. Not only Nature, but also Practice and Habit, amazingly increase the power of exertion and the power of resisting fatigue. Some can fix their thoughts on one single subject for hours together, day after day, and yet keep up their mental activity; whereas the 'pious' rustic, who tries to hear devoutly the whole of the Sunday sermon, may almost at once fall a victim to irresistible slumber. An unpractised Muscle is soon crippled by unusual efforts, while a well-trained Muscle can keep up prolonged Exercises of endurance; and so it is to a great extent with the Brain-Muscles. And, like bodily activity, mental activity is helped or hindered by a number of other conditions—good or bad food, enough or too much or too little food, good sleep or a bad night, the state of mind at the time, e.g., food, pleasure or pain, all these have their effect.

As Brain-Freshness and Brain-Fatigue are matters of great importance to the Athlete, it may at once be said that the chief condition which affects us is our Food. We find that Heat, for example, almost immediately deadens or paralyses the Brain-power of many. No other influence is a quarter as powerful as Food. For example, to do twelve hours' hard Brain-work on a dozen Protene Biscuits and two apples is less likely to tire me than to do two hours' easy and slow Brain-work on an ordinary Diet. The Waste-products from animal's flesh probably are still Waste-products when they reach the Brain, so that the effect is almost the same as if we had formed these Waste-products *for ourselves* by hours and hours of hard work. A similar principle would apply to the effect of the Flesh-foods on physical Exercise.

It has been found possible to write down, in the form of a curve, the mental Fatigue of many School-children. Their capacity for work was found to increase during the first half-hour of School, but to decrease steadily from that time onwards.

Such experiments have an important bearing on the question of how long a Lesson should be, and how long a time should be given for relaxation afterwards.

In most English Schools that I know the length of an average Lesson is an hour, but one would imagine that the amount of Fatigue would depend largely on the subject or change of subject, and on the Teacher.

With regard to the length of a Lesson, it is very hard for children, especially before the period of development (that is, from the 7th to the 13th year) to keep up steady attention for a whole hour. Indeed, they actually make more progress in short and frequent than in longer and less frequent Lessons. For this reason it has been asked that Lessons of only half an hour should be introduced into National Schools, these would keep the children mentally fresher, and would yield far better results. (Zimmermann.)

*The usual intervals between lessons are too short;* on this point all are agreed who have enquired into the care of Health in Schools. Burgerstein, for example, requires at least 12 minutes after each School-hour (the latter would then amount to 48 minutes); Eulenberg would have 5 minutes after the first hour, 15 after the second and third, and 20 after the fourth.

The subjects also should be chosen according to the Fatigue they produce: each person knows best which subject *is* most fatiguing. While one is freshest, i.e. soon after the first part of the time, the more tiring subjects should be taken.

But it is also to be remembered that the Brains of some people do not get into swing and working order at first: after an hour their work is twice as good and twice as easy.

## EFFECTS OF BRAIN-FATIGUE ON BODY-FATIGUE, AND VICE VERSA.

This section should be read very carefully by those Athletes who are also Brain-workers, and by all who have in their hands the arrangement of the work and exercise of others.

A short time ago it was generally thought that hard Exercise was a capital change after hard Brain-work, because it acted as a relaxation and relieved the Brain of its excess of blood. Thus, in the year 1899, Professor von Nussbaum, the Munich Surgeon, wrote, 'If the thinker, who all day long has exerted his Brain and made it full of blood, goes in for athletic exercises, the Muscles will be distended with blood, which will thus be withdrawn from the over-full Brain.'

Gymnastics were considered as a mental relaxation, and Gymnastic Lessons were inserted in some German Time-tables between the other Lessons, or were even put immediately after a succession of Lesson-hours.

But the true state of things is by no means so simple as was formerly supposed. Brain-work, Muscle-work, and the work of the senses (e.g., sight and hearing), are by no means separate circles apart from one another; on the contrary, these circles intersect one another: severe Brain-work wearies the Brain, but it also weakens the power of the Muscles for Intentional exertion, and *vice versâ*. In the same way the sensibility of the skin (other kinds of sensibility have not yet been made the subject of experiment) is impaired by Brain-Fatigue.

As to this sensibility of the skin—Griesbach was the first to show that the skin has a less delicate sense of touch when the Brain is tired. He used a special instrument, which need not be described here.

Wagner also used this method in finding out the effect of Gymnastics and play between Lessons, and came to the conclusion that—generally speaking—'no refreshing result is to be expected from energetic Gymnastic Exercises, and the effect of hours of play is merely hypothetical.'

Possibly this applies to German rather than to English methods of 'play'.

Although his method, taken by itself, may be too liable to error for us to draw sound general conclusions from it, yet the Data which have been obtained by it, together with other Data, should certainly help to guide the care of Health in Schools.

It may in any case be taken as proved that Brain-fatigue affects the senses by a kind of sympathy, and especially that it makes the sense of touch less delicate.

For Athletes this is important: so much of the accuracy of a Stroke, especially of its strength, depends on the delicacy of the sense of touch. The catching of a Cricket-ball, for example, may depend *partly* on the sense of touch.

Similarly, Muscular Fatigue affects Brain-power: severe muscular exertion may bring a disinclination and incapacity for Brain-work. Hard Exercise uses up Nerve-force, and also makes Waste-products circulate in the blood; and so the section of the Brain is hindered. On the other hand, many people who do a great deal of Brain-work know that an early morning walk, a pull on the river, or a spin on a bicycle, is most refreshing and stimulating, and actually makes them more inclined for Brain-work, that is to say if they are in fair training and do not take enough exercise to make them really tired. It would certainly be a great advantage to know how far Exercise and movement are a helpful stimulus to Brain-work, and how far they are a hindrance. *

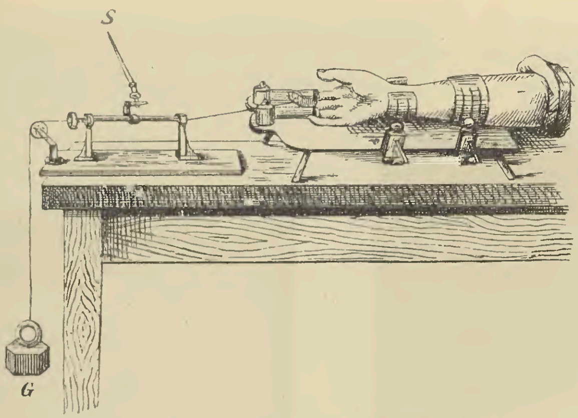



Fig. 186*a*. Mosso's Ergograph (Work-register).

Practice and Habit also alter the results very considerably. The great Physiologist Mosso, of Turin, has examined the effects of Brain-fatigue on a small Muscle-area, viz., the muscles of the middle finger. Diagram 186*a* shows the instrument which he used, the Ergograph. It will not be described here, but its results (on a revolving drum) are shown in Diagram 186*b*.

The curves, taken from different persons, show a singular difference. Diagram 186*b* shows that the force grows less by degrees from the very beginning, and gradually sinks into complete exhaustion, while in Diagram 186*c* the force hardly grows less for a long time, until the feeling of fatigue and slackness suddenly sets in, so that the curve drops to zero. Curves from

* This question is of exceptional interest. On the ordinary Diet I could seldom work well without regular and hard Exercise *daily*. I suppose that this helped to get rid of the Waste-products. Now, however, on the Simpler Diet, I can work for days together without any appreciable exercise. And yet this does not put me out of training for a hard Tennis-Match. [E. H. M.]

other persons show other types of fatigue. That is to say, the way in which we grow weary is not only *different*, but is also typical and characteristic in each individual case. *For, if we repeat the experiment with the Ergograph on the same person under similar conditions, we invariably get similar curves.* It may indeed change in the course of time, owing to regular practice, but the typical Fatigue-curve scarcely changes its peculiar character at all.

The test of the Ergograph was applied to the same man two days running at the same hour of the day, the only difference being that on the first day he had had no hard Brain-work before the experiment, and

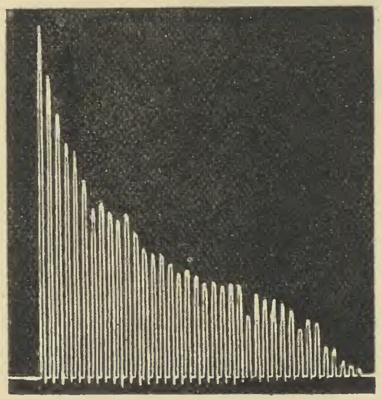


Fig. 186*b*.

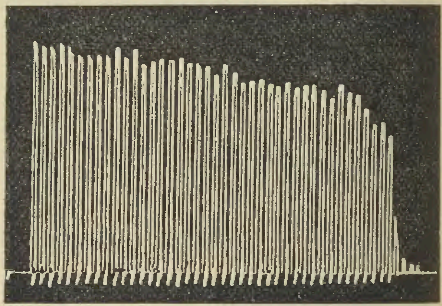


Fig. 186*c*.

therefore came to it fresh; while on the other he had already given a lecture.

The result was that, on the day when he came fresh, he drew up 3 kg. 48 times, with a total exertion of 7,161 kg.; on the other, when he had lectured, he drew 3 kg. up only 38 times, with a total exertion of 5,055 kg.

Some months afterwards, experiments were made on him before and after an Examination which lasted several hours, and which entailed much Brain-work; and the result was even more pronounced.

Before the Examination the Ergograph recorded as follows:—

| | |
|---|---|
| number of contractions . . . . . . | 40 |
| exertion in kg. . . . . . . . . . . | 6,087. |

After 14 persons had been examined, we find

| | |
|---|---|
| number of contractions . . . . . . | 24 |
| exertion in kg. . . . . . . . . . . | 2,745. |

And, on the last day of the Examination, we have

(1) Before the Examination-work began (Diagram 186*d*)
number of contractions . . . . . . 43
exertion in kg. . . . . . . . . . . 5,694.

(2) After 19 persons had been examined (Diagram 186*e*)
number of contractions . . . . . . . 11
exertion in kg. . . . . . . . . . . 1,086.

Even when the muscles of the Middle Finger were moved, not by the will, but by electricity, similar Fatigue was shown

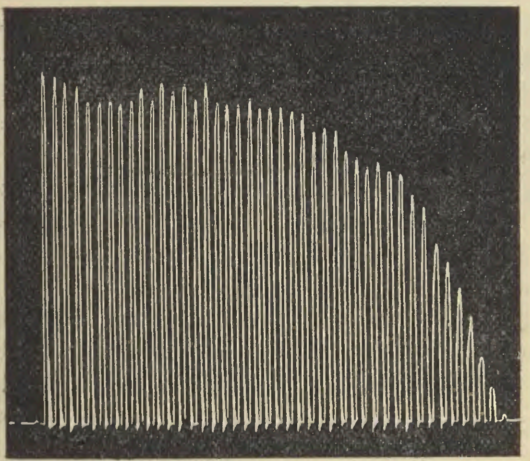


Fig. 186*d*.

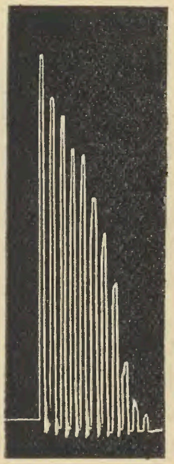


Fig. 186*e*.

after Brain-work. That is to say, Brain-work not only changes the Will-Nerves, the Motor-centres of the Brain, but it actually effects the Muscles themselves.

If we ask why these Motor organs thus grow tired, the most obvious answer is that Waste-products are circulating in the blood, these being produced by muscular work as well as by Brain-work. Mosso further suggests that Brain-work uses up some materials which would otherwise have produced force in the Muscles.

After such Brain-fatigue it would (theoretically) seem a mistake to go in for any Exercise requiring more Brain-work, e.g., Fencing. But the pleasure and interest of many Games cannot be left out of the calculation.

These discoveries are of particular importance in their bearing on School Exercises; they must help to settle the question, What is the best time for Exercise at Schools, and what kinds of Exercise are the best?

It is beyond question that a dull Gymnastic Lesson, coming immediately after some three or four hours of hard School-work, may be a very heavy tax on the Brain and Nerves, and can hardly be a relaxation. Those exercises might be good which require the least possible amount of Brain-work, and yet allow of abundance of Muscle-movement. Such, above all, are the semi-automatic movements of Walking, Running, Jumping, and the movements of Games where feelings of pleasure come in. Exercises in skill, on the contrary, might be a heavy tax, especially upon the more awkward beginner.

Much more is this the case with complicated exercises of attention, with fencing, or even the more difficult games of ball, which require great presence of mind and readiness.

But these last statements seem to be far too sweeping. So much must depend on how far the individual really enjoys himself and how well he can do the thing. Handicaps also should be very freely used after hard Brain-work.

The suggestion which recently has been widely accepted, is that Brain-work should be given in the mornings, and that Exercise (as well as Technical Education, such as singing and drawing) should be taken in the afternoon, when the pupils are rested and fresh.

The forerunner of the movement in favour of Games in Germany—viz., Hartwich—pointed in 1880 to the goal to be aimed at: 'The morning for the mind,' he said, 'the afternoon for the body.' German Schools seem to be working in this direction, and Games are becoming more and more general.

But since we cannot afford to give up all those valuable Exercises which demand a certain mastery of the muscles, skill, nimbleness, speed, readiness, and presence of mind, it is necessary that the pupil should come to these when he is fresh. *Then* they can be done successfully and without harm.

At the time of severe Examinations there should be no systematic Gymnastics or such as involve mental strain; Games and short trips and excursions should turn Exercise into a kind of holiday.

But probably a great exception should be made in favour of the evening hours from 5 to 7; there are thousands who work then far better than at any other time. The best ideal of an *easy* day would seem to be 'Exercise in the very early morning and a bath ending with cold water, then Brain-work for the rest of the morning; a very light lunch, and Exercise again after a short interval of rest; perhaps a few biscuits about 4.30; then work again till 7.30; a meal; a short interval

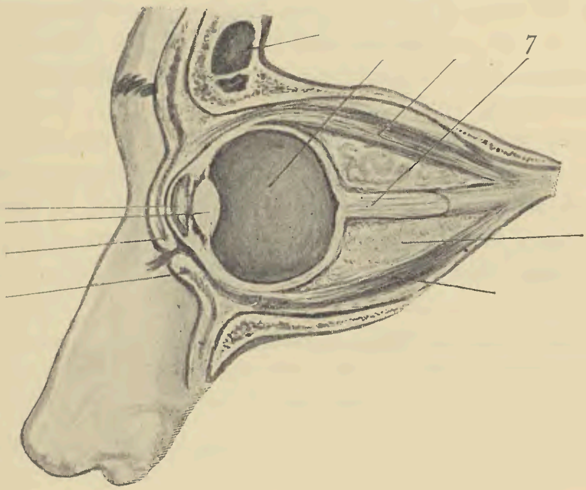



Fig. 187. Section of the Eye.
(7. Optic Nerve.)

of rest; then gentler work, and light reading or open air; then a bath again, and sleep'. (E. H. M.)

## THE EYE (A FEW NOTES).

Man, as compared with other animals, not only has larger 'whites' to his eyes, but—thanks to certain Cartilages—he can also move his eyes from side to side over a wider area without turning his head.

There is in each eye a round spot where the Eye-nerve enters: this is called the Blind Spot. Since we see with both eyes, each eye does the work for this Blind Spot in the other eye, and so we seldom notice it. But, if we close the right eye, and look at a white cross marked on black ground with the left eye, at about the distance at which we usually hold a book when reading, the great wide round space on the left entirely disappears: for it falls on the Blind Spot. If we close the left eye and look at this round space with the right eye, the cross disappears.

The Eye, by certain Muscles, adjusts itself and focuses itself to a certain range: e.g., in reading small type it will have to focus itself in one way, in reading large type, in another. And so it is with distances: the Muscles work differently for short-distance sights and for long-distance sights. This should be taken into account in reading etc., before certain Games. Continuous looking at objects near at hand, or close work, like reading, writing, drawing, etc., require a continuous effort on the part of certain special Muscles (called the Ciliary), and may finally weary it; so that looking into the distance will be a relaxation for it.

We call the point up to which we can remove an object from the eye and yet see it clearly the distance-point of the Eye; and the point up to which we can bring it close to the Eye, and yet see it clearly, we call the near-point. The distance between these two points is the range of the Eye-sight.

In old age the axis of the eye becomes shorter, and thus long-sightedness is sometimes a sign of age. For the same reason eyes which have been very short-sighted become less short-sighted, and even normal, in old age.

This should be borne in mind in the choice of Exercises and occupations as we grow older.

### SHORT-SIGHTEDNESS.

The number of those who become short-sighted during School-life is far too great. The number of course increases with the demands made by the School and as we come to the Upper Classes. We have many collections of data on this subject. According to H. Cohen, the short-sighted children in Germany average

| | |
|---|---|
| In the Gymnasiums (something between Public and Grammar Schools) | 42.5% |
| In the Realschule (Polytechnic schools) | 30.0% |
| In the higher-class girls' schools | 10.0% |

Similar results have been obtained in the schools of other countries, e.g., Sweden (by Axel Key), and Russia. In England, on the contrary, not only is the number of spectacled persons among the learned classes far smaller than in Germany, but there is a considerably smaller number of short-sighted School-children.

It may be mentioned that the absence of Spectacles is no proof that there is not short sight: English people are far more reluctant to wear spectacles than Germans are.

Apart from considerations of inherited tendencies towards short-sightedness or defective sight, it is a very great mistake to exert the eyes too much before and during the period of development. The age before maturity, the age when development begins, is that in which over-strain of the eyes is most apt to lead to short sight. *After maturity the eye gains a greater power of resistance.* One proof is that craftsmen who have to execute very fine work (e.g., watchmakers) do not often become short-sighted in consequence of their trade.

In School-children, too, the short sight is due not only to the close work of reading and writing, but also to the unhealthy conditions, such as ill-lighted schoolrooms, unsuitable desks, an incorrect position during writing, badly printed school-books, etc. To these must be added work done at home, e.g., reading and writing in the twilight, and by bad artificial light. As a matter of fact, in Schools where healthy conditions are attended to, the number of short-sighted pupils never reaches such an alarming figure, and those who are already short-sighted need not become more so. The demands which should be made of the authorities are: Large light Schoolrooms with the windows to the left of the pupils; good desks adapted to the pupils, and assigned to them according to their height; attention to a faultless attitude in reading or writing, and to the right position of writing papers and books; a large clear handwriting (many consider upright characters to be the best); the use of those School-books only which are in large clear print; sufficient intervals between Lessons, during which the pupils should be taken into the open air; Lessons in the morning only or chiefly, but plenty of out-door Exercise; and the limitation (as far as possible) of home-lessons. To this should be added a regular Examination of the Eyes of the pupils by the School Doctor. He should oblige pupils who are already short-sighted to wear proper glasses. These glasses should not be selected by an Optician, but prescribed by an Oculist, especially as other Eye-diseases may exist together with short sight, and may require suitable treatment.

In Games the player should also never shrink from the use of glasses if his eye-sight really requires them: there is some danger, it is true, and nasty accidents have occurred, but the evil of straining the sight (to say nothing of the unsatisfactoriness of playing badly) must also be considered. Here also an Oculist should be consulted.

MISCELLANEOUS NOTES ON THE VALUE OF FINE SENSES.

To people who are obliged to work in bad air, in drains, chemical works, tan-yards, glue-manufactories, etc., the loss of the sense of smell is an advantage. But, on the other hand, it has its dangers for the dwellers in overcrowded and close

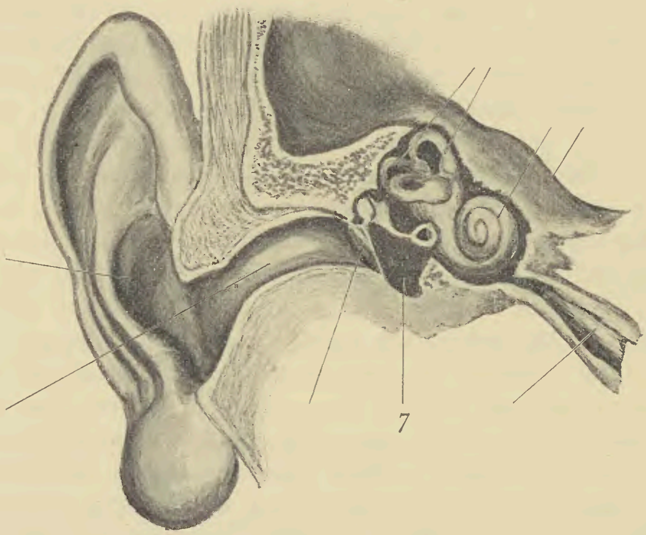



Fig. 188. Section of the Ear.
(7. Hollow of the Tympanum.)

Schoolrooms, Lecture-rooms, bedrooms, etc. No one but a person coming from the fresh air outside can realise in what vile and foul air people may exist with apparent comfort. Habit is unfortunately dead against ventilation in Public Buildings; but perhaps some day Government will realise the importance of this point.

As skill in Games partly depends on the Ear and Eye, much care should be taken in keeping these organs clean, and especially the Ear. It seems a small point, but, if you hear a stroke very well, you can often (more or less instinctively) judge a good deal about the pace and direction and spin of the ball.

The sense of Taste, again, is seldom cultivated; it may be spoilt by rich and irritating Foods, and then it will perhaps cease to guide you in your choice of Foods. It is wonderful how accurate and reliable a critic the taste can become, if it is never spoilt. It is like a very tender conscience, which may be dulled by constant offences.

The senses of the internal organs are also to be considered, they keep us informed of the place and positions of our limbs, and of the amount of resistance to any movement, so that we may use just the requisite amount of muscular effort. They also may tell us of emptiness and fatigue.

They, therefore, should be carefully attended to: their fine warnings should never be disregarded.

The effects of Diet, on all the Nerves and Senses, cannot be too often insisted on; the fineness of the Eye, the Ear, and the sense of Touch, may all be spoilt by errors of Diet.

On the other hand, happiness and cheerfulness, such as come from many Games, are a real Nerve-tonic. When we are worrying or nervous, we often feel unable to play well, but a Game may distract the thoughts, and may bring pleasure and cheerfulness: these in their turn may improve our Game itself, and may help us to bear the worry and to get rid of the 'nerves'. And so, apart from good Air and Light, good Sleep, and certain Water-Applications, and good Diet, the best and surest Nerve-Tonic may well be our favourite Game.

# PART V.

## POSITIONS AND MOVEMENTS AND EXERCISES.

## I.—POSITIONS (STANDING, SITTING, ETC.). EASY ATTITUDES, AND THE POSITION OF THE FEET.

When we are in any easy position, two forces must be engaged, viz.,

(i) Muscular forces: for the Muscles contract and expand, and are elastic;

(ii) other forces, e.g., weight, Balance, the resistance made by Bones, and by bands or Ligaments. These may be called physical forces.

As we move we constantly alter the Balance: we shift the Centre of Gravity. And in every position we have to keep the Balance by exerting some Muscular force, though we can help ourselves, e.g., by leaning against a wall.

We have already seen the body standing on both Feet so that its weight was divided between them: the Feet touched at their Heels, and formed a right angle there. The Weight (the Centre of Gravity) fell exactly in the middle (i.e., it bisects) this right angle. This is called the First Position.

In Military Carriage the body is bent further forward: it is thus more on the stretch, more alert, more ready to step out, but a greater Muscular effort is needed. The Muscles of the Abdomen are also stretched.

In both the Military and the Ordinary Carriage the head is erect, the Shoulders drawn back, and the Chest thrown easily forwards.

Meyer says that the natural position is that which calls for the least Muscular force, and can be kept up longest.

Which is the better position is much disputed. But for our present purpose, the Training of the Body, it may be said that, in Exercise, a degree more or less of Muscular effort is of little importance; anyhow the First Position must allow of a sudden change to vigorous action. The Centre of Gravity must therefore be, if not in front of, at least over, the axis of the Hips.

Meyer's Position, however, is so 'natural' that it is very likely to pass into the Slack Position, which expresses Muscular weakness and lack of energy.

### STANDING WITH THE WEIGHT MOSTLY ON ONE LEG.

The Leg on which most of the weight of the body rests is called the Standing Leg: the other is called the Free Leg, or, in German, the 'Playing-Leg'.

To stand on one Leg tilts the Pelvis, and so, for the time being, curves the Spine. Yet it is a very common Position. When one Leg gets tired, we change to the other, and so curve the Spinal Column in the opposite way.

It is a sign of Health, however, to stand firmly on both legs.

In most cases, as the Muscles on the right side are stronger (see above), the right Leg is used as the Standing Leg. There is a danger that this habit may curve the Spine permanently, in the case of young people who have to stand frequently and for a long time; the danger is still greater when other bad habits in sitting act in the same direction.

It is said that this choice of the right Leg as the Standing Leg affects the walk and makes it uneven.

Dr. Schmidt says that in fencing, when we lunge, the Left Leg is the Standing Leg. I cannot understand this, for, when I fenced, I always used to hold the Foil in my right hand, my left arm being up: then as I lunged forwards, down went my left hand to my side. And, again, the weight of the body was *shifted* by the Lunge—that seemed to me the very essence of the Lunge, as of the strongest blows in Boxing—*from* the Left Foot to the Right.

In many Games the Standing Leg is now the right and now the left. (E. H. M.)

This 'Base' has to be very firm, so as to allow the body to move backwards and forwards a good deal. In a Backhand stroke, in Games with a racket, the left Toe is usually pointed somewhat round. Some people make it face almost straight back, but this seems going too far.

The distance between the Feet should not be too small or too great; for the 'Base' must not be unsteady. A very unsteady 'Base' is when the Feet are far from each other and in a straight line, as sometimes in skating.

It is a good Exercise in Position and Balance to stand on one Leg and move the other about in all directions, and to try to keep the body as still as possible all the time.

### STANDING ON TIP-TOE.

We have seen that 'Tip-toe' is usually not the actual tip of the Toe. Of course this also is an insecure 'Base', and very tiring as well.

Nevertheless it is a common fault in Ball-games to make Strokes from the Tip-toe Position: this is a great error, as the weight of the body and some of the strongest Muscles can only be used when the 'Base' is firm. But as a Balance Exercise it is good.

## SITTING.

As to Sitting we have already said a good deal. If we are not sitting forward, it makes a difference whether the chair etc. has a back or not.

Notice how in 188*a*, one Leg is crossed over the other, that

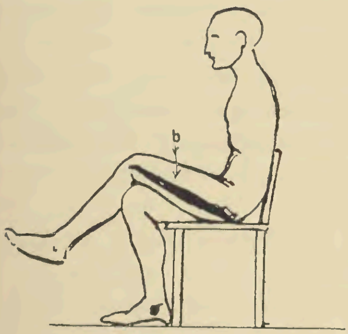



Fig. 188*a*. Crossing the Legs.

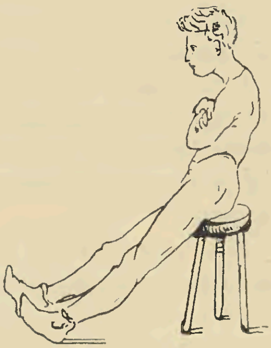


Fig. 188*b*.

the trunk may not slip forwards. By this means the long bending Muscles (starting from the seat) are stretched and do not allow the seat to slip back; the uncomfortable position of 188*b* is partly due to the stool having no back.

Above, we saw that if you sit on soft cushions etc., these will come into close contact with much of your seat. In prolonged sitting this pressure hinders the Circulation here, and so most people whose work is sedentary prefer a fairly hard seat.

## SITTING ON ONE SIDE.

As the habit of standing on one Leg (generally the right Leg) may produce the faulty Curve of the Spinal Column, so may the one-sided (generally the left-sided) seat. Since this is often persisted in for several hours a day during School-life, i.e. before the shape of the Spine is fixed, it is especially likely to injure the Spinal Column and to make it curve permanently to the left. Other Curves result from this single Curve.

### LYING, SQUATTING, AND KNEELING.

To lie on the back while resting is possible to human beings alone: other mammals can only lie on their sides.

*If we lie on our back on a soft and yielding surface,* which supports the whole surface of the back, we give complete rest to nearly all the Muscles of the body, and let Breathing and Circulation on both sides go on without hindrance: we do not displace the Abdomen's Viscera, as we may when we lie on our side.

On a hard surface, on the other hand, the body rests only on certain parts—viz., Shoulders, Seat, Calves, and Heels. Between these points are arches to be supported by the Muscles. So it is not possible to rest really well on the back on hard ground.

But to lie on the back (at least if the Head is on its back) often gives nightmare to many people.

Few people lie on the Abdomen, unless disease etc. make it necessary.

When the Heart is weak, sitting may be better than lying.

Among many tribes, Squatting is the favourite way of 'Sitting', e.g., among the Arabs and the Negroes of Central Africa.

If we keep the trunk erect and the knees apart, we strain certain Muscles very greatly and even painfully.

Here we have one of those Exercises which produce violent Local Fatigue without any profitable Muscular exertion for any great organ or function of the body, e.g., for the Circulation or the Breathing. The Stretched-out Arm is another extremely fatiguing movement; the twisting of sticks has also a tiring effect on the Wrist; and so has the repeated raising of heavy Dumb-bells, from the ground to high above the Head.

But some Wrist-Exercises, especially, are indispensable for Skill in Games, and the tired feeling soon wears off.

## HANGING.

Hanging with the Arms extended is the most 'natural' way of Hanging. A branch, or bar, beam, or ladder-rung, or the top of a wall, may be used. In Hanging by the Hand, the Hand may grip the branch etc. in many ways.

What good can Hanging do to us?

The Chest-Muscles, tensely stretched by the lifting of the Arms etc., lift the Ribs to the extreme position of Breathing-in; thus the Chest-Cavity is fully stretched.

But the Chest or Thorax cannot return to the position of Breathing-out, so long as we hang. If we hang for a long time, the Thorax makes no Breathing movements: only the Diaphragm can still rise and fall, and so keep up the Breathing.

Hanging, therefore, stretches the Chest and exercises the Diaphragm. It may also improve the Carriage.

But Hanging is a very great strain, not only upon special Muscles, but also generally.

The body can of course be raised from the Hanging position: this also is an Exercise of Strength.

Hanging Head-downwards disturbs the body considerably: the Viscera in the Abdomen press upon the Diaphragm and push it into the position for Breathing-Out, and so stop it from Breathing at all. The Veins of the Legs become emptied, those of the Head, Brain, and Neck become fuller. Giddiness follows. Such an Exercise is hardly a Health Exercise, and of course is not one for those who are liable to a rush of blood to the Head.

## RESTING ON THE HANDS.

After severe exertion, we like to lean forward on some solid object and rest upon our Hands, for it relieves the ordinary Breathing-Muscles by helping to bring extra Breathing-Muscles into play. This is anyhow a good Exercise to practise occasionally.

Parallel-Bar Exercises lift the Shoulder and draw it forwards, while the Chest sinks. But, if the Back-Muscles are too weak, the Head will sink down and the Chest will be hollowed and the Exercise will be hurtful. In any case there is apt to be a severe strain.

## 2.—LOCOMOTION (WALKING, ETC.) IN GENERAL.

Animals move their bodies forward on land, in the air, and in the water, in many ways and by many mechanical contrivances: of these, Flying has aroused most attention lately, but all are interesting.

Borelli, in his classic work 'De motu animalium' (1680), tried to illustrate the various ways of Walking etc. as follows:

On a pond is a boat, quite still. If a man who is in it wishes to go on, he must find something fixed, some '*fulcrum*', in order to move his boat.

If he has a long pole, he can dip it into the water until it touches the bottom. If he then tries to push the ground away with his pole, the boat will move in the opposite direction.

If the pole has a hook at the end, the man in the boat can also gain a 'fulcrum' by hooking his boat-hook to a tree, a fixed stone, a ring in a wall, or some such object, and then pulling at the pole, as if he were trying to draw the object to him. But the object is fixed, and so the only movement will be that of the boat towards the object. Here, then, we have two ways. First the attempt is made, as it were, to push the object away, in the other to draw it nearer. The result is the same: the boat moves.

If, however, the water is too deep for a pole to reach the bottom, and the bank too far off, then the water itself may serve as a 'fulcrum'. With an oar the rower tries, as it were, to fling the water back from his boat: the water yields a little, but still the boat is moved forwards, i.e. in the opposite direction.

In each instance, the power that moves the boat is that of the man in it. The power brings two points nearer to one another or draws them further from one another. In both cases one point may be fixed and the other point may be movable, and only the movable point will then change its place.

The body also can move by a thrust-off, e.g., by thrusting off from the solid ground (as a 'fulcrum') by means of the Big Toe, which is here a 'Lever'. Or it can move by a pull, e.g., by pulling itself forwards on a sloping ladder.

Thirdly, the body can move in the water and in the air, e.g., by a backward thrust-off with the foot; the act of moving in the air is still in its infancy.

There yet remain the Cycle, the Boat, Skates, Snowshoes, etc., which work on much the same principles as the natural methods.

### 3.—WALKING, MOVEMENT IN WALKING.

In Walking, the body never entirely leaves the support of the ground, as it does in Running. Of special kinds of Walking we shall speak below. By a 'Natural' Walk we mean that the body is carried over level ground at almost a uniform pace, and with little (or the least) exertion.

Here again, we may speak of the Free Leg and the Supporting Leg (for the 'Standing' Leg would not be quite right).

Recently French scientists, and Marey, above all, have done much to clear the way in which we walk and should walk, by new kinds of experiments; Meyer, Vierordt, Braune, Boegle, and others have been working in Germany. The question is important, not only for Walking itself, but also for every other kind of Locomotion; as we shall see when we treat of Running and Jumping.

These methods are: first of all, *the Graphic Method*, especially for measuring pressure; and secondly, *the Photographic Method*, for measuring time also.

### THE REGISTERING OR 'GRAPHIC' METHOD.

Marey invented a special Shoe for showing with what force the Feet pressed upon the ground.

The time when both feet are on the ground is called the time of Double Support: the exact opposite is the time when (as in the Run) neither Foot is on the ground.

The up and down movements of the Head and the Pelvis can be registered in much the same way.

### THE PHOTOGRAPHIC METHOD.

This supplements the 'Graphic' Method. Photography is now in the front rank as a means of experiment and observation. Anschütz, the well-known photographer, and Prof. Kohrausch of Hanover, have done good work here.

Some day the Cinematograph will be used for teaching Exercises and Games.

In France the great Prof. M. Marey has made an ingenious use of Photography in his Institute (at Boulogne-sur-Seine), which is magnificently fitted up by the French Government. While Muybridge, Anschütz, Kohrausch, and others, give a separate picture of every moment in the course of a movement, so that the whole series can be again combined, by the Zoetrope or Wheel-of-Life, into a single moving picture of the whole movement. Marey tried to put the successive movements on a single plate. He dressed the subjects in white, and made them walk or run past a black ground: as they did this, he took them a certain number of times at short intervals on the same plate. By clothing one Leg of his subject in black, so that it did not appear in the Photograph, he got a picture of the movement of one Leg only in Walking. His Diagram also shows the rise and fall of the Head and of the Pelvis in walking.

Sometimes Marey dressed his subject entirely in black, but sewed strips and dots of white metal on the Heads, limbs, and joints.

### PRESSURE OF THE FOOT ON THE GROUND.

Of course we only get full advantage of the pressure when the ground is firm: on a hard road we walk faster than on loose dry sand.

Moreover, the angle of the Feet makes a great difference, because much depends on whether the Big Toe gets its full leverage or not.

Individuals differ in their pressure; and the Oscillations of the body differ also.

Then, again, as the Step gets longer, the Centre of Gravity gets lower.

### SIZE AND TIME OF THE STEP.

It has been calculated that, in the natural walk of an ordinary person, the more he strides the less time the step takes, and, *vice versâ*, the less he strides (i.e., the shorter his step is) the more time it takes. See the Tables below.

| Length of step. | Duration of step. | Velocity p. sec. | Making 1 kilom. in |
|---|---|---|---|
| 0.851 m. | 0.335 sec. | 2.397 m. | 6 m. 58 sec. |
| 0.835 „ | 0.394 „ | 2.119 „ | 7 „ 51 „ |
| 0.804 „ | 0.417 „ | 1.746 „ | 9 „ 32 „ |
| 0.762 „ | 0.507 „ | 1.503 „ | 11 „ 4 „ |
| 0.661 „ | 0.604 „ | 1.106 „ | 15 „ 4 „ |
| 0.595 „ | 0.726 „ | 0.819 „ | 20 „ 21 „ |
| 0.543 „ | 0.846 „ | 0.627 „ | 26 .. 34 „ |

When time is beaten audibly by 'counting' or by music, the steps are (according to the brothers Weber) rather longer in proportion to their duration than in quite a natural walk; this is not without interest—e.g., for the Army when marching in time. Some of his estimates were got by an experiment on the same person, who covered a distance while time was counted out loud.

In Walking, the Leg swings like a pendulum: a long Leg is like a long pendulum, which will swing slower, while a short pendulum will swing quicker. As a general rule, shorter people should take shorter steps, taller people more deliberate steps. To make children of different sizes keep in step is therefore to some extent a mistake, though it has advantages.

The French have lately tried a Marching-step which was supposed to use up least Muscular force, and so to be least tiring, in proportion to the pace. Marey helped here and also in experiments in Marching with bent knees.

## FORCE USED IN WALKING.

The force used by the Muscles is made up thus:—

(1) The body goes up and down at every step. This varies generally according to the length of the step, except in Walking with Bent knees;

(2) the forward-movement;

(3) the rotation of the Pelvis and trunk, and the Swinging of the arms.

In more rapid walking, all three increase: the up and down motion grows slowly greater, and thus more force is used; the forward-movement grows much greater; and the effort of swinging the Legs increases regularly as the pace becomes quicker.

An increase in both the number and the length of the steps in natural quick walking in the erect position is only possible up to a certain length of step. Beyond this point the step grows shorter, because there is less and less time for a full forward swing of the Leg.

In any case, extraordinary totals of exertion can be reached in Walking and Marching on level ground: and of course the greatest total is not reached by the quickest Walking or by the longest strides.

The subjoined Table is of interest:

| Length of step. | Duration. | Velocity pr. sec. | No. of steps. | Time. |
|---|---|---|---|---|
| 0.881 m. | 0.436 sec. | 2.020 m. | 49.3 | 21.50 sec. |
| 0.831 „ | 0.436 „ | 1.598 „ | 52.3 | 27.17 „ |
| 0.794 „ | 0.592 „ | 1.342 „ | 54.7 | 32.35 „ |
| 0.704 „ | 0.706 „ | 0.997 „ | 61.7 | 43.57 „ |
| 0.631 „ | 0.801 „ | 0.798 „ | 68.8 | 55.08 „ |

## THE BODY AND ITS POWER OF ENDURANCE WHILE WALKING ETC.

Estimates of exertion in walking may be inaccurate, but at least they prove that by walking we may easily, and without appreciable Fatigue, get through great exertion; in a few hours this may reach the highest total of labour of which the body is capable in a day.

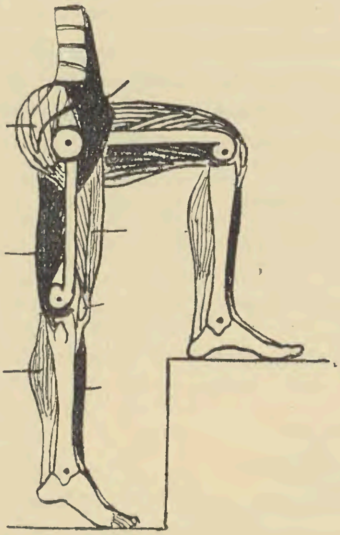
In this exertion, which means that great 'Changes' are going on in the Muscles engaged, lies the great value, not only of Walking or Running, but also of other ways of moving in even rhythmical sequence—e.g., Climbing, Rowing, Cycling, and Swimming.

How is this amount of Endurance and Speed possible?

1. *The work is distributed over many Muscles, and these are the strongest in the body.* The Muscles which move the lower limbs form 56 % of the whole Muscular structure. Not one of the Muscles called into play needs be taxed to its utmost capacity, but may merely be forced to a slight and moderate effort. It is the addition of all these slight efforts which makes the whole force so great.

2. All these movements have this in common, that they go on in rhythm, and that there is a constant interchange of effort and relaxation. During relaxation, some of the Waste-products of the Muscle may be washed away.

3. The bending and stretching Muscles of the Legs work under very favourable conditions, thanks to their position about the Joints; *for each movement stretches or extends the Muscles which are to be brought into action next.* Bending prepares for and begins the next Stretching, which in its turn prepares for



188*c*. Muscles of the Leg while mounting.

and begins the next Bending. See Diagram 188*c*. The angle of the Hip-Joint looks to the front, that of the Knee to the back, and that of the Ankle again to the front.

4. Every bending of the Joint stretches the Stretching-Muscles, every stretching helps the Bending Muscles, and the greater the movement is the greater also is the help. This is of extreme importance for the smooth and easy working of the 'Mechanics' of movement.

Walking is usually so much practised in ordinary life, and we exact so much exertion from the Muscles of the Pelvis and Legs, that the Leg-muscles are perpetually more or less in training for prolonged exertion.

They therefore work frugally, with little expenditure of material, and they are less easily tired by prolonged exertion than the Muscles of the Shoulders and Arms, unless these have been trained—e.g., by some Handicraft.

It is not necessary for the bulk of the Leg-Muscles to be very great, if the Legs need extraordinary endurance. This has already been explained, in the account of practised and trained Muscles.

5. The rhythm in these muscular movements needs an extremely small Nervous effort (unless we specially vary them by act of will, or have to give constant attention to something): for they go on semi-automatically. And, the less Nervous-effort we require, and the less Nerve-fatigue we feel; Muscular exertion is less likely to produce tiredness; and the muscles are more ready for prolonged exertion.

| | Steps pr. min. | Force expended in kg-m. in 1 min. | in 1 hr. | Length of step. | No. of kiloms. pr. hr. | Force expended in 25 kiloms. | 25 kiloms. traversed in |
|---|---|---|---|---|---|---|---|
| Slow walk . . | 80 | 720 | 43,200 | 0.75 m. | 3.6 | 289,520 kg-m. | 6 hrs. 56 min. |
| Quick step . . | 140 | 1316 | 78,960 | 0.72 ,, | 6.04 | 326,368 ,, | 4 ,, 8 ,, |
| Marching at full speed . . | 180 | 3150 | 189,000 | 0.66 ,, | 7.128 | 661,500 ,, | 3 ,, 30 ,, |

| 1. Ordinary business walk: Step 80 cm. long, Steps pr. min. 120, 1 km. in 10 min. 24 sec. | | 1. Slow saunter: Step 48 cm. long, Steps pr. min. 60, 1 km. in 34 min. 43 sec. | |
|---|---|---|---|
| | Exertion in kg-m. | | |
| Per step . . . . . . . | 7.215 | Per step. | |
| ,, second . . . . . . | 14.43 | ,, second . . . . . . | 4.33 |
| ,, hour. . . . . . . . | 51,948.7 | ,, hour . . . . . . . . | 15,588.00 |
| ,, kilometre . . . . . | 9,018.5 | ,, kilometre . . . . . | 9,026.1 |
| ,, mile(German)(=7.5 km.) | 67,640.5 | ,, mile (= 7.5 kiloms.) . | 67,703.25 |
| ,, 5 miles (= 37.5 km.) | 338,202.5 | ,, 5 miles (= 37.5 kiloms.) | 338,516.25 |

## EFFECT OF WALKING, ON THE LUNGS AND THE HEART.

It has been shown by the English Physiologist, Mr. E. Smith, that in Walking and in Marching the volume of Breath increases to many times its ordinary amount. Even in slow Walking it is almost doubled, in Walking at an ordinary pace (4.8 kilometres an hour) it is multiplied by four, and by a vigorous or hasty march (6.4—9.6) from seven- to nine-fold. This increase is the more important (as compared with the brief and transient increase—e.g., from Exercise with some apparatus), because a quick walk, and with it the increased volume of Breath, can be easily kept up for several hours. No other exertion of the Lungs can be prolonged so easily. If, for instance, certain extra Breathing-movements were added, the Walking could be made twice as tiring.

The Fatigue is small partly because the Will is scarcely used,—for such regular and Rhythmic Exercises easily become semi-Automatic,—and partly because the Muscle-areas which are used are large, and partly because each Movement prepares for the next.

The Breathing, generally of its own accord and without any special intention on our part, suits itself to the needs of the blood. A great exertion brings extra Carbonic Acid into the blood, and hence extra Oxygen has to be provided, to keep the balance: the Lungs work harder as the Muscles work harder. Large parts of the Lungs are thus brought into action.

We shall not enquire here whether, as was formerly supposed, this quicker Breathing is caused by the action of the blood (which is over-stocked with Carbonic Acid) on the Nerves which regulate the Breathing, or whether (as seems at present more probable) the Waste-products have some effect also.

As more Oxygen is needed by the Muscles, and Oxygen can only be carried along to them by the red Corpuscles in the blood, the Heart has to pump more red Corpuscles along, i.e., more blood. It does this (1) by working faster, and (2) by pumping larger volumes of Blood.

This Walking is a Lung-Exercise and a Heart-Exercise of a very excellent sort.

### EFFECT, OF WALKING, ON THE MOVEMENT OF THE BLOOD IN THE LEGS.

The Circulation of the blood depends on the pumping of the Heart, which is affected by (1) the sucking-action of the Lungs, and (2) Muscular movements, especially those that go on in regular Rhythm (contracting and relaxing). These two do more work in quick Walking, as also in Running, Rowing, Cycling, Swimming, etc., but less work in slow Walking.

To these two we may add (3) the effect of the Ligament.

Fig. 189. Natural walking with the heel coming down first.

Now in prolonged Standing the Veins of the Legs become fuller, and the Circulation of blood in them becomes more sluggish: for the blood is kept down by its own weight (Law of Gravitation). And, if Walking movements are made very

Fig. 190.

slowly, these three forces do not work hard enough: they do not overcome the attraction of the blood downwards. Hence, when you Walk slowly and with short steps, your Legs remain over-full of blood, and become heavy. Instead of being quickened, the Circulation is actually hindered, for the 'Waste-products' are not carried away quickly enough. Hence slow 'Walking', though only a small exertion for the Muscles, soon brings on a feeling of Fatigue. While the vigorous Walker keeps fresh, by walking with long strides, the sauntering idler soon needs rest; and yet the former gets through far more muscular exertion.

THE NATURAL TREAD.

In a Natural gait the Footsteps (as we see on sand) turn outwards; this is partly because the Muscle that moves the *Thigh* outwards is stronger than the Muscle that moves it in-

Fig. 191.

Fig. 192.

wards: the Thigh affects the Knee. The outer border of the Foot is also lower.

The Heel comes down first, and its inner border before its outer border: but the thrust-off is made from the outer border. Hence, in the shoes of most people, the outer border wears out more quickly, except at the Toe, where the inner border (near the Big Toe) wears out.

If is different when we *Walk with Bent Legs*. Whether this Walk (which we shall presently describe in detail) should be called 'natural' may well be disputed. As far as quick Walking is concerned it has this claim, that *it needs least expenditure of force*. On the other hand, it does not come 'naturally' from the natural erect attitude of the human body, but needs a bending of the joints of Hip, Knee, and Ankle, i.e. it means an attitude neither natural or beautiful.

Travellers have often been struck by the fact that the American Indians, in Walking, point their Feet straight in the direction of the line of march, and that, in Walking, they are capable of remarkable performances. Attention has been called to this fact, and it has been proved that, in numerous other races, the usual hasty Walk is done with Bent Legs, while the Walk with 'Straight' Legs is used for slower Walking, e.g., to express majesty and dignity.

In this Walk with Bent Legs the whole sole of the foot is set down flat at the same moment, the Feet being turned

Fig. 193. Walking and marching with Bent Knees.

straight forwards and not outwards. This is natural, since the outward rotation of the Hip- and Knee-joints (see above) does not go on when the Legs are Bent, but only when they are 'straight'. This way of walking has recently been recommended and tried *in France as being particularly good for long Marches, as it does not fatigue those who are practised in it as much as Marching with 'Straight' Legs.*

SPECIAL STEPS.

What is called a 'Gravitatic' Step has been called a second 'Natural' Step, by the Weber Brothers, the first being the Step with

'Straight' Legs and the Toes turned outwards. In this the Toe feels the ground before the body rests itself on the Foot. This step we often use instinctively when we walk in the dark on unfamiliar ground. It is also the Step of the Blind, and is sometimes used in solemn processions etc. The step is short, and the pace slow.

The 'Natural' Step can be altered at will. Those who 'naturally' take their steps too short should practise—with conscious effort and as a separate Exercise—slower and longer Steps, letting their Legs swing further forwards. This will soon become a saving of effort.

Exercises in Walking may have for their chief aim the performing of certain feats of endurance and speed. Such racing and record-breaking feats are apt to affect the 'Natural' Walk, and to become more and more habitual.

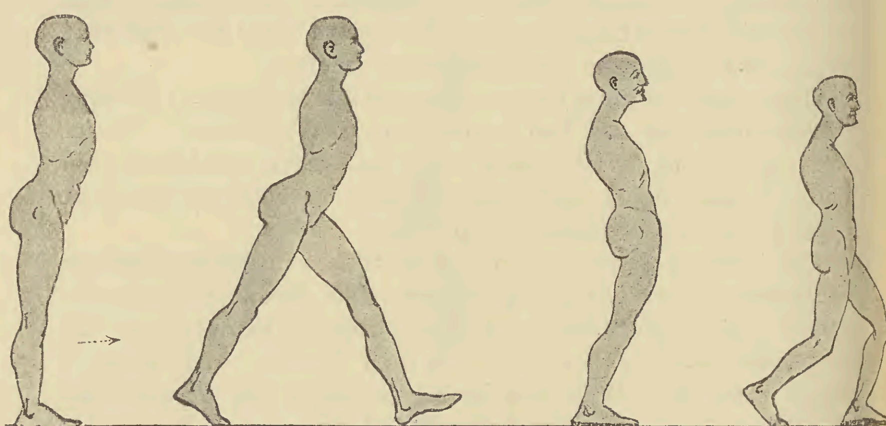
Habit here is a great factor: if you get into the habit of Walking briskly, then you will find it quite hard to Walk slowly. Notice how, in a long Walk, when once you have quickened your pace, if only for a mile, you will tend to keep up that pace even if you are beginning to get tired.

The ordinary semi-automatic Walk differs in different persons according to their body (e.g. height), their character, their education, their occupation, and their habits. The workman, the sailor, the cavalry-officer, all have their Walks. And, within a single class, one Walk will be self-confident and free, another slack and clumsy, another hurried, and so on.

Now if the character and temper will naturally show itself in the Walk, and if the Walk can be altered by special Training and Practising (especially by practising Part-by-Part, at first slowly), is it not likely that the new Walk may have its effect on the Character and Temper? We have already spoken of the Face-Muscles. These suggest that very likely the Training in a particular kind of Walk may some day prove to be a great help in developing a particular kind of Character, e.g., the hasty and rash Character might be partially checked by Practising (Part-by-Part) a slow and measured Step. This may be recommended to psychological specialists.

A similar suggestion may also be made with regard to *Positions of the body*: Despondency and Despair and Weakness show themselves in special attitudes. Might not the careful practice of a happy or vigorous attitude help actually to produce the feeling of happiness and vigour? In America—at any rate in New York—the relaxed and contented attitude and expression should rather be cultivated.

A careful Gymnastic Training in a regular course of Walking and Marching-Exercises may help to form a graceful, free, active, and vigorous way of Walking, and thus achieve an important end. Such Training in a quick striding gait is valuable in life, not only for the hasty business-walk, but more especially for the brisk refreshing 'Constitutional'. To step out happily on a long and difficult path and not to shrink from exertion, so that one may see the beauty of scenery—of meadow



Figs. 194—5.
Stride from the tense upright attitude and from an easy slack attitude.

and of wood, of mountain and of valley, of river and of lake, especially in one's own land, to feel a real joy in walking, are almost worthy to be aims in themselves. To train the young in this way is a task of true education of body, mind, and character.

The first need, if one would acquire a free and graceful walk, is a good erect Carriage while one is *standing*. From the tense, 'Military' attitude (see above), in which the Centre of Gravity is further forwards, so that the Heels are already slightly lifted, the long stride of one Foot for a brisk Walk follows as if of its own accord.

When, on the contrary, a person starts from the lazy position of ease, the Leg is still bent as it is thrust forwards, and the Supporting Leg tamely drags after rather than boldly pushes off.

The Step is short, the whole Walk proceeds in slower time—with small Muscular effort, it is true, but then the result is poor as movement. But, above all, such a Walk is a picture of languor, of indolence, of the lack of brisk energy and purpose.

Thus a good Carriage of the body in Standing is the first condition of a graceful Walk.

All these ways of Walking are practised *forwards*, the true and only direction of the human Walk. It is, however, possible to walk sideways, by either extending the Right Leg to the side and drawing the Left after it, or by extending the Left to the side and drawing the Right after it. And it is also possible to Walk backwards.

*And Sideways-Walking, as well as Backwards-Walking, is*

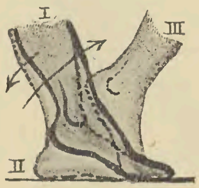



Fig. 196.
Foot set down toe first (I); then heel set down (II); then follows the thrust off with the big toe (III).

*invaluable for certain Games.* Mention need only be made of the thousands of Strokes in Ball-Games, such as Lawn Tennis or Fives, Fielding in Cricket, the Foot-movements in Boxing and (to some extent) in Fencing, to say nothing of the sudden stepping backwards or to the side to escape a danger, e.g., a cab. In fact, so important are these movements, that they may well be recommended as special and separate Exercises.

## WALKING ON TIP-TOE, ETC.

As we saw above, 'Tip-toe' is a misnomer: the Walking is really done on the Balls of the Feet. Needless to say, the Walk is apt to be unsteady, because the 'Base' is small; and the Steps must also be short. Moreover, the Exercise is tiring.

Nevertheless, it is useful to be able to move very quietly, not only for the reasons which 'Young Alf' gives in 'Hooligan Nights', but also when people are ill or asleep. Moreover, the Tip-toe Walk is most excellent practice for many Ball-Games. Hence it is valuable as an Exercise, that is to say if Exercises include success in games among their objects.

Walking with the Toes put down first is, for some reasons, an absurdity, since the Walk is tiring, the Steps are slow, and a Backward movement is actually inserted. But still, for hasty people, such a Walk is not without its Lesson in patience and self-restraint.

For ordinary purposes, however, the firm, light, unconstrained

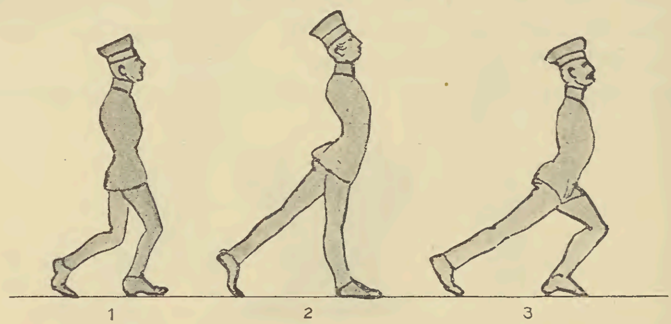



Fig. 197.
Training of a shambling recruit by exaggerated gait.

Walk is better for the female sex as well as for the male. It may be mentioned that the above Walk has much the same effect as a high-heeled boot and shoe.

### A MILITARY STEP.

In the Military Marching-Step, the Leg is 'Straight', and the whole sole is set down at once. A shambling recruit can be trained by an exaggerated Military Step, as in 197.

Its value is partly due to the quickness and length of the Step, partly to the firmness of the Step, and to the smartness of the Carriage. As to the firmness, it must be noticed that in this Walk the trunk oscillates less.

These good qualities are gradually and unconsciously transferred from the Military to the ordinary and Natural Step, and may remain through life.

But the Military Step has a certain disadvantage.

It is a fact that to set down the sole of the Foot flat, with a single movement, needs *more muscular force.* The Toe must be pressed down, and the outer border of it must be lifted. The sudden shifting of the Centre of Gravity to the Foot just set down gives *a shock* to the body at every step. Hence, in Marching for hours together, it is not possible to keep up the typical Military Marching Step; it passes over spontaneously into the Natural step. The Parade-step is only fitted for exercise and practice, not for prolonged Marching.

The Military Training has been accused of making soldiers dependent automata. But this shows ignorance of the demands made by modern warfare, especially in scattered fighting, outpost duty, etc. And the brisk March in close order gives the troop, i.e. every man in it, a sense of irresistible and unconquerable strength in attack. The deadly march of the Prussian Guard before St. Privat, when they advanced and overcame the enemy under a hail of bullets and with countless losses, yet in firm and steady order as if on parade, shines in the history of all time as the crown of Prussian marching discipline.

It would be an error to practise the Military Walk, and that only: but, as one way of Walking, it should by no means be neglected.

### THE 'GOOSE-STEP'.

The so-called 'Goose-Step' is no more than a slow analysis of the Military March into its several parts or acts of motion. The Step is shown above, and in Diagram 198, where the Stick movements are added.

It may be done slowly at first and then quickly, but anyhow it demands an *upright and steady Carriage* of the trunk, with Chest thrown forward and Abdomen kept back, with rigorous extension of the Legs, and other Muscle-movements. Moreover, it is an admirable Exercise in *Balance,* to strengthen the Muscles that hold up the Pelvis and Spinal Column. But, above all, it is Training for the Marching Stride.

Although this preparatory Exercise, tried by a novice on the Exercise-ground, may sometimes look rather like a caricature, and may even he ridiculed, yet this is exactly the drill that is needed to train the recruit, who is often, from his youth up, accustomed to a bad, limp carriage both in Standing and in Walking. In a short time it leads him into the habit of holding himself well and smartly.

WALKING WITH BENT KNEES.

In this way of Walking, the Legs are kept bent at the Knee all the while, the back Leg being just slightly extended at the thrust off. The Foot is set down on the whole sole, and the trunk of the body is carried well forward.

It has already been mentioned that this Walk with Bent Legs is common among people of many races, who also run


Fig. 198. 'Goose-step' with stick-exercises.

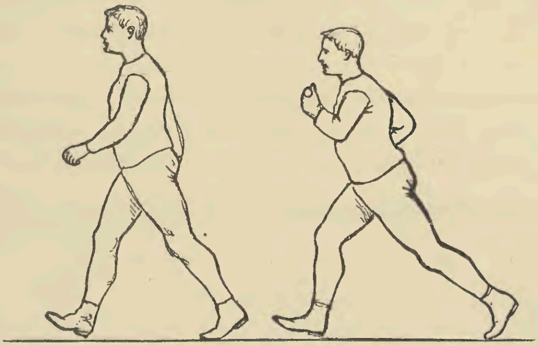
with Bent Legs. And some of these races are capable of wonderful endurance in Walking and Running. In Germany many of the country folk cover the ground in this fashion, and it is well known that dwellers in mountains prefer to walk with the Legs much bent while mountain-climbing, and this is particularly recommended by guides to Alpine-climbers on long expeditions on the mountains.

For about 20 years, experiments in regard to this way of marching have been made on a very large scale by the French Army. De Raoul, a Captain of Artillery, and Dr. Regnault, a medical man, have tried to perfect and popularise this kind of

Walking, and very exact experiments, on its 'Physiological' properties and value, have been made in Marey's Institute.

The Instructions for this Walk are somewhat as follow.

It is an example of the system of Learning and Practising Part-by-Part: see p. 16 foll.



Figs. 199—200. Walking with straight legs (199), and with bent legs (200).

The first position should be free and unconstrained; the trunk should be held high, the Chest forward, the Head high; the Arms are bent at the elbows, the Lower Arms being held as

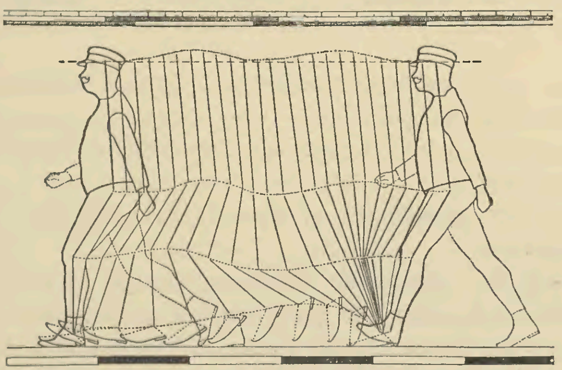


Fig. 201. Ordinary Walk or March with Straight Legs, by Marey (from Regnault and Raoul, *Comment on marche*).

in 202. In Walking, the Legs are bent, so that the Centre of Gravity is dropped lower and the body looks shorter. *The Feet trail on the ground*, i.e. they are lifted no higher than is necessary in order to keep clear of the unevennesses of the road. The advancing Foot is set down, as far as possible, on the flat sole and quite noiselessly. The trunk is bent forward, not in the Spinal Column, but at the Hips; thus the Back is kept extended, the Head high, the eyes to the front. The more the trunk is inclined, the longer becomes the Step, because it has to come up with the forward-falling Centre of Gravity, and to support it. It might be said that the person is pulled along by the Centre of Gravity.

It is important that the reader should read the above paragraph two or three times, lest he should confuse Bent-Leg Walking with Slouching. Let him notice especially—'the Chest

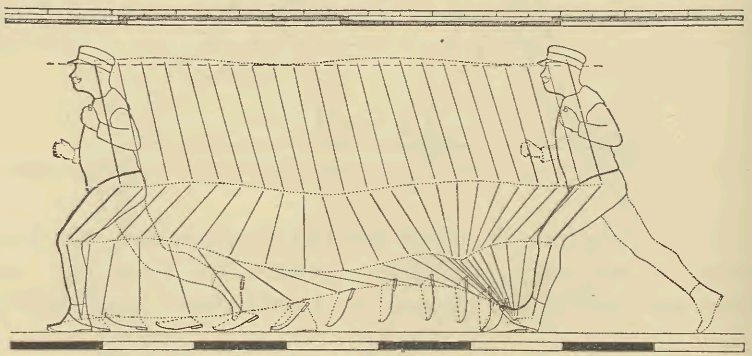


Fig. 202. The March with Bent Legs, by Marey (from Regnault and Raoul).

forward', 'the Head high', 'the trunk is bent, not in the Spinal Column, but at the Hips'.

The contrast between this and the ordinary Walk are seen in 201 and 202.

Among the *advantages* of this Walk with Bent Legs are the following:—

1. Since the Leg to be set down is bent at the Joints, *the shock* received by the foot (and carried on from it to the trunk) at each setting down of the Foot, *is lessened and broken*. In Walking with Straight Legs, the shock caused by the setting down of the Foot is carried on directly to the Pelvis, and it acts as a drag, and thus checks the forward-movement of the trunk: in fact, the speed after the foot has been set down, must each time be given afresh to the body, by a new impulse. This means extra muscular force, and, slight as this may be for each single instance, yet in a great number of steps, such slight

units mount up to a great total of exertion. The fact that this shock to the body at each step of the advancing leg is spared or greatly lessened, saves muscular exertion.

2. But still more exertion is saved by this Walk with Bent Legs because *the body is raised far less than in ordinary Walking, in proportion to the length and speed of the Step.* Thus the ordinary Walk means a waste of power, since this exertion does not move the body forwards.

In a Table, Dr. Schmidt gives measurements taken (in Marey's Institute) from a single person, who performed great feats with both kinds of Walking. See the Running measurement p. 383.

In Walking 1 mile very quickly when the Legs are 'Straight', the body is raised more than twice the height that it is raised when the Legs are Bent.

3. In Walking with Bent Legs, *the Centre of Gravity is in front of the 'Base'* (the Feet), and, as we have seen, helps to pull the body forwards. In fact, the apparatus shows that less force, less pressure, is used by the Foot that thrusts off from the ground, than in the ordinary Walk.

Walking with Bent Legs, therefore, not only allows of great speed, but this with the utmost economy of force. Anyone who has covered a course in this fashion will be astonished at the ease of his progress.* But one or two points are to be noticed.

(1) A certain amount of Training is needed, if one wishes to Walk correctly in this way and to get the full advantage. The Walk should be begun with small Steps, and these should be *gradually lengthened and quickened* by a greater bending of the trunk. The first mile should be covered in sixteen minutes, the second in fifteen, the third in fourteen. The latter is given as the mean speed of this kind of march. People in good practice can do better still, finishing the mile in from 9 to 10 minutes; but Running with Bent Legs is really better in such a case. Besides, in very quick Walking a person naturally breaks into a Run.

(2) This Walk, on level ground, looks unusual or even ridic-

* Recently I experimented with it in Yorkshire, and found that the difference it made was enormous. One day I walked more than 40 miles over very bad and uneven roads, and in a drenching rain, without much fatigue, though I am not at all a good walker. (E. H. M.)

ulous. An average Englishman or boy is little likely to risk it: still less an average English woman or girl.

For many purposes such a method of marching would often be valuable; the statelier and firmer March with 'Straight' Legs need never be given up, but the 'Bent Leg' Marching should also be practised.

With French troops who had thoroughly practised this March, the speed never fell below a mile in 13 minutes, even over unlevel ground, ploughed fields, etc., and twelve miles *were easily covered without a rest.* In long Marches of more than 30 or 35 miles the occasional change of Walking with Bent Legs for Running with Bent Legs serves as a relaxation for the Legs and thus lessens Fatigue.

According to these statements, the March with Bent Legs is highly to be recommended for prolonged quick Marches: and not only for level ground, but also for going up and down hill and in mountainous country. But it must once more be insisted upon that it should have been practised beforehand, so that it may go on Half-Automatically.

### QUICK STEP.

Exercises in Walking should be practised even in the earliest years of School life. A child almost always walks with its Legs further apart than a grown person; it straddles. The Feet are not so much turned out, but point straighter forwards, or in many cases the Toes actually turn in. The Steps are of unequal length, and therefore irregular. It has been particularly noticed that the Left Foot often takes longer Steps; this may be due to the more powerful Muscles of the Right Leg; the Right Leg thrusts off more vigorously, and gives the Left Leg a longer swing forwards.

The Average Length of the Step depends partly on the height of the body, the length of the Foot, etc. Here it need only be said that children or boys of different heights should not be made to walk in step together.

Too long a Step is tiring for ordinary Walking, but for Athletic purposes of course a long Step is necessary. Too short a Step, again, is not good for ordinary purposes.

Nevertheless, *in many Games and Exercises it is essential* *to be able to take short Steps, as well as to* start quickly (which is best done from an 'alert' position), and to run fast. In Rackets, in Tennis, in Lawn Tennis, in Fives, in Cricket (when Fielding and, occasionally, when Batting), in Football, in Boxing, etc., the long stride is often singularly out of place. When you have to reach one place from another which is, let us say, two strides and a half away, then three or four short Steps are often best. The Racket-player who cannot take short Steps is generally 'out of it' in a fast game.

For an average School-Walk or March, 112 to 114 Steps a Minute should be suitable and the Carriage of the body, etc., should be frequently supervised.

The Quick-Step 'in three time' is a common Quick-March, differing from ordinary Marching only in the time in which the Steps are taken. In marching in time it is a rule to lay special stress on the *first* of every two Steps. And, in general, it is every step with the Left Foot which is so emphasised. We are in the habit of marching in time.

*Left*, right, *left*, right, *left*, right, *left*, right, or—

$\underline{1}$ ◡ $\underline{1}$ ◡ $\underline{1}$ ◡ $\underline{1}$ ◡

The stress laid on each step of the Left Foot calls each time for a special slight effort of Will, while the next Step follows as if automatically.

This only holds good at first: for the 'Three-Time-Step' can become half-automatic.

If we take three-time instead of two-time, thus—

$\underline{1}$ ◡ ◡ $\underline{1}$ ◡ ◡ $\underline{1}$ ◡ ◡ $\underline{1}$ ◡ ◡

the marking steps are as follow:—

*Left*, right, left, *right*, left, right, *left*, right, left, etc.

Here the accentuated Step is followed not by one, but by two almost automatic Steps. One side of the Brain has not to give the slight stimulus for every other step, but only for every sixth, and the change may be good for both Hemispheres of the Brain.

For the Practising of this Step Schmoele has written Verses to take the place of Music in three-time.

It has been found, by frequent experiments, that as a matter of fact the pace can be greatly quickened by Walking in this time; thus a March of exactly 16 miles was done (without a break) in three hours, fifteen minutes. It seemed also that the feeling of Fatigue was slighter than in an ordinary Quick March at the same pace. So we herewith commend to lovers of long walks the experiment of walking in three-time.

## 'ATHLETIC' QUICK WALKING.

This is one of the hardest Races in Athletic Sports.

In this Walking, as the Right Leg swings forward, the Right Arm and trunk come forward also; when the Left Leg swings forward, the Left Arm and trunk come forward also. Here then it differs from ordinary Walking, where the Right Arm goes back as the Right Leg swings forward.

The Legs are 'Straight', the body is erect, the Head stretched back a little; the Elbows rest at the sides, with the Lower Arm pointing forwards; and the Hands clenched or even gripping a cork etc.

The Toe of the back Foot must not have left the ground before the forward Foot touches the ground.

The Step should not be too long, i.e. it should not go beyond the pendulum-swing of the Leg, or else the pace will actually be lessened.

As the Arm swings forward, the Shoulder is lifted, so as to 'ventilate' the upper part of the Chest.

In practice, care must be given to the work of the Arms, which act as levers to draw the body forwards; and special care, because the movement is the reverse of the movement in ordinary Walking.

Before a person is quite used to this way of Walking, which has a long stride from the very outset, it should be taken at a very small pace, 10 or 11 minutes to the kilometre. Not until a good style of moving has been thoroughly impressed on the organs of movement, and has become half-automatic, should he practise covering a short course at the top of his speed; after such practice he should, at the signal for starting, step out at once at his utmost speed.

The records show how much faster this Walk is than even a very Quick March.

The power of doing such records means a heroic endurance. Athletic Walking is far from reducing the exertion to a minimum, and employing it to the best advantage, for very long distances. To keep it up requires extraordinary muscular effort. The violence, and the stretching and straining of the Muscles are apt to bring on severe muscular pain even in those who are in practice, and, above all, pain in the Shin-bone. To endure and suppress this suffering by a strong effort of Will can alone lead to 'Record-breaking'.

'Athletic' Walking is of no importance for the Training of children or the general public. The practice for it is usually so severe that, while it lasts, it excludes any other form of exercise.

### WALKING TOURS AND EXCURSIONS.

These are chiefly an exercise in Endurance, and a pleasant change etc., rather than an exercise in Speed. They should not go on after general fatigue has shown itself:

Childhood, before the period of development begins, is admirably suited for exercises of Speed, but is not suited for exhausting exercises of Endurance.

The following points are worth mentioning:—

1. The distance is not to be reckoned solely by itself; the character of the road should also be taken into account. A distance that can be easily covered on a smooth level highroad, may mean double the expenditure of Muscle-force and Nerve-force if the ground is sandy or very damp. Other hindrances are opposing winds, not only because of resistance, but also because of the Breathing, dust, rain, snow, and great heat.

2. *The best time for a Walk is the early morning*, as then one is freshest. No exertion should be made directly after a meal. Night Walks are seldom to be recommended, for, among other things, night is the time for rest.

3. The Walk should here and there be broken by *pauses*. Of these, the first might be made half or three-quarters of an hour after the start, as then the muscles of the Shin-bone often need a rest, as is proved by their painfulness. After that, the Walk may be kept up for a longer time. The pauses should be short (about 5 minutes), and during them the body should be erect. Experience proves that to sit down makes one more liable to be tired when one gets up again. A short halt should be made before climbing a steep ascent, so as to begin it with fresh strength and easy Breathing. *An occasional Run* is a good change.

4. In Walking for a long distance a person *should not step out in quick time at the start*, but should begin more slowly, and should gradually increase the pace. For boys and grown-up people a slow trailing Walk is much more tiring and brings on the need of rest sooner than a brisk quick Walk.

5. As regards the clothing for a walking-tour, the first requisite is good and easy Shoes which have already been worn a little while. On no account should new Boots be used. For the rest, the Clothes should be light, and not tight anywhere.

6. *Food* has already been considered.

(a) Good drinking-water can seldom hurt, if it be taken in moderate quantities. If the water is very cold, do not drink till a rest of a few minutes has made the Breathing easy.

(b) Next to good spring water the best drinks are Lemon-juice (in some form); or water with a little vinegar in it. *

(c) As soon, however, as a certain amount of Alcohol is exceeded, the Alcohol is apt to have a paralysing effect upon the Muscles. Beer, especially, is to be avoided. The experienced Walker knows that Beer taken on the way soon reduces his vigour and capacity for exertion.

Brandy should be utterly and entirely rejected, and, above all, the popular (German) custom of pouring a glass of brandy into the overheated stomach and then following it up by a quantity of Beer.

(d) The food on long Walks should be nourishing and concentrated. †

(e) In Tours lasting several days special attention should be given to the care of the Feet. They should be put in cold water and rubbed at night-time: if they are hot, their soles should be powdered with Salicylic dusting-powder (3 parts Salicylic, 10 parts Flour, 87 parts powdered Magnesium Earth), or rubbed with an Ointment of Salicylic Acid and Mutton-fat. Blisters on the Feet should not be opened by the way, but when the evening quarters are reached; then the place should also be treated with Salicylic Ointment.

(f) Careful attention should be paid to the action of the *Bowels*. In Constipation a mild aperient may be in place (but see above). In the more violent kind of Diarrhœa, which makes the continuance of the tour doubtful, it is perhaps safest to remove the cause of the trouble by taking a dose of Castor Oil.

* Here Dr. Schmidt recommends Coffee, strong Soup, Meat, Tinned Meat-Sausage, Chocolate and Hard-boiled Eggs. I cannot agree with him. Light Cheese, which he recommends, is good; and Stale Hovis Bread and Protene Biscuits are excellent. (E. H. M.)

† As to Tea and Coffee see above: here, as in the statement that 'a light country wine . . is always of use,' I cannot agree with Dr. Schmidt at all. (E. H. M.)

## 4.—CLIMBING AND MOUNTAINEERING. CLIMBING AND ITS MOVEMENT.

Under Climbing can be classed Walking or Running up an inclined plane, or up Stairs or Steps, or on poles or wires etc. Up a ladder etc. the movements of the Arm and the Balance are generally helped by the Arms.

Climbing is a sort of Walking exaggerated in certain directions: in fact, a very gradual ascent can hardly be distinguished from ordinary Walking; but, when the ascent becomes steeper, the 'pressure' alters (as registered by the measuring Machine).

Details are unnecessary here, except to say that, besides the (1) extra 'pressure', (2) the 'free' Leg does not swing like a pendulum and half-automatically: it must be lifted by an intentional

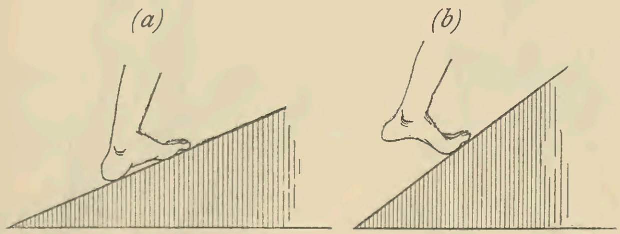


Fig. 203. A rather steep incline (*a*), and a very steep incline (*b*).

effort. In Climbing, as in Walking, every act of the whole movement is a preparation for the next act.

3. The oscillation of the body from right to left is especially marked in slow ascents, and always more so than in ordinary Walking.

4. The advanced Foot touches the ground—unless the ascent is exceedingly slight—not with the Heel, but either with the whole sole at once, or *with the Toes.* A very steep ascent makes it impossible for the Heel ever to touch the ground, and the ascending movement is then performed on the Ball of the Foot, as in 203*b*. This greatly hinders the grip of the foot on the sloping ground; and at last a steepness may be reached at which the ascent is only possible on rough ground and with rough soles to the Shoes (spiked, mountaineering Shoes), or with bare feet which clutch the ground and cling to it.

Or the toes may be turned out, or a zig-zag course may be taken, or the body may 'squirm' up the incline, or a stick (204, 205) may be used. Thanks to the stick or stock, the body may be bent further forwards.

5. In a rather steep ascent, the whole body is inclined forwards, being bent at the Hip and at the knee, as though it bore a burden on the back (204). This increases involuntarily with the increasing steepness of the way. When a very high degree of steepness is reached, it is not possible for the body to incline further forwards without touching the slope with the Knees and the hanging Arms. The hands must then be used

Fig. 204. Fig. 205.
Mountaineering.

for support and hold, and they move in unison with the Legs; the ascent then becomes a climb.

As for Running up-hill, it is only a gain if the ascent is moderate; if it is very steep, then finally less ground can be covered with the Running than with the Walking Step.

In 'storming' a steep ascent, therefore, the movement should not be a Run, but a greatly quickened Step.

## GOING UP STAIRS AND LADDERS.

Far steeper ascents can be managed with stairs than without them. The upward movement is a great exertion, however, and, if the steps are too broad or too low, or irregular, an uncomfortable exertion also.

Ladder-Climbing without using the Hands is a severe exercise in Balance, as the base is small. The Hands are generally used, and 207 shows one special kind of Gymnastic Climbing.

Fig. 206. Ascent of a high step.

## DESCENDING.

The body in Descending, as contrasted with the body in Ascending, is held upright, or is even bent back a little, as if it had a burden in front. Here also a stick may be useful.

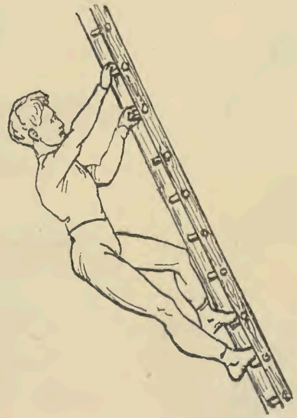


Fig. 207. Ladder climbing.

Descending is, in other ways, a contrast to Ascending. In ascending, there is great force exerted in continually lifting the weight of the body, but this exertion is happily distributed among many Muscles, and only brings on Local Fatigue after long and difficult climbs. In Descending, which needs far less

Muscular exertion—viz., in checking the impetus given to the body by its own weight, Fatigue is nevertheless liable to be brought on, because the work taxes a small Muscle-area especially. Hence a descent is considered far more 'trying' than an ascent.

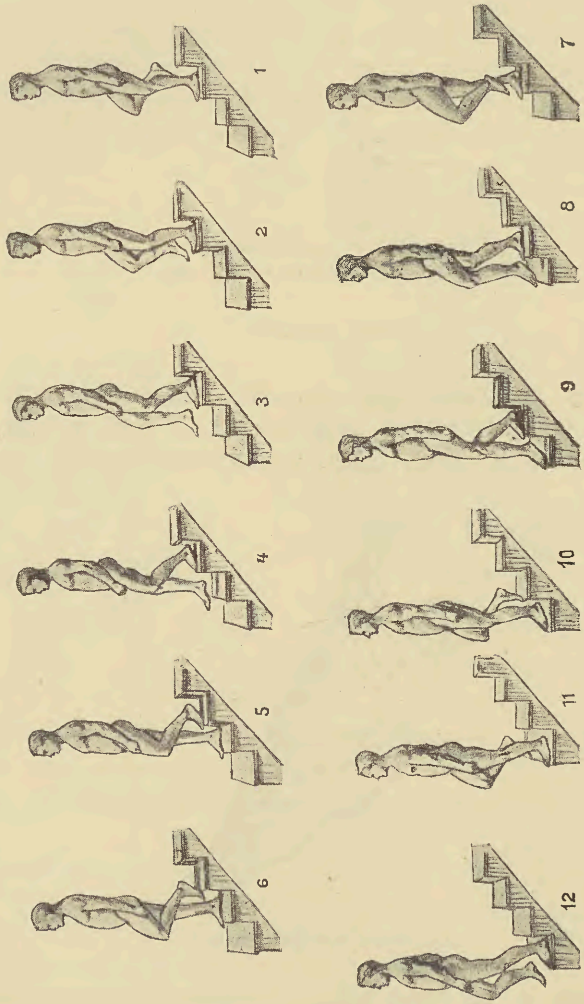



Fig. 208. Going downstairs (from right to left).

Again, a steep descent uses the Heel first,—in fact the heel is often dug into the ground,—whereas a steep ascent uses the Toes, and the Heel ordinarily does not touch the ground at all.

Once more, we saw that, in an ascent, the faster one goes the shorter one's Steps are and the less one's body is apt to oscillate; in a descent, if one runs, the Steps are longer, and the oscillation greater. But if the descent is very steep, the shock of long Steps is great, and the danger of falling is also great, and hence one often runs down a steep hill with short Steps, and one often weakens the shock by keeping the Legs far apart, or by running in zig-zag lines. To come down sideways is also useful occasionally.

Fig. 209. Down-hill.

To descend a Ladder without using the Hands is a harder exercise than to ascend it, especially if one goes slowly.

## FORCE EXERTED IN CLIMBING.

In no 'Locomotion' is the force which is used so easy to estimate as in Climbing; for the force is here the raising of the weight of the body to a certain height. Of course we must take into account the weight of the clothing and of anything carried.

But this is not all. There is the extra work of the Breathing Muscles and of the Heart; this is extraordinarily increased by Climbing. And yet, even ordinarily, the work of the Breathing Muscles and of the Heart claims 15 % of the 'Changes' of Material in the body (Zuntz).

We must, moreover, add the forward-movement. On a very slight slope this may need more force than the raising of the body, but it becomes smaller and smaller in proportion as the steepness increases, and is almost immaterial when we go upstairs, or up a Ladder.

The force expended in Walking on level ground is made up thus:—

(1) the thrusting-off or supporting Leg lifts the body and moves it forwards;

(2) the swinging or hanging Leg bends and stretches itself.

The amount of these exertions varies very greatly according to the way in which one walks (see above). But in any case the value of 3 is always small, while (except in very slow walking) the value of 2 is greater than that of 1.

(3) To this we must add the Breathing-exertion and the Heart-exertion.

In Climbing it is different; here (1) grows greater as the ascent grows steeper; (2) grows smaller; (3), on the other hand, grows greater.

Certainly Mountain-Climbing is one of those exercises in endurance which allow of *great exertion without correspondingly great Fatigue.*

It must, however, be expressly stated that at heights of more than 500 feet a whole series of *other influences* come into play, which often affect the body far more strongly than the mere muscular effort of the ascending movement. Among these we must place foremost the influence of the *rarefied air* in high mountains; this may bring on mountain-sickness. The chief signs, which often appear quite suddenly, are failure of the bodily powers and a feeling of absolute Muscular weakness, with nausea, vomiting, obscured sight, and disturbed Circulation.

We must also mention the effect of cold.

To these may be added the nervous anxiety of dangerous climbs over precipices, the Fatigue of walking on snow and ice, and finally the powerful effect produced on the Nerves by the majesty and loneliness of Nature in mountainous country, and by the constant tension and heedfulness required on difficult and dangerous paths. The often marvellous feats of human energy in mountaineering cannot be expressed by cold figures.

On the other hand, the exertion that can be taken in the cold mountain air is prodigious: the man who at home is a lazy loafer or sedentary worker will, in the Alps, cover huge distances, and, when he gets home again, will often—return to his usual habits. The effect of the ordinary air when one comes down into the valley may be as depressing as that of the mountain air was exhilarating.

The ascent or climbing of a ladder of wood, rope, or wire, with a very limited foothold, may be ranked, in a marked degree, as an exercise of skill.

Under exceptional circumstances an ascent acquires the character of a pure exercise of speed, to wit, in the rapid rush up a slope or up-stairs.

### EFFECT, OF CLIMBING, ON THE BODY.

Climbing differs in its effects, according to the kind of Climbing.

For example, the Climbing of a rope or wire (a tight-rope) would be an exercise in skill.

Rushing up a slope may be an exercise in Speed, and may put the Heart and Breathing to their utmost limit of exertion. The temperature also rises. In repose, the Breathing becomes normal sooner than the Heart's action does.

Mosso has given some interesting Figures with regard to *the Heart* (Pulse), *the Breathing, and the Temperature,* before, during, and after Climbing.

I.

| | Pulse. min. | Breathing. min. | Temperature. deg. |
|---|---|---|---|
| Before the ascent . . . . . . . . . | 60 | 15 | 37.2 |
| Ascent of 100 m. in 6 min. 55 sec. | | | |
| Shortly after the ascent . . . . . . | 114 | 30 | 37.7 |
| About 10 minutes later . . . . . . | 84 | 21 | 37.8 |

The Breathing returned to normal after about 27 minutes' rest;
The Pulse after about an hour's rest;
The Temperature also after about an hour's rest.

II.

| | Pulse. | Breathing. |
|---|---|---|
| Before the ascent . . . . . . . . . . . . . . | 70 | 19 |
| Ascent of 100 metres in 4 min. 33 sec. | | |
| Directly after reaching the end, for about 1 minute thread-like and impossible to count. | | |
| After $1\frac{1}{2}$ min. . . . . . . . . . . . . . . . . | 150 | 31 |
| After 38 or 40 minutes . . . . . . . . . . . . | 90—94 | 18 |
| After 1 hour 40 minutes . . . . . . . . . . . . | 72 | 17 |

III.

| | Pulse. | Breathing. |
|---|---|---|
| Before the ascent (accelerated by mental excitement). | 98 | 20 |
| Ascent of 100 metres in 3 min. 45 sec. | | |
| Directly after reaching the end, and for the next 2 min., thread-like and impossible to count. | | 38 |
| After another minute | 140 | 33 |
| 11 min. after reaching the end | 120 | 20 |
| After an hour and a half of rest | 96 | 18 |

Thus in the end the Pulse and Breathing were rather less frequent than before the upward rush.

The Breathing was found to be from two to four times as deep after the ascent as before.

As a rule mountain-climbing is done at a pace which does not bring the action of Heart and Lungs in a short time to their utmost exertion and bring on Fatigue, but at a pace which keeps their activity within certain bounds, and which thus allows the exercise to go on for several consecutive hours.

Mountaineering is a good exercise of Endurance in all cases in which the vital organs are to be purely and effectively helped.

Mountaineering *sets great masses of Muscles in motion with a constant rhythmic* change, from contracting to relaxing and from relaxing to contracting.

Another favourable point, as we have seen, is that each movement prepares for and helps the next. We have seen that a Muscle will lift the heaviest weight best when it is *beginning* to contract; and, in climbing, the Joints of Hip, Knee, and Ankle, and their Muscles, lift the weight of the body just at the best time—i.e. when they are beginning to contract.

*Thus in mountaineering immense totals of exertion are reached without excessive strain or Local Fatigue.*

The 'changes' of materials in the body are therefore enormous, and these in their turn alter the temperature of the blood, even to feverishness.

But much depends on the way of moving, on the Training and practice, and of course on the Diet. For instance, strong and skilful and experienced mountaineers may show hardly any rise in their temperature.

The most noticeable and important effect of mountaineering is, as we have seen, its effect on the Breathing and on the *action of the Heart.*

The volume of Breath is largely increased according to the exertion, both because more Breaths are taken, and (more especially) because at every breath the Chest is more thoroughly dilated. Thus, in mountain-climbing the volume of Breath is many times greater than in repose.

In the same way the action of the Heart increases to 3 or 4 times the original amount, first, by the larger number of contractions in the same time (the Pulse-rate being doubled), and, secondly, by forcing at every beat more blood than usual into the Arteries.

This increased exertion of the Lungs and Heart takes place purely automatically, without the Will. The Nervous-System guides and adjusts the work of Lungs and Heart to the needs of the moment, and works with most marvellous precision.

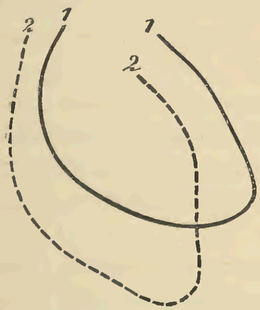



Fig. 210. The Heart
(1) before the ascent of the mountain, (2) after a short ascent.

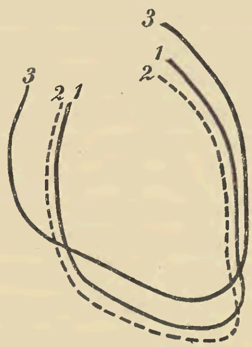



Fig. 211. The Heart
(1) before the ascent, (2) after a short ascent, (3) after a long ascent.

It cannot always regulate the balance accurately, however, especially where the ascent is uneven or slippery; in such cases, Lungs and Heart may become exhausted for the time being, and palpitations and irregular Pulse and Breathlessness may compel the climber to rest. The Heart-Muscle cannot contract enough to empty itself, and so gets its right chamber too full and too dilated. Mosso has shown the alteration in the Heart (210, 211). The Heart has become broader, and its apex lower.

Real and permanent over-strain of the Heart may result from a series of such individual strains; and many dwellers in the Alps die of Heart-disease.

But it is certain that exhausting Bicycle-rides are far more likely to bring on over-strain of the Heart than mountaineering is. It is no mere chance that the most famous Cyclists almost to a man are in their zenith for a short time only, in spite of their most diligent attention to health. They often fail after two or three years of excellence, and with all their efforts never again attain their old records.

To be able to climb continuously without early Fatigue one must always take into account the character of the road, and above all go more slowly (take fewer and shorter steps) as the ascent becomes steeper.

To be in practice for exercises of Strength and Skill means (to some extent) to avoid unnecessary movements and thus to economise Strength and effort. Practice in continuous movements, which bring about considerable 'Changes' of materials in the body, means to economise materials. The practised mountaineer therefore has two advantages over the unpractised: his Muscle-work brings about less 'Change' of materials, and his Lungs are able to breathe better.

Yet, necessary as it is, in mountain-climbing as in all other forms of Exercise, to practise and to prepare beforehand and to start gradually, people are always sinning in this respect, and especially those who were once good climbers, but have not climbed for a long time. *

The Rhythm of Breathing also makes a difference in Climbing. Even in ordinary Walking, the Breathing naturally is guided by the Rhythm of the movement, so that the same number of Steps are regularly taken at a single breath. Now if a person walks now slowly and now fast, this Rhythm is disturbed, and the result may be unpleasant.

On good roads with a slight or moderate inclination the Rhythm of Breathing naturally adapts itself to the even movement of ascent. A practised mountaineer in a moderate ascent generally takes three Steps to a breath. If, however, the uphill road is uneven, if big stones, stone steps, slopes, and other

* I have heard of some who have practised on a small scale (e.g. going upstairs or up small hills) before going out to Switzerland for their holidays: this is thoroughly sound. The Exercise of Walking up an inclined plank, then turning, and then walking down again—all quite slowly—is one of the very best and simplest means of getting *rapidly* into good condition. (E. H. M.)

obstacles, have to be passed over with wide springing Steps, or climbed—e.g., by a swing upon a high branch, or by the grasping of roots, etc.—the Rhythm of Breathing is also disturbed, and the Will has to regulate the Breathing, more and more. It is important to regain the Rhythm as soon as possible after these obstacles have been surmounted.

For the same reason, also, it is better not to shout, or to smoke, or even to speak, during a steep ascent: for this will disturb the Rhythm.

Oertel has done much to show the value of gentle mountaineering for those who suffer from Heart-troubles, etc. He recommends those whose circulation is impeded (by fatty Heart, general Fattiness, etc.) to take one breath every other step: to inhale at one step and to exhale at the next.

We have already seen how mountaineering may increase the work of the Heart to exhaustion. But it must be insisted on that, on the other hand, the Climbing-movement itself *helps the action of the Heart* and quickens the circulation. This is because going uphill *brings into play the extra Muscles of Breathing*. First and foremost among these we must mention the action of the Lungs. The expanding of the Chest or Thorax in every direction helps to suck more blood into the Heart at each In-Breathing, and so to prevent too slow Circulation of the blood.

The quickening of the Breath in the pure air, the wholesome excitement of all the Nerves, also help the blood-formation, i.e. they enrich the blood with the red corpuscles which carry Oxygen. Possibly the mere living in mountain air, at a height of 5000 feet or more itself increases the number of these red corpuscles in the blood, but this suggestion may be left on one side, though a number of experiments within the last few years point towards some such effect.

Finally, the effect of mountaineering on the Nerves varies considerably. Sometimes the emotions called forth by it have a healthy refreshing effect on the whole Nervous life and, with it, on all the functions of the body.

First come the ennobling effects of the Scenery in all its variety; now the wide plains and now the towering mountains, now the comfortable valleys and now the grand masses of rock and forest, these must all have their effect—these and the splendid loneliness and majesty of the place.

Further, the cool and often breezy air gives birth to a wholesome feeling of vigour, and, when the mountaineering is hard, of excitement and pleasure in the struggle.

Against these, and other 'stimulants' to the Nerves, must often be set divers impressions which weaken and depress the Nervous System. Continued bad weather which blots out every view, storms from which little shelter can be found, impassable roads, and all the evils to which the mountain-tourist is exposed, may paralyse energy and tend to bring on premature Fatigue, apart from any severe exertion.

### HINTS FOR MOUNTAINEERING TOURS, ETC.

Little need be said here with respect to Dress; a comfortable Shirt—perhaps a Flannel Shirt—a comfortable (not leather-lined) Hat, or a Cap (which latter the Germans might well try instead of their ugly peaked hats), and a Norfolk-jacket, etc., these will be sure to be attended to.

The Boots and Shoes should have thick soles and broad heels, and should not be too large or too small, and certainly should not be new. Other details, such as the spikes or nails, will be seen to during the trip; and so will the Alpenstock.

The Knapsack should have its softer contents towards the back, on which it is carried. It might have, among other things, sewing materials, map, compass, guide-book, Powder and Ointment, Plaster, etc.

As to the Foods and Drinks, Protene Biscuits, better than 'Bacon' or 'Smoked and pressed Meat-Sausage' or 'vin du pays', might be taken with one.

A certain amount of previous practice is important if the tour is to be a success. Before starting for the mountains one should try a few long walks not only on good roads, but also on cross-cuts over stubble fields, stony slopes, underwood, etc. In the mountains one should begin with short and only moderate long Walks and small heights, getting gradually into training for greater feats.

In mountain-tours, as in Walks, the start should be made early in the morning, and the longest Walk should be in the early hours. Too many hours of Walking should not be put into the afternoon: supper is more appetising and digestible, and sleep is sounder and more refreshing if they are not taken soon after one has arrived in an exhausted condition.

The Walk should be begun slowly, and an ascent should not be made at a great pace, but should be kept up for hours at an even steady pace. In a steep ascent you may have a pause of 10 minutes, standing, after each hour of Walking.

In going up-hill on hard dry ground the feet should be turned outwards, in going down-hill they should be parallel, or even turned inwards, as in checking a run at skating.

Much Alcohol is bad, and Beer and Brandy are bad: pure water is good. Some maintain that a little of the 'vin du pays' is 'the most wholesome drink'.

Sponging with wet towels as a means of refreshment is well worth remembering.

## MOUNTAINEERING AS A HEALTH-EXERCISE.

We have already mentioned—

(1) the quickening of the 'Changes' of materials in the body: the tissues consume materials, especially Fat;

(2) the Skin, Kidneys, and Lungs get rid of more moisture, this also helps to remove the appearance of Fatness;

(3) the amount of Breath is increased, and the Lungs work harder;

(4) the Heart works harder, and its Muscles grow stronger.

These good results of proper and moderate mountaineering have led to its use as a cure *for Fatty Heart*, for weakness of the Heart-Muscles, and for general Fatness. We owe this use of mountaineering as a Health-Exercise to the late Prof. Oertel of Munich.

It is a cure as excellent when used rightly and under proper medical supervision, as it is dangerous when used wrongly or haphazard.

This so-called 'Terrainkur' of Oertel consists at first of slow prescribed Walks in the mountains: these Walks grow longer from day to day and gradually steeper. Secondly, with this mountain-climbing goes a special Diet, in which all liquid supplies are limited (including Soups); this is to ease the action of the Heart. The fundamental idea is systematically to strengthen and train the enfeebled Muscle of the Heart. In various Health-resorts, of which we will only mention Meran, Reichenhall, Heidelberg, and Wiesbaden, roads have been chosen or purposely laid out, the steepness being marked by Notice-boards etc. Oertel has given directions as to the pace, the Breathing etc.

A substitute, though not a good one, is going upstairs, and another is the Mountain-Climbing apparatus, by Dr. Büttner (cf. the pedals of an organ), and by Dr. von Corval and Dr. Zutt (cf. the treadmill). They are said to have the advantage of saving the useless descent!

An inclined plane in gardens would not be expensive, as it need only be a few feet broad.

### EFFECTS OF GOING DOWN HILL.

The exertion here is far smaller than in ascending, and it is chiefly an exertion for certain Knee-Muscles: hence the Lungs and Heart do not get such fine exercise, and in fact, in coming down hill, the effect on the Pulse is very like that of an actual rest. The Breathing also becomes shallower and less frequent.

Yet the Local Fatigue, especially if the road is very steep or 'loose' or slippery, is considerable, and quite out of all proportion to the exertion.

## 5.—RUNNING AND RACES.

### THE MOVEMENTS OF RUNNING.

In Running, as opposed to Walking, *both* Feet are never on the ground together: either (a part of) one Foot, or else neither Foot, is on the ground. The flying clear of the ground is the essence of Running.

The study of Running, like that of Walking and other forms of locomotion, has been carried on by the Graphic method (measurement of pressure), and by the Photographic Method.

In fig. 212 we see the movements of Running, the Runner here having (by Marey's plan) small white and round discs on the limbs: he was dressed in black and ran in front of a black background.

Some of the movements of Running are somewhat as follow:—

1. The Foot thrusts off, and the body flies into the air: the thrust-off may be stronger and quicker, and the fly therefore longer and more rapid, but the time spent in the air is not altered so appreciably as one runs at different rates. So far then a run seems like a series of jumps from Foot to Foot. But, as a matter of fact, in Running,

2. during the 'flying', the body simply drops, and the Legs are

drawn away from under the body. Moreover, the Pelvis in Running, as opposed to jumping, is lifted just as the Head is lifted.

3. The Run differs in its movements (as the Walk does) according to whether the Legs are 'Straight' or Bent, according to whether the Run is lazy (the Heels, in the lazy Run, e.g.,

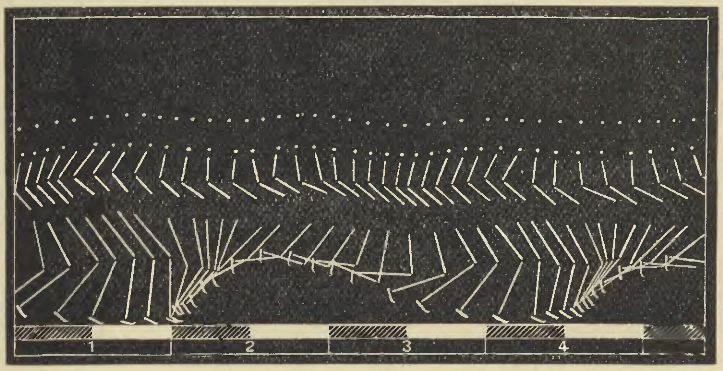



Fig. 212. Running movements (registered by Marey).

see 213, often come down first), or very swift (in which case we have 'Tip-toe' Running).

Figures 214—5 show some other features of the Running-movement, better than words can show them.

Notice, however, that

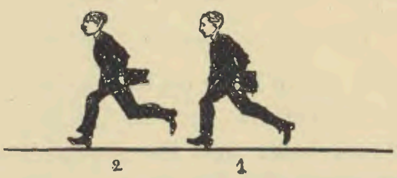



Fig. 213. A lazy run, with the heel put down first.

4. The oscillation of the Pelvis (from right to left and left to right) which is so marked a feature of Walking and Climbing, is less and less marked as the Running grows quicker and quicker.

5. The trunk is bent forwards so as to throw the Centre of Gravity as far forwards as possible, especially at the thrust-off.

6. As in ordinary Walking, the Arms move in the opposite direction to the Legs.

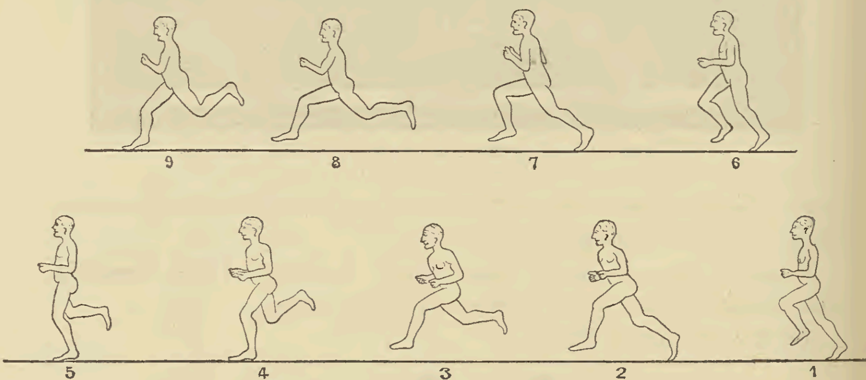
But in Running the Arms do not hang down, as they do in ordinary Walking; the Forearms are always bent towards the

Upper Arms, usually at a right angle. By this position, which is generally unintentional, the Upper Arms and Shoulder-blades are held steady and so give play to the extra Muscles of Breathing which are so much needed by Runners.

### FORCE EXERTED IN RUNNING.

The force exerted in Running is enormous. To cover over 100 yards in a single breath and in well under 12 seconds, in other words to hurl a body of, say over 150 lbs. all this distance in this short time, merely by our own forces, is an amazing exercise of Strength and Speed.

The human body is not capable of a greater feat, in so short




Figs. 214—5. Running movement.

a space of time, as in the Race up to 200 yards. Of course all artificial means of movement, such as Cycling, Rowing, Skating, etc., naturally do not come into the comparison.

The exertion at each step has been carefully calculated, the forward and upward and sideway movements being taken into account; it is said that the force used in making *300 steps in a minute would lift 100 lbs. to the height of a metre (i.e. over a yard) 144 times.*

If one tries to do this with the Arms, one begins to realise the meaning.

The whole exertion in a unit of time is naturally much greater in Running than in Walking; firstly, because there are many more Steps, and, secondly, because each individual Step calls for a greater effort.

It is only in very slow Running, of about 180 steps or less per minute, that the exertion of Running, above all as regards forward movement, becomes much slighter, and even sinks below that of Walking at the same pace. This shows that, *for a certain speed which we can reach in Walking, Running is nevertheless more economical:* it reaches this speed with less effort and with less Fatigue than a Walk at the same pace would. We become aware of the limit quite naturally. As soon as the Quick-Step goes beyond a certain speed, we feel that Running would give the same speed in a more comfortable way, and almost involuntarily the movement of Walking passes over into that of Running.

And the smaller exertion, calculated in such figures, is not the only reason why we prefer a slow Run to a very quick Walk. For a very quick Walk means a strain upon the Will, whereas the Running is done semi-automatically, and is therefore far easier and far less tiring.

### SPEED IN RUNNING.

Marey and the brothers Weber have made certain calculations about the speed in Running: they are given here:—

| 1 | 2 | 3 | 4 Traversing. | | | | | |
|---|---|---|---|---|---|---|---|---|
| Steps per minute | Length of step | i.e. a speed per min. of | 100 metres in | | | 1 kilometre in | | |
| 140 | 0.675 m. | 94.5 m. | 1 min. | 3 sec. | | 10 min. | 34 sec. | |
| 180 | 0.925 „ | 166.5 „ | — „ | 36 „ | | 6 „ | 3 „ | |
| 200 | 1.05 „ | 210 „ | — „ | 28 „ | | 4 „ | 45 „ | |
| 220 | 1.165 „ | 256.3 „ | — „ | 23 „ | | 3 „ | 54 „ | |
| 240 | 1.93 „ | 319.2 „ | — „ | 18.8 „ | | 3 „ | 8 „ | |
| 280 | 1.51 „ | 422.8 „ | — „ | 14 „ | | 2 „ | 21 „ | |

According to the measurements of the brothers Weber the figures are:—

| 1 Duration of step | 2 i.e. steps per min. | 3 Length of step | 4 Speed per sec. | 5 i.e. metres in min. | sec. |
|---|---|---|---|---|---|
| 0.247 sec. | 240 | 1.753 m. | 6.66 m. | — | 15.0 |
| 0.268 „ | 223 | 1.542 „ | 4.745 „ | — | 17.4 |
| 0.298 „ | 205 | 1.214 „ | 4.383 „ | — | 22.8 |
| 0.301 „ | 200 | 1.208 „ | 4.021 „ | — | 24.8 |
| 0.314 „ | 191 | 1.138 „ | 3.623 „ | — | 27.6 |
| 0.326 „ | 184 | 0.934 „ | 2.862 „ | — | 34.9 |
| 0.317 „ | 189 | 0.819 „ | 2.584 „ | — | 31.7 |
| 0.304 „ | 194 | 0.519 „ | 1.706 „ | — | 59.6 |
| 0.301 „ | 200 | 0.315 „ | 1.047 „ | 1 | 35 |

The speed in Running may vary extraordinarily. As is shown by these figures, *it is the length of the Step* more than anything else which increases with the increasing speed of the Run, while the duration of the Step is only slightly altered. For it is only the time of the thrust-off that can be shortened, whereas that of the clear flight in the air stays practically the same. From this we gather, as regards practice in Running, that the runner should learn before all things to *take long Steps*.

But the greatest speed can only be kept up for a limited distance: beyond this, the longer the distance, the more moderate the pace, as is shown by Records in Athletic Sports etc.

The small differences between these Records (often a difference of a few seconds or fractions of a second), in spite of the careful training and the thousands of Races year after year, is most noteworthy. There is almost a series of Laws of Speed.

For instance, the Records do not show the greatest pace in distances of under 100 yards or over 120: 109 yards is the best distance. This omits to take into account the 'Flying Start'.

The reason is the Health and Lungs cannot keep up this pace for longer distance, while the Limbs cannot reach this pace in a shorter distance, any more than an engine can start at full speed. This is the case however much the Start has been practised by itself.

A trained runner can run at *half* this pace for an hour continuously. Long-distance Running, however, seldom goes hand in hand with Sprinting: the Hundred-yards man seldom wins the Three Miles also.

| | | | Records mins.: | secs. | | Average Speed | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 45.7 | m. | in | — | 55.0 | = | 100 | m. | in | 12.0 | secs. |
| 68.5 | ,, | ,, | — | 77.7 | ,, | 100 | ,, | ,, | 11.0 | ,, |
| 91.4 | ,, | ,, | — | 92.5 | ,, | 100 | ,, | ,, | 10.12 | ,, |
| 201.0 | ,, | ,, | — | 225.0 | ,, | 100 | ,, | ,, | 11.19 | ,, |
| 402.0 | ,, | ,, | — | 477.5 | ,, | 100 | ,, | ,, | 11.87 | ,, |
| 804.0 | ,, | ,, | 1 | 535.0 | ,, | 100 | ,, | ,, | 14.11 | ,, |
| 1609.0 | ,, | ,, | 4 | 154.0 | ,, | 100 | ,, | ,, | 15.87 | ,, |
| 3218.0 | ,, | ,, | 9 | 115.0 | ,, | 100 | ,, | ,, | 17.14 | ,, |
| 6436.0 | ,, | ,, | 19 | 36 | ,, | 100 | ,, | ,, | 18.27 | ,, |
| 12872.0 | ,, | ,, | 40 | 20 | ,, | 100 | ,, | ,, | 18.80 | ,, |
| 25744.0 | ,, | ,, | 88 | 6.0 | ,, | 100 | ,, | ,, | 20.61 | ,, |

## EFFECTS, OF RUNNING, ON THE BODY, AND ITS ADVANTAGES FOR HEALTH.

*Running is the most effective of all Exercises in Speed, and, like all Exercises in Speed, can be changed into an Exercise in Endurance by a certain moderation of pace.*

The chief effects of Running come from this, that it demands a large amount of effort in an extremely short time. As this effort is distributed among *great masses of Muscle,* and as none of the Muscles which take part in it are taxed to their utmost power, and as the movement is not interrupted because special Muscles are exhausted, the strain for the Muscles in the most rapid Running is less than the strain for the Heart and Lungs.

(a) As to the *Breathing,* the exertion fills the blood with Carbonic Acid, and this can only be thrown off by forced Breathing.

The Lungs are overfilled with blood, and the Breathing changes its character, the In-Breathing becoming long, deep, and panting, the Out-Breathing becoming very short and *staccato.* A moment ago the Runner stood at the starting-point breathing quite quietly, though perhaps nervous; but after the shortest possible space of time we see him, at the end of the Race, struggling convulsively for breath, and catching at any solid object with his hands, so as to bring the Extra Muscles of Breathing to share in the work by fixing the Arms quite firm. This picture lasts but a short time. After a few minutes the Breathing, though still deeper and quicker, becomes regular once more, and gradually returns to its usual course.

In a longer course it is different. Here the Runner has to learn to husband the powers of his Lungs, and to moderate his pace as he begins to get out of breath.

(b) *The Heart* is strained as suddenly as the Lungs; if the pace is great, it may be strained to the very utmost limit of its powers. The Pulse, quiet and strong and beating 60 or 65 before the Race, runs up to 160, 180, 200, or even 250 beats a minute, in the few seconds needed for the 200 yards. It becomes quite weak, and indeed can hardly be felt: it is far less tense, and the Artery can easily be compressed. And the Heart-Beats are not only hurried, they are also irregular and unequal, and now and again intermittent—the first sign of Heart-Exhaustion.

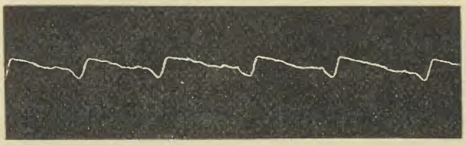


Fig. 216. Normal Pulse-curve before the race.

The Heart, so suddenly taxed and tired, cannot any longer force enough blood through the Arteries; the Lungs (see above) become too full of blood, and this increases the Breathlessness.

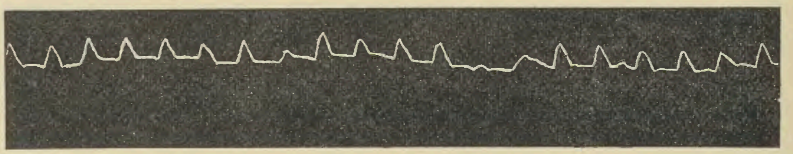


Fig. 217. 1—2 mins. after passing the winning-post. No. of beats per min. 140.

The Arteries on the surface of the Skin, on the other hand, are empty, so that the face of the ill-trained or untrained Runner at the end of a Race is often pale.

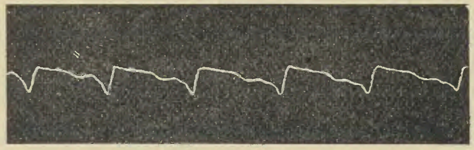


Fig. 218. Normal Pulse before the race.

But in repose these signs soon disappear; even after a few minutes the Pulse grows stronger and its beats more regular,

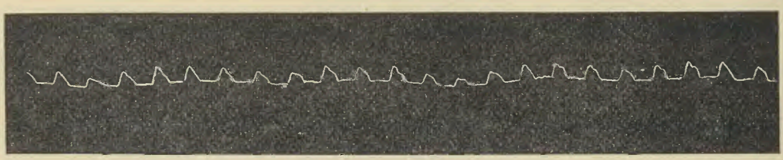


Fig. 219. 30 secs. after passing the winning-post. No. of beats per min. 180.

though still faster than usual, even after the colour has come back to the face.

In Long-distance Running, as in Sprinting, the strain on the Heart and Lungs is so great that the pace must at first be very carefully regulated and consciously.

(c) The effect on the 'Changes' of materials in the body is naturally greatest when the Run is quickest and longest and when the Runner is least in Training. Trained Runners consume far less material, and are far more 'economical' here than the untrained. The Local Fatigue of the Leg-Muscles, which

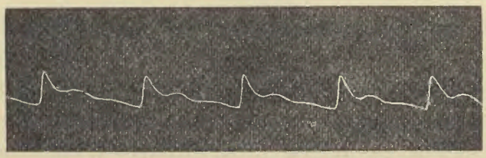


Fig. 220. Normal Pulse before the race.

so often comes in a Long-distance Run, as well as the Fatigue of the Breathing Muscles, does not allow such a great total of exertion in Long Runs as can be easily reached in mountaineering and Walking, that is to say, apart from special feats, as, for example, when J. Saunders, in 1882, ran 100 miles in

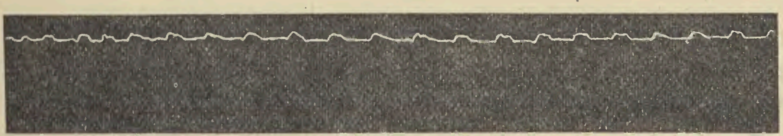


Fig. 221. Immediately on arrival at the winning-post. Rate at first, 250 per min.

Figs. 216—221. THE PULSE AS AFFECTED BY RACES OF ABOUT 220 YARDS.

17 hours 36 minutes 14 seconds, and 120 miles in 22 hours 47 minutes 13 seconds.

(d) The effect, of Running, on the Circulation of the blood, is invigorating and helpful so long as the Heart is not overtaxed (that is, in a moderate Long-distance Run); this is the case also with Climbing and quick Walking.

(e) That running increases the strength of the Muscles of the Legs goes without saying, but here we may once again point out that, in the regular practice of Running, *the Legs gain less in bulk than in firmness and toughness.* The Legs of famous Runners often look singularly thin and slender, but close observation shows them to be extraordinarily hard and sinewy.

*The advantages, of Running, for the Health* may now be considered.

They follow, as a matter of course, from these various effects upon the body. By Running, Lungs and Heart are developed more than by any other Exercise.

It develops the Lungs, it brings most of their Breathing surface into action, as in Walking, Mountaineering, etc., and obliges them to help in the quickened and deepened Breathing. It also forces the whole Lung to exert itself to the utmost. This is the case, at least, whenever Running is practised as a pure exercise of Speed. Every available part of the surface of the Lung-tissue is drawn into the work, and no part of the Lung, no group of 'Pulmonary Vesicles', remains wholly unused. Thus *all parts of the Lungs* are encouraged to grow and develop.

Running is equally important for the growth and development of the Muscle of the Heart. Although, as long as a man lives, his Heart works without ceasing, and is thus the best trained Muscle in the body, yet, if it is to be very powerful, its Muscles require strong stimulation, occasionally, and especially during the period of growth; such a stimulation and impetus is given by an exertion which taxes it to the verge of its capacity.

How important it is to develop fully the Organs of Circulation and Breathing if health is to be unimpaired, and diseases are to be resisted, and if all conditions of life are to be enjoyed freely and used properly!

The 'Changes' of materials in the body have already been mentioned.

But the following provisos are essential.

I. *All ages are not equally well adapted for Running;* they do not all share its good results.

Running is undoubtedly most effective for young people before and at puberty. Running is then quite a necessity. The growing child is always ready for a Run. No sooner does the idea arise of getting over the ground more quickly than a healthy boy starts to run and race—there is no effort of will as there is with adults. The exertion which a growing child puts forth in Running for two hours, and without loss of freshness, is quite beyond the scope of a grown person. This is because of the Organs and the Circulation, viz., the *wide Arteries and small Heart*, which works with ease owing to small blood-pressure. Hence the child is peculiarly well qualified for quick short Runs, and can begin again fresh, after a short pause.

A prolonged and continuous Long-distance Run, on the contrary, e.g., for several hours, is an unsuitable exercise for the young; for it means great 'changes' of materials in the body; and the child needs a large part of these materials for another purpose, viz. for growth. Therefore to set children to exhausting feats of endurance is (as is the case with Exercises of Strength) actually *to hinder growth*.

II. From puberty to maturity (about the 30th year) the relative size of the Heart and blood-vessels is gradually reversed. *The Arteries are comparatively narrow, the Heart comparatively large;* and so the Heart has to make a stronger effort to force its blood into the narrow Arteries, and *the blood-pressure is far higher* in the adult than in the child. Hence the work of the Heart and Lungs is far more likely to be disturbed by Exercises of Speed, and the restlessness and weak irregular Pulse come much sooner after such Exercise. At this age, want of practice, in particular, is apt to be far more severely felt than before puberty; quite small performances bring violent Breathlessness in those who are unaccustomed to Running. Dr. Schmidt thinks that it is only by constant practice, which trains the Muscles, uses up the unnecessary reserves of material, and educates the Muscles to work with less consumption of material, that a grown person successfully avoids exhaustion of Heart and Lungs. *

On the other hand, young men and men in full vigour are better qualified than the very young for Exercises of Endurance.

III. But as soon as (with the 40th or 50th year of age, in some cases sooner, in others later) the walls of the blood-vessels begin to be permeated with chalky 'Salts' and to stiffen, Running becomes still harder. Disturbance and exhaustion of

* I cannot at all agree with Dr. Schmidt here: I am over 30, and I find that quick Running does not tire me, if I am careful in what I eat and drink, whereas, if I am not careful, even if I have 'practised', quick or even slow Running will tire me.

the Heart's action set in much sooner. It makes a great difference whether the Pulse-wave strikes against an Artery-wall of the same elasticity throughout, or on one which is hardened in parts. For here the Rhythm of the Heart's action is soon disturbed. To borrow a simile of Mosso's, it is as if one were Cycling joltingly with a bad and damaged tyre, and enduring constant shocks, while a well-filled, elastic tyre would pass smoothly over all the unevennesses of the road. Hence *from the 40th year onwards Running as an Exercise of Speed becomes less and less desirable.*

IV. Moreover, good as Running is at a certain age, yet even then it must be used with caution: indeed it should be altogether *forbidden when Organs of Breathing or of Circulation are impaired by Disease.*

In Heart-Disease, where the Circulation may only just be able to go on regularly while the movements are quite quiet, Running would upset the balance, and quick Running especially should be avoided.

With Lung-Disease, again, and particularly where the apex of the Lung is affected (as is so often the case) a quick Run may fill the Lung too full of blood and Lung-hæmorrhage may follow. Käpernick died of this, during a Race. But such hæmorrhage would probably not be suddenly started in sound Lung-tissues.

In 'Emphysema', quick Running would also be forbidden.

V. There is no doubt that the Stimulus given to the Breathing, and to the 'Changes' of material, by Running in moderation, makes it of value for 'bloodless' or *Anæmic* persons; but, on the other hand, the want of red Blood-Corpuscles lessens the supply of Oxygen; the Muscles in vehement action need an extra supply, and hence in very quick Running are soon exhausted. Here then, Running is useful only in moderation.

VI. Finally, there are 'external' conditions which may spoil the benefits of Running. A long-distance Run in foul or very dusty atmosphere (as in a badly cleaned Gymnasium) may often do more harm than good.

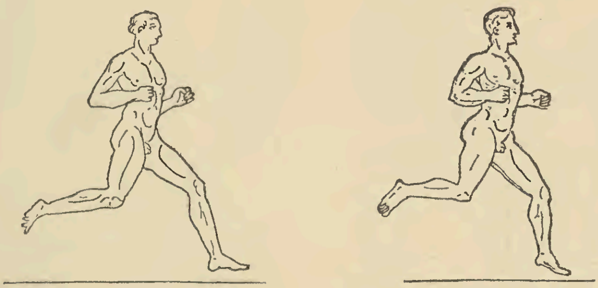
VII. While Running in the open air, do not keep the mouth open against a strong keen wind: though the bad effects of this upon the Air-passages have been exaggerated.

VIII. In very great heat, quick Running, so excellent in cool and cold weather, may cause too great a rush of blood to the Head and Lungs. Football is played during the cool and cold time of the year partly for this reason. *

RUNNING ON TIPTOE (SPRINTING, ETC.).

The movement in the short quick Run or Sprint, under which we may include the end of a Long-Distance Race, differs from that of the Long-Distance Race itself, and this again from the 'Lazy' Run. In the first the toes alone touch the ground, in the second, more of the Foot or even the sole itself, in the third (sometimes) the Heel comes down first.

These different ways of setting down the Feet affect the whole attitude of the body. If you come down on your Heel



Figs. 222-3 Greek Runners.

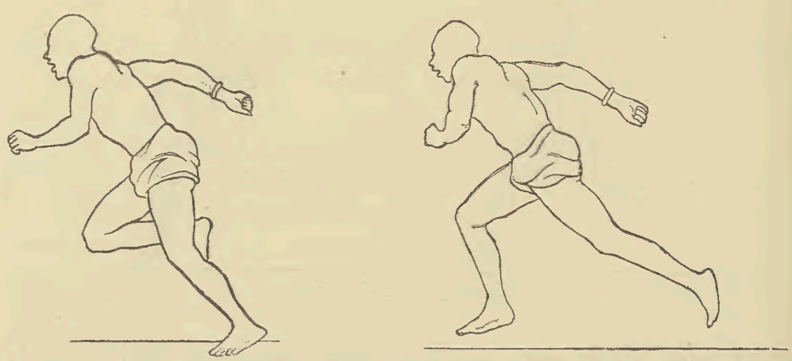
or on your whole sole, you can bring your trunk well forward: whereas, if you run on your Toes, your trunk will be really upright, or the Head may even be bent backwards.

Figures 222-3 show that the Run on the Toes was the 'Classic' way of sprinting: the trunk is erect (and slightly bent forwards at the Hips), the chest is thrown freely forwards and is fully expanded; the Shoulders are drawn back; the Head is straight, or slightly bent backwards, so that the face is turned upwards (e.g., notice the finish of the 'Hundred' or the 'Quarter'). The Arms are bent at the Elbow, and the Fists are closed. The Arms, moreover, are kept close in to the sides so as to help the extra Muscles of Breathing.

* Dr. Schmidt is wrong in saying that we confine it, in England, to October, November, and December: Association goes on vigorously at the beginning of the year also. In fact, at Marlborough we used not to play Association at all in these three months, but only later. (E. H. M.)

In Running, the Shoulders and Arms are brought forwards alternately at each step, in a direction opposite to that of the Legs, as in Walking etc.

The Greek Runners often seem, however, to have flung forward the Shoulder and Arm together *with* the Leg on the same side, as we do in 'Athletic' Walking. And it must be remembered that the Greek figures were very true to nature in such points. It is needless to say, however, that this 'unnatural' movement could only be done after constant and strenuous practice (on the lines laid down in Part I., e.g. at first consciously and slowly). No modern results of such a method have been published, so far as we know. The experiment would be of value, however.



Figs. 224-5. The Run with bent legs (from Regnault aud Raoul).

The Greeks also were careful to set down the Toe very lightly on the ground.

Just as, in Walking on Tip-Toe, you can only take short Steps, whereas, in walking with the Heel set down first, you can take long Steps, so it is in Running. In 'Tip-Toe' Running the Step is shorter, and hence more Steps have to be taken.

RUNNING WITH THE HEEL PUT DOWN FIRST.

But though, if the Heel is set down first in Running, the Step is longer, still it cannot be so quick, and needs far more muscular effort than the run from Toe to Toe. In fact, it wastes both time and strength. Moreover, it gives a greater shock. And hence the Run with Heels set down first is tiring as well as clumsy.

To set the Foot down Heel first is therefore bad for quick Running, and is useful only for a slower pace. In this case it is certainly a natural way of Running.

RUNNING WITH BENT LEGS.

Of walking with Bent Legs we have already spoken. In Running with Bent Legs the whole sole is set down, as in Running with the Heel set down first; and so in both cases, as in walking with Bent Legs, the centre of gravity can

Figs. 226-7. The run with bent legs. (By Marey. From Regnault and Raoul.)

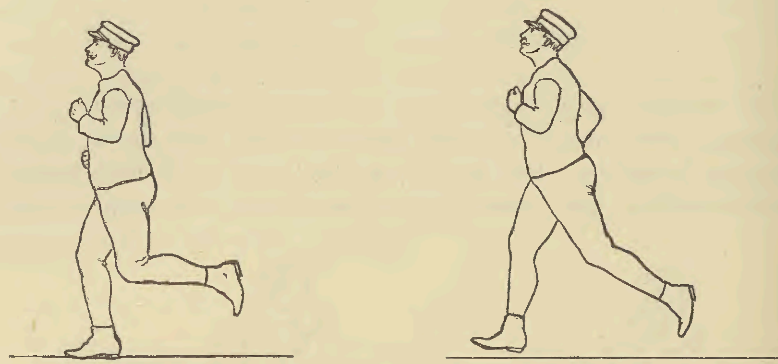
be kept well forwards, and can help, as it were, to pull the body along.

This Running uses up less force than the quick Run on the Toes, and is therefore best for Long-Distance Runs (if only one dares to do it, and if only one has practised well beforehand).

In this Run almost the whole method of movement is different, as the reader may see from Figs. 226-9, which should be very carefully studied.

The Centre of Gravity is further forward, the Leg is Bent at the knee (even shortly before the Foot is set down on the ground), and the body looks shorter. This position is *naturally* and instinctively used by people who have to run Long distances. The Greeks did not fail to recognise this difference: thus contrast Figs. 222 and 223.

From the natural method of Long-Distance Running, Raoul and Regnault have developed the artificial Method of the Run with Bent Legs *(course en flexion)*; this, like the walk with Bent Legs, enables the Runner to perform extraordinary feats of Endurance.



Figs. 228-9. The run with legs more extended. (From Regnault and Raoul.)

What we have said about walking with Bent Legs will apply to a great extent to Running with Bent Legs—e.g., the Chest is thrown forwards, the Shoulders back; the Head is

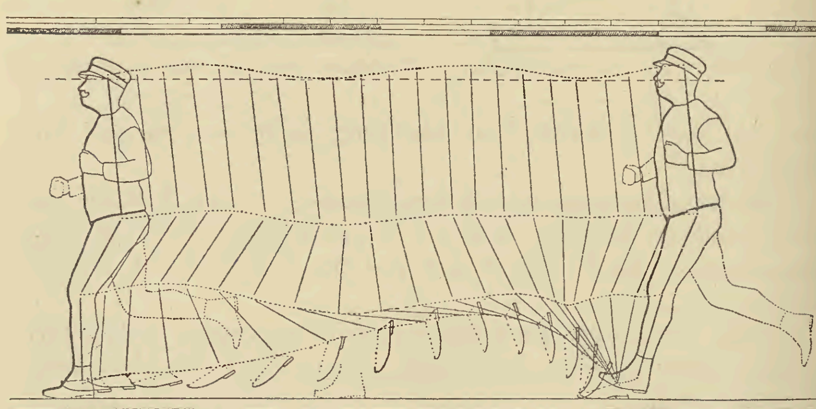


Fig. 230. The ordinary run and the run with bent legs.

held high or even bends slightly backwards; the Elbows are bent, the Lower Arm points forwards, and the Fist is closed. Raoul recommends that a stick should be passed across the back and through the bent Elbows. The Knees are bent, and the Centre of Gravity is so far forwards that the Runner seems to be 'running after himself'.

*The Feet move just above the ground; they are lifted no higher than barely to clear the roughnesses and irregularities of*

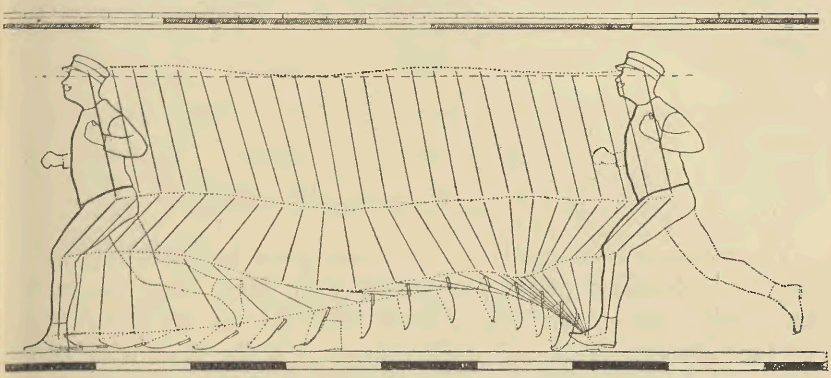


Fig. 231. The ordinary run and the run with bent legs.

*the path.* The sole of the Foot is set down as far as possible at once, Toe and Heel touching the ground together, lightly and without noise.

As compared with ordinary Running, this Run with Bent

| Way of running. | Length of double step. | Length of single step. | Duration of steps in $\frac{1}{100}$ths of a sec. | | | | Height of the Head. | Raising the body. | Bending forwards of trunk. | Oscillation of the different parts of the lower limbs. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Double step. | Period of support for each foot. | Oscillation. | Flying clear of the ground. | | | | Thigh from Trunk. | Lower from Upper leg. | Foot from Lower leg. |
| | m. | m. | $\frac{1}{100}$th | parts | of 1 | sec: | m. | m. | deg. | deg. | deg. | deg. |
| Ordinary Long-distance Run. | 2.59 | 1.295 | 57 | 18 | 39 | 12 | 1.64 | 0.07 | 85 | 65 | 84 | 53 |
| Run with Bent Legs. | 2.77 | 1.385 | 61 | 23 | 38 | 7 | 1.54 | 0.05 | 77 | 77 | 65 | 62 |

Legs has advantages like those of the corresponding walk as compared with the Military March. *The Step is longer, the raising of the Body is slighter*, and the average height of the body considerably less than in ordinary Running, because of the Bending. Marey gives the above results of measurements.

As to the Exertion, if we count it by kilometres we get these results:—

| Way of running. | Length of step. | Rise at each step. | Steps per kilometre | Total Raising of the body in a course of 1 kilometre. | Force used in raising a body weighing 75 kg. |
|---|---|---|---|---|---|
| Ordinary Long-distance run. | 1.295 | 0.07 | 786 | 55.02 m. | 4126.5 kg. m. |
| Run with Bent Legs. | 1.385 | 0.05 | 722 | 36.01 m. | 2707.5 kg. m. |

In covering a kilometre at the same pace by ordinary Long-Distance Running and by Running with Bent Legs, the force for raising the body was a good third less in the latter than in the former. This by itself shows that the Run with Bent Legs has an advantage, because it needs less Muscular exertion. That the pressure on the ground is less in this Run, is proved by the smaller depth of the Foot-prints on soft ground.

*But, if you would do the Run with Bent Legs properly and with advantage for long distances, you must study and practise it very carefully beforehand.*

Raoul, after 36 Lessons, succeeded in making French soldiers run 12 kilometres at a stretch. The men wore drill-shoes, light trousers, and sweaters; and they changed their things after every Run.

*He always made them begin with quite a short step* and at a slow pace, taking 10 minutes to get over the first kilometre; then the speed was increased by slow degrees. Even fully trained Runners begin with rather a slow Run, and only get to full speed at the third kilometre. The summary below shows the progress made in such a course of Training.

| | Length of Course. | Pace over the 1st, min. sec. | 2nd, min. sec. | 3rd kilometre. min. sec. |
|---|---|---|---|---|
| At the beginning of the training | 3km. | 10,00 | 9,30 | 7,45 |
| After 15 lessons | 5 ,, | 8,45 | 7,30 | 6,30 |
| ,, 30 ,, | 9 ,, | 8,00 | 6,45 | 5,45 |
| ,, 36 ,, | 12 ,, | 7,45 | 6,15 | 5,43 |

From the fifth kilometre onwards, the pace averaged one kilometre in 5 min. 30 sec. *At the end of the training a preference was given to courses over uneven ground, ploughed fields, etc.* In such cases the Legs had to be still more bent. The Run with Bent Legs may also be used with advantage *to surmount heights and to run down steep inclines.*

In the last case the Legs must be excessively bent, the Runner making himself 'quite small'.

The first attempts show that this way of Running has many advantages; it is easy, it is less tiring and, above all, less of a strain on the Breathing, even though it undoubtedly may cost some Muscular pains to get used to this unwonted Carriage and Movement.

## FOOT-RACES, AND HINTS.

Together with the Long-Distance Run, the Race has a special

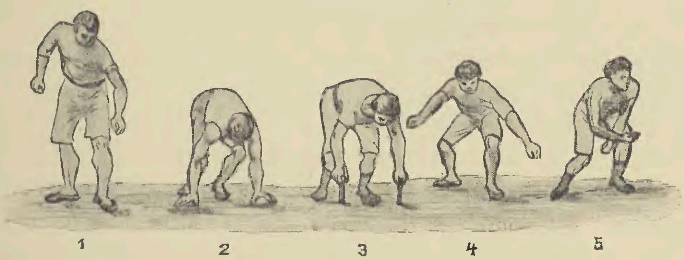



Fig. 232. Different starting-positions for a race.

value as a feat that requires all the resources of speed in the body to be exerted. It is a mistake to suppose that short Races are easy, while long Races are exhausting or even dangerous. This is only the case with the unpractised Runner, but not with one who has been trained, and understands how to husband his strength and to regulate his speed according to the length of the course.

In a short Race *the Start* needs most assiduous practice: to Start a Race by the dropping of a handkerchief compels the Runner to look up, and so does not give him a free choice of position. A pistol is the model 'Starter'.

This gives Races over a short course a fresh value as Exercises—viz., as Exercises for the Nerves. One has to charge the Nerves and Muscles with energy, so that almost at the moment the signal is given and heard the movement may be in full swing and the body hurled forward with the strongest impetus: this needs a very special training of the Motor-Nerves. Of course besides this the Runner, by his position at the starting-point, stretches the Muscles which will begin the Running at full speed; this position lets him pass with a slight upward bound into immediate rapid motion.

The back Foot should be set down on its Ball, with the Heel just lifted from the ground, and *with the Toes turned out (almost at a right angle)*, while the advanced Foot has its Toes pointing straight along the course. The advanced Leg is slightly bent. The trunk is of course bent forwards, the Centre of gravity resting chiefly on the advanced Leg.

But the actual attitude varies (as in fig. 232).

Just before the Start, a deep Breath should be taken in, so that, in a short course, all the Breathing may be Breathing-Out: the Greeks apparently used to scream as they ran short Races.

Unsuitable *Clothing* may prove a great hindrance in a Race: the Knee-joint should be left quite free.

In preparing for a Race, we must *practise* the Start indefatigably, so as to get up the utmost speed from the very beginning, and we must practise the best pace, with regard to the number and the length of the Steps. But it is also necessary to strengthen the Heart and Lungs as much as possible, and bring them to their highest pitch of power. Although this can be partly done by the frequent practice of short Runs, yet *the prolonged Long-Distance Run produces far more permanent effects here*, demanding, as it does, a continuous uniform exertion of the Muscles of Breathing and the Muscles of the Heart.

The same things happen here which we have already mentioned with regard to the ordinary Muscles; frequent Exercises of Strength increase the bulk of the Muscle and make it more capable of brief violent effort, but not of feats of Endurance. Brief efforts do not train the Muscles to work with less 'Change' of materials. But it is exactly this training which we need for Heart and Lungs. For it is the overtaxing of the Breathing and Circulation which hinders the Running or even brings the Run to an end.

In longer Races it is important that the Runner should find out the measure of the strength of his Heart and Lungs, that he may modify his pace accordingly.

A Race over a long course ought not to be run too vehemently. *It is as well not to start even at the average pace* at which the course can be done, but gradually to get up speed for several seconds together. The strength so economised

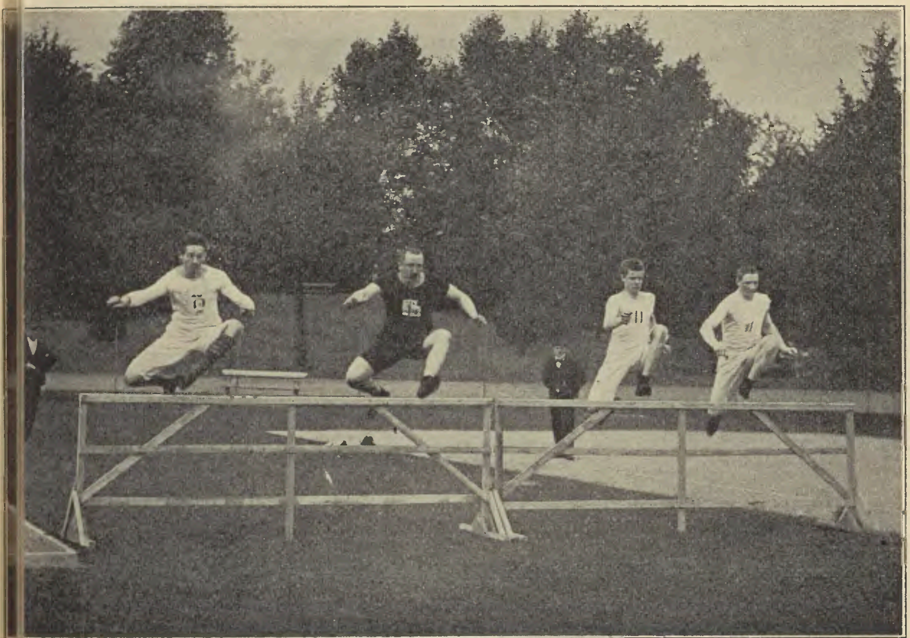


Fig. 233. Hurdle-jumping.

allows the Runner a spurt at the end. Even then the runner must not exhaust himself; for the winning-post should be passed at full speed. All this requires diligent study and practice beforehand. The unpractised should not try a Race over a long course.

After the Runner has passed the line, it is important for him to get rid of the extra blood in the Lungs and the oppression on the Chest by quieter and (more particularly) deeper Breathing. *Speech should at first be avoided.* Meanwhile the overheated runner should not stand still: he should walk about, and, in cool and windy weather, he should throw something round him.

## OBSTACLE-RACES.

These are good Races for a change, and as Exercises in Promptitude as well as Rapidity. Of the 'Extra' obstacles we shall not speak here, but shall simply mention the Hurdle-Race.

The distances between Hurdle and Hurdle and the height of the Hurdles, are fixed, and so practice can bring about brilliant Records, which would be impossible if the distances or heights were irregular or unknown beforehand.

Since the Hurdle-Race needs skilful 'Gymnastics', and may be useful in ordinary life—e.g., in running across country and over hedges and ditches, and as a preparation for Military Service—these artificial conditions, the uniform height and distance, though increasing the Speed, obscure the true purpose of the Exercise, and rob it of much of its 'Educational' value.

It is astonishing to hear some first-rate Hurdlers describe how almost unconsciously the Race is gone through when once the pistol has been fired.

## HINTS FOR RUNNING.

Apart from Running to catch trains, etc., we may run.

1. as an Exercise—e.g., in Drill;
2. in Races etc.;
3. in Games.

1. Exercises in Running 'at the word of command' are very valuable if properly carried out. The object is to get used to a long-stepped, though not too rapid way of Running; the time should be lengthened by degrees to 12, 15, and to 20 minutes. To Run for longer at a time may have very serious risk for growing children, though in the case of grown-up people it is useful to try a greater feat now and again, and it is also satisfactory to test oneself in this way.

The Arms should be bent at the Elbow, and the Lower Arm should point forwards. A stick may occasionally be kept across the Chest by the Hands, being held from below by preference. This Practice in gentle Running together with

Stick-Exercises, has a fine effect, particularly with the stick in front, then up, then behind, the Shoulders.

As to the Breathing in Running, great stress is commonly laid on the necessity of *Breathing* only through the Nose and of keeping the Mouth shut: but this is easier said than done, especially by us Europeans, who have not the wide nose, or what the Germans call the Dog-nose, of the Negro: Schoolboys often have very narrow Nose-passages, for various reasons.

Hence the Breathing-Out, which is less helped by Muscular force than the In-Breathing is, is imperfect, and the Lungs are not completely emptied, and Breathing soon fails. In any case, the Breathing-Out becomes short and *staccato* as we run quickly, in contrast to the deeper, longer, and panting In-Breathings. The Lungs cannot relieve themselves of the reserve of air, overcharged as it is with Carbonic Acid. So it has been proposed that, in Running, a person should inhale through the Nose, and exhale partly through the Mouth. This would be a great help.

Again, it has been proposed that, in Long-Distance Running, a person should breathe through the Nose, but should interpose a specially deep and full In-Breathing and Breathing-Out, by the Mouth, between every four or five Nose-Breathings.

In running at fullest speed (Racing) Breathing by the Mouth, either with the lips apart and the teeth shut, or with the Mouth simply a little way open, cannot be prevented. It is often feared that contact with the cold air will chill the coating of the Air-passage, and do it some harm. But, as a matter of fact, this membrane is rich in blood during a Run, and therefore less liable to the effects of cold. It is different if the air is very dusty, for then, as a matter of fact, large quantities of dust are drawn in with the breath. Running should not be done on a dusty road, nor in a dusty Gymnasium.

The Footfall, in Running, should be as light as possible, without heavy stamping. A clumsy step gives the body a violent shock and hastens on Fatigue. It also raises unnecessary dust.

The chief object of a true training in Running is to practise the best way of Running, up to its fullest and most successful extent as regards the pace, the length of the Step, and the length of the Run itself.

Special extra ways have their value: e.g., a Rocking or Oscillating Run (for dodging in football), the Run with lifted Knees (for Constipation etc.), etc.

The Jäger-School gives elaborate instruction for many other kinds of Running.

The Alternate Walk and Run as a special Exercise even for short Races, but at any rate for Long-Distance Races, is very useful at times. A long Sprint, and a Long-Distance Run, done 'straight on end' continuously, are apt to be a strain. But take a *short* Sprint, and then a Walk, and then a moderate Run, and then a Walk again, and the amount of exertion got through without Fatigue, or even without getting out of Breath, is prodigious. Just in the same way I have found it to be the most excellent Training that the whole mind can have—*to take short spells of active work amid long spells of quiet work.* I believe this method has a great future before it.

## RUNNING IN GAMES.

*The Running in Games is the very best form of Running for the young.*

In some Games the Running may now be like the Long-Distance Run, now like the Short Race; it is like the Long-Distance Run seeing that the total exertion, in playing for hours together, is very similar. Often, however, the Game demands full speed, as with a Rugby Three-Quarters, or a Batsman, or a Fielder: the Run then has the character of a Race.

As we have said above, many Games do a great deal more than this: for

(i) they give intervals of relaxation, if not of actual rest; hence eventually more Exercise may be got through and that too more pleasantly;

(ii) they give varieties of Running—e.g., Backward Running, sideways Running, etc.;

(iii) with the Running are various Exercises (e.g., Arm-Movements), which may be made to help the Breathing (i.e. bring into action the extra Muscles of Breathing);

(iv) other Exercises (e.g., for the Stooping in Fives) may serve other purposes.

(v) Promptitude, and Originality, are also exercised: 'Wiliness' (cp. Bowling at Cricket, for example) has not much scope in simple Running.

(vi) The player in a Game generally has not the same temptation to overstrain himself as the Runner in a Race: Games are not usually carried on at full pressure throughout.

(vii) Games also give more scope for individual differences; each player may be given the place that suits him best.

(viii) But there is something else that makes Running in Games especially valuable, and this is, that the power of Running, and with it the total performance, is very much greater here than in Running 'at the word of command'. This is because the pleasure and the interest of the Game excite the motor-centres of the Brain, and this helps the Motor-Nerves and Muscles to an extraordinary extent, and makes them far

Fig. 234. High jump from one Foot. (From a photographic series by O. Anschütz.)

less tired. The sum total of exertion which is easily got through in Games, without great Fatigue, is unattainable by Running 'at the word of command'.

But this does not apply to all Games equally.

## 6.—JUMPING. (JUMPING IN GENERAL.)

Figure 234 shows the Jump from one Foot.

As in Running, so in Jumping (and Hopping), the body at one time flies clear of the ground. But, in Jumping, the body moves in a Curve, reaching its highest point near the middle of the clear flight, just as a lifeless object would, if you threw it up. In Running, the body reaches its highest point directly, and then falls naturally by its own weight.

### THE MOVEMENTS IN JUMPING.

These movements have been investigated by the same methods as the movements in Running, i.e. by Photos, and by the measurement of pressure. Here also Marey has done good work, for he has invented a Shoe to register the pressure.

We may notice:—

(1) the preparation: the Centre of Gravity is lowered, because the body is bent at the Thigh and at the Knee-Joint and at the Ankle; the Heel is lifted; the Lower Arm is bent a little, and the Elbows are drawn back a little;

(2) the Spring: when the body has been 'lowered' enough, the Muscles are used to make the body rise erect and to fling it forwards from the tip of the Big Toe; the Arms begin to swing forwards;

(3) the body now goes through a Curve (called 'Parabolic'), the Legs being bent, and the trunk also being bent forwards, and the Arms swinging, till the greatest height is reached. Then the Legs are extended downwards, and the trunk is bent backwards. The bending and extending grows greater as the Jump itself grows higher.

(4) Just before the Feet touch the ground, the Knees and Hips are bent, so as to weaken the shock of the fall, and the Feet are stretched

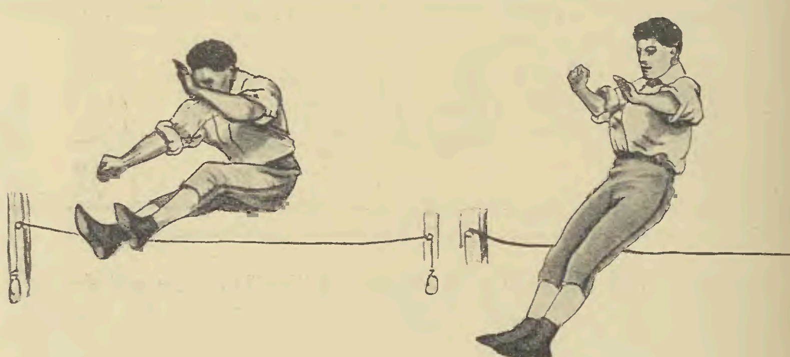


Fig. 235. The trunk bent and extended in quick succession during a high Jump.

out, so as to touch the ground with their balls first. Then, when the ground is touched, the bent joints are straightened, the trunk is brought forwards, and the Jumper stands erect again, as in 236.

This is only a general account.

As to the preparatory Bending, of course it is essential: a steel spring will not work so long as it is stretched straight out. For another preparatory movement see below.

According to Schwann's Law, which holds good in Walking, Running, and mountain-climbing, each movement is here a preparation for the next; the Muscle therefore can exert most force as the contraction begins, while at or shortly before the greatest contraction it can exert only a little force. But here most force is needed to jerk the body upwards, and this must not be used in raising the body after a low bending down. The Jumper must not bend too much, nor too little.

What is the '*Mechanism*' of a Jump? Borelli (1680) compared the Jumping body to a compressed elastic spring which has one end pressed against the ground, the other end being bent down and then suddenly released. The spring would stretch out both ways if the ground were not there: as the ground checks the downward movement, the upward movement is increased. In the body, he said, this 'releasing' was done by the sudden extending of the three bent joints.

According to Daley this might merely produce an extended body:

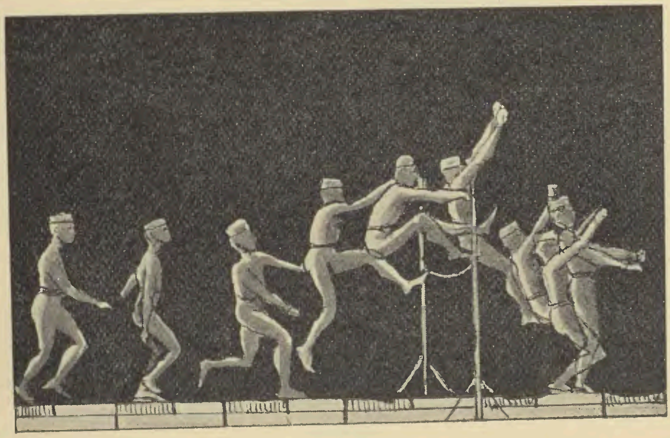


Fig. 236. A High Jump at 9 consecutive moments.

the Jump includes a sudden check given by the Muscles that bend the joints. The Legs are not suddenly extended at the moment of Jumping.

The Jump must be from good standing-ground: a 'grip' is necessary. But a spring-board etc. may of course increase the force of the movement.

THE DIRECTION OF THE JUMP.

The chief Muscles for the Jump will be illustrated by fig. 239. Notice how the Ankle-movement throws the body backwards, the Knee-movement throws it forwards, the Hip-movement throws it back again. All these help to drive the body upwards: the direction is decided by the inclination of the trunk when it is 'preparing' for the Jump, as will be seen in figs. 240—3 which tell their own tale.

Of sideways Jumping we need say little here.

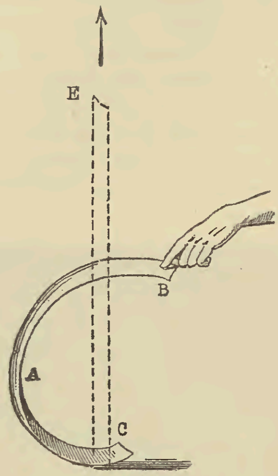



Fig. 237.

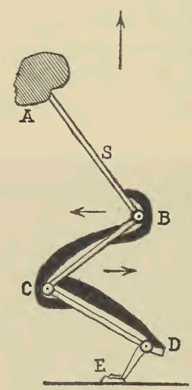



Fig. 238.

In Jumping on to a higher plane (e.g., in Jumping upstairs), the descending Leg is of course shortened, while in Jumping on to a lower plain (e.g., in Jumping downstairs), it is lengthened.

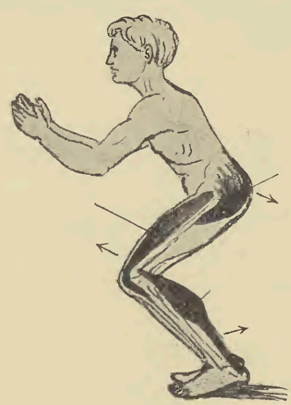


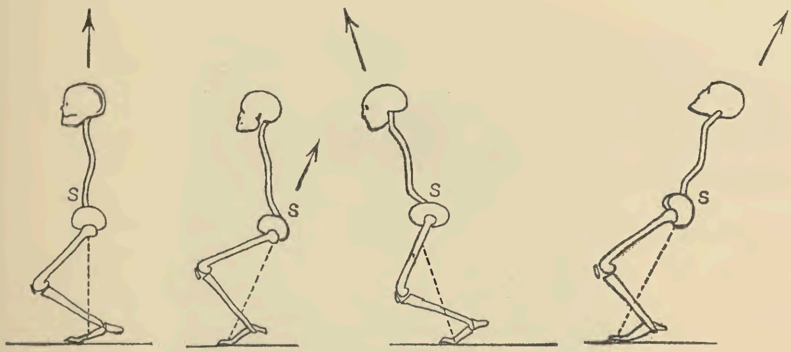
Fig. 239.

FORCE EXERTED IN JUMPING.

The force can be reckoned by the pressure of the Foot that thrusts off and also by the height of the Jump and its Curve.

But in a Jump over some objects—e.g., a string or piece of wood or hurdle—we must not only take into account the course of the Pelvis (which is like the course of the Centre of Gravity), but also the bending of the trunk and Legs towards one another, so that the body may be carried over the piece of wood without touching it, even though the space between it and the Pelvis is but small. Hence it is not only the greatest actual force, but also a particular kind of skill, which makes the highest Jump possible.

In order to avoid touching the piece of wood, the so-called




Figs. 240-3. Directions of the Jump.

Scotch jump, with slanting preliminary run, is often practised in English Athletic Sports. This High Jump is not taken straight, but at an angle, so that, with the sideway turn of the trunk, the Legs may be thrown over the cord one after the other. This sideway turning of the trunk may be so pronounced that, when the body flies over the piece of wood, the Pelvis and Foot may be at nearly the same height. The Pelvis need only pass close above the piece of wood, i.e. *the Centre of Gravity need not be thrown so high* in order to get over an obstacle of a certain height as it must be if the High Jump is made straight forwards: this latter is the kind usually practised in German Gymnastics.

In the Jump from the side, some of the elasticity, which would carry the body straight up, is lost by this turning sideways. Sweeney, in his record Jump at New York (244), is nearly parallel to the ground. The record of the Centre of

Gravity, as well as of the height 'cleared', would always be interesting to know.

Some people have proved '*mathematically*' that, if two Athletes are of equal Muscular strength in proportion to their height, then they can jump equally high, whatever their actual height may be!

THE UPPER LIMBS IN JUMPING.

The upper limbs in Jumping are used partly for the sake of balance

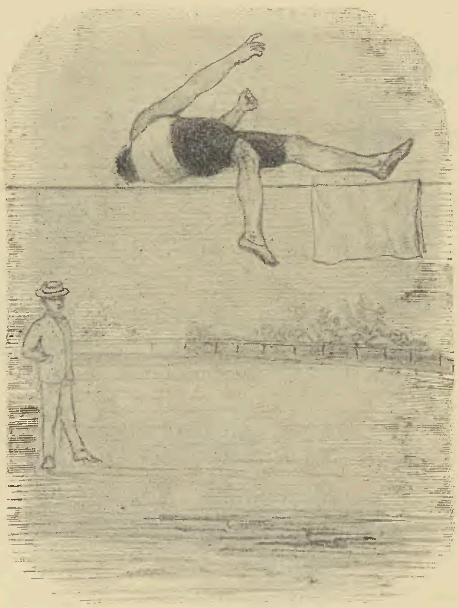


Fig. 244. The highest jump on record; made by Sweeney at New York. (From an instantaneous photograph.)

they are held in different positions according to habit, practice, the intention of the Jumper, etc.

It is a question whether (and, if so, how far) a forward swinging of the hands (holding weights, if possible) will add to the height and length of the Jump. The Greeks thought that such a use of weights made a great difference, and possibly such weights helped the balance, and lessened the shock of the descent, and made the place of descent easier to mark.

## DIFFERENT KINDS OF JUMPS.

So far we have only considered the pure Jump: but the Jump after a Run is far commoner. It may be made on to both Feet or (in a Hop) on to one Foot.

A pure Jump, or Jump from the spot, can be taken—
1. from both Feet;
2. from one Foot;
   (a) to both Feet,
   (b) to the other Foot, or
   (c) to the same Foot (Hop).

The pure Jump may be taken as—
A. a Jump on the spot (upwards);
B. Jump after a Walk or Run on level ground. The Curve of the Jump is here a 'parabolic' curve. According to the sharpness of this *Curve* we distinguish—
(a) the High Jump, in which the Curve ascends sharply and is almost perpendicular;
(b) the Long Jump, in which the curve is flattened and is near the Horizontal;
(c) the High-Long Jump (or Long-High Jump), in which the Curve is between those two.

According to the *Direction* we distinguish—
1. the Jump forwards;
2. the Jump backwards;
3. the Jump sideways,
   to the right
   to the left;
4. the Jump at an angle—
   to the right,
   to the left;

C. the Jump to a higher plane;
D. the Jump to a lower plane.

By combining these various forms of Jumping with rotation of the body, with particular positions, and Exercises of the Arms, we can easily get an immense variety of Exercises, one or other of which may be used to increase skill etc. But Jumping should be also practised as a useful art.

## THE RUN AND JUMP.

The least hesitation in the forward-movement decreases the vital power of the Run.

Hence if, after a run, the Jump is made on *both* Feet, only a small part of the velocity attained by the run can be used for the Jump, because to put the Feet together at the starting-place must interrupt the running.

It is different when the Jump is made from one Foot only: for here the back leg swings forward, and, as it were, goes on running in the air, during the clear flight.

Which Jump is the more successful, then, depends on whether the full power given by the unchecked Run, the thrust-off given by one Foot, is greater than the partial power given by the interrupted run, the thrust-off given by both Feet. In a Standing Jump, of course, the Jump from both Feet is the better, but in the Running Jump that from one Foot is the better.

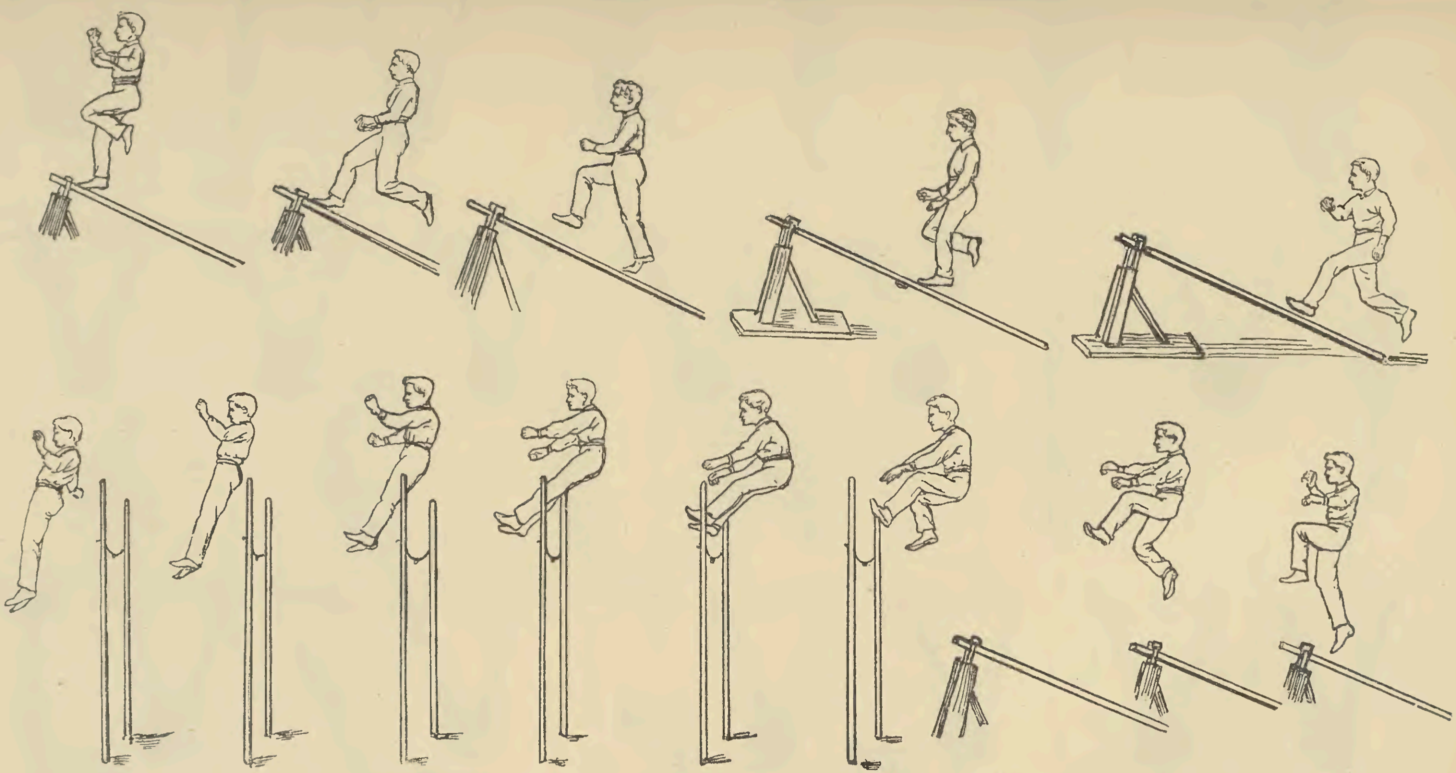
As to the 'take-off', the spot from which one jumps, practical experience has decided that the best spot is distant from the thing to be jumped just half the height of the piece of wood etc., so that in a jump of 4ft. it would be 2ft. away.

As to the run, the beginner often lets the right moment for Jumping go by, or jumps too soon. For this reason beginners may only take a short run, (e.g., three running steps before the Jump), and may take a longer run by degrees after more thorough practice. The run should never be too long. Its purpose is to give the body a certain impetus forward, and from 9 to 12 steps may do this. If a longer run is taken the speed is hardly appreciably increased, and, on the other hand, it becomes harder to get the right moment for the spring. The distance may be misjudged, or the Steps may not fit in well.

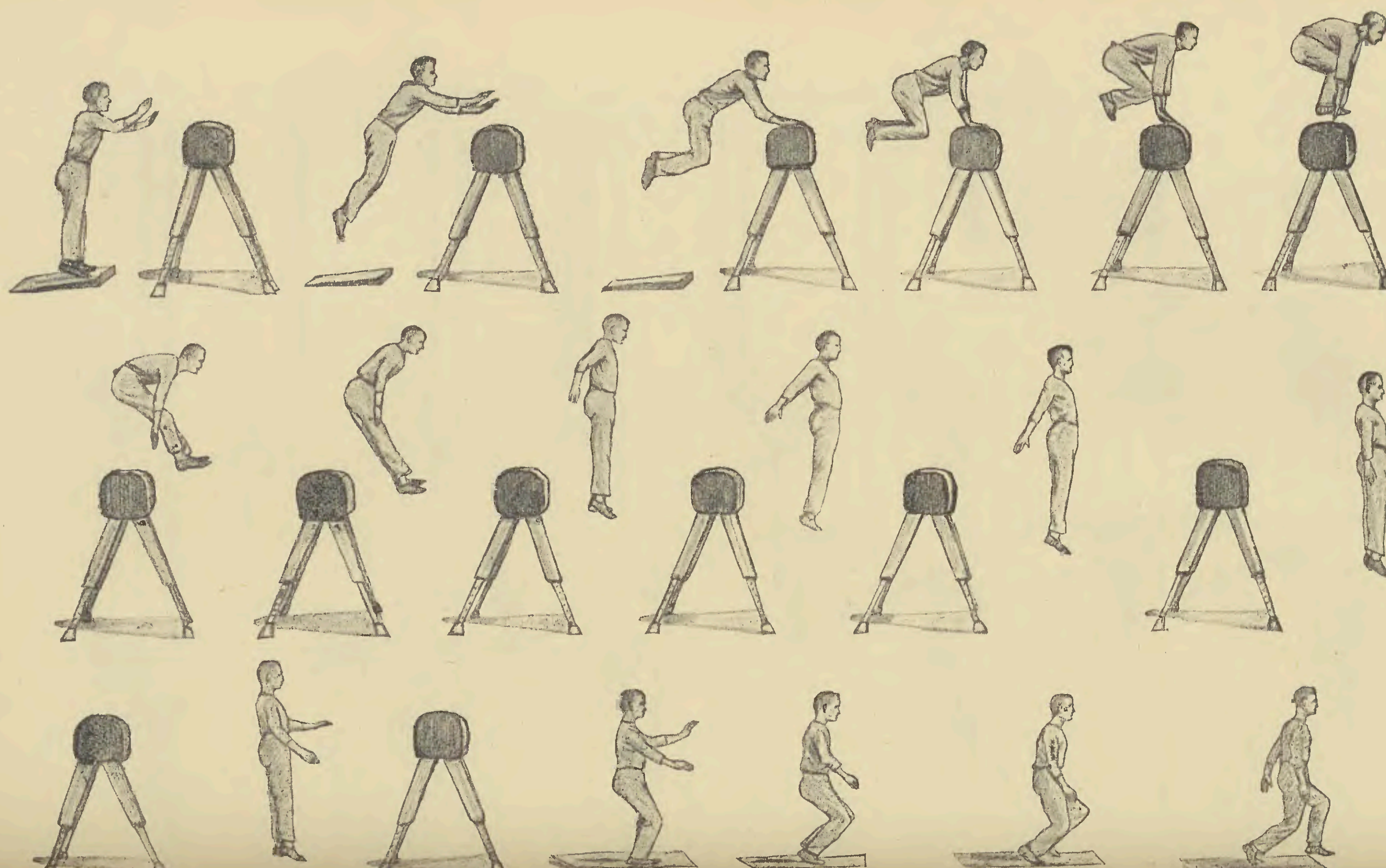
In the recent Athletic Sports of Oxford and Cambridge v. Harvard and Yale (1898), the American Jumpers had yard-measures, so as to get the exact distance of their run. Each Jumper should of course know beforehand exactly what the length of his run is. At a certain point 'en route' some small object was put on the side of the track to show whether the step was right.

## TRIPLE JUMPS.

This is often called 'the German Triple-Jump': after a run the Jumper jumps from one Foot to the other, then with this other Foot he makes a second jump, and so on. Of course the second and third



Figs. 245—6. Jump from a rising spring-board (by Dr. Kohlrausch).



Figs. 274—9. Horse-jumping with hand support (by Dr. Kohlrausch).

jumps are not so good us the first, since they have to be made after the body has alighted.

Opposed to this is another kind of Triple Jump, the Hop, Step, and Jump, practised in England and North America and Australia and in recent days occasionally in Germany under the name of the 'American Triple Jump'. After a quick run, a Jump is made from one Foot on to the same Foot (i.e. a Hop), then comes a Step, with the other Foot, and this step must not lead to a deep bending of the Knee; finally, the first

Fig. 250. The hand as a lever in certain jumps.

Foot again jumps with its full force. Thus we have either

Right to Right to Left to Right<br>
Hop Step Jump<br>
Left to Left to Right to Left<br>
Hop Step Jump.

The advantage is that for the chief Jumps, i.e. the first and third, the force of first one Leg and then the other comes into play full and unweakened. By this kind of Jump huge distances can be flown over. Better records have been done with the Hop, Step, and Jump than with the 'German' Triple Jump. It carries further.

*Both kinds are of great value in practising and developing the striding and jumping power of the Legs.* In practising the Hop, Step, and Jump, German Gymnasts often find the greatest difficulty in the long Hop, because in a Run and Long Jump they are used to jumping from one Foot either to the other Foot or to both Feet.

## JUMP FROM A RUN UP AN INCLINE.

The Germans call this the 'Storming' Jump: it is a Jump after a run up an inclined plane, which may or may not be a Spring-board. In English Gymnasiums we have various Jumps and Vaults over the 'Horse', after a run up the Spring-board.

## VAULTING ETC.

Vaulting between the Hands is illustrated in 250. It is often practised by street-boys in Leap-Frog etc., or over posts. The Gymnasium has the 'Horse', etc.

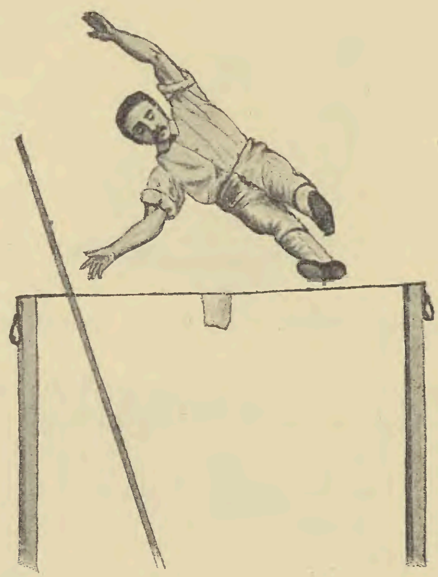


Fig. 251. Pole-jumping. (From an instantaneous photograph by Lugardon of Geneva.)

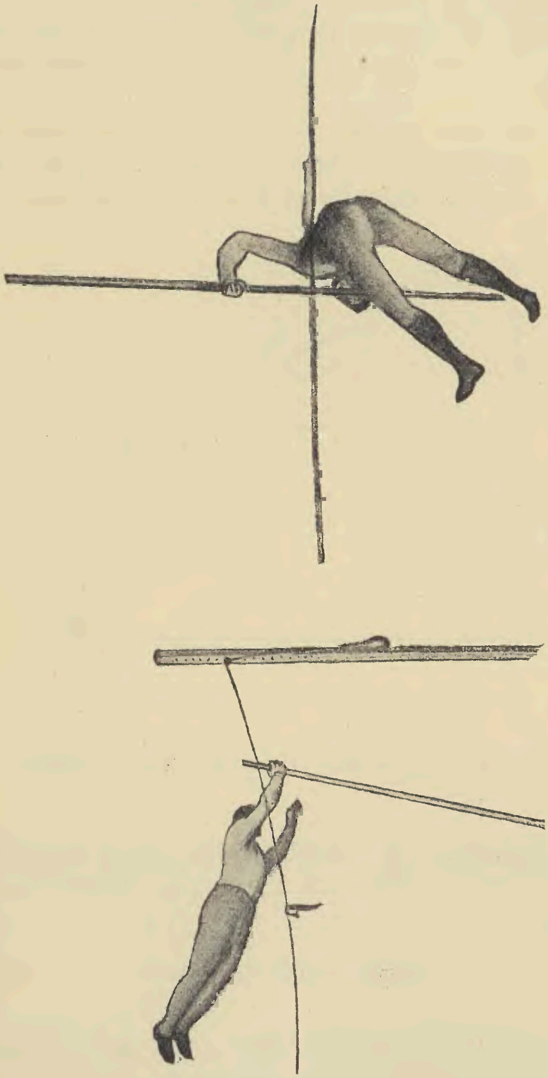
In England, when we wish to get over obstacles (e.g. Walls), we prefer the Side Vault, which is easy and not ungraceful.

## POLE-JUMPING.

The Pole-Jump is not often seen now: it is illustrated in 251—3. Of course the height is far greater than in a High Jump; and an Alpenstock can be used for Pole-Jumping.

EFFECTS, OF JUMPING, ON THE BODY.

To lift the whole body, as Jumping does, is an Exercise of Strength, which gives power to Leg-Muscles: being a very



Figs. 252—3. Pole-jumping. (From instantaneous photographs).

brief Exercise, and not long and continuous, it is not so tiring as many Exercises of Strength are wont to be.

It is also, at least when it is being learnt, an Exercise of Skill. To measure and time the movement, to break the shock of the fall by bending the Knees etc., to keep the balance when the ground is reached, need great care and skill to begin with, and admit of wonderful gracefulness.

Promptitude, in seizing the right moment, is also exercised, at any rate till the seizing of the right moment has become half-automatic.

This is also one of the very few Exercises for the 'Eye', the 'Eye' meaning not correct eye-sight, but the rapid and harmonious working together of Eye and Brain and Muscle.

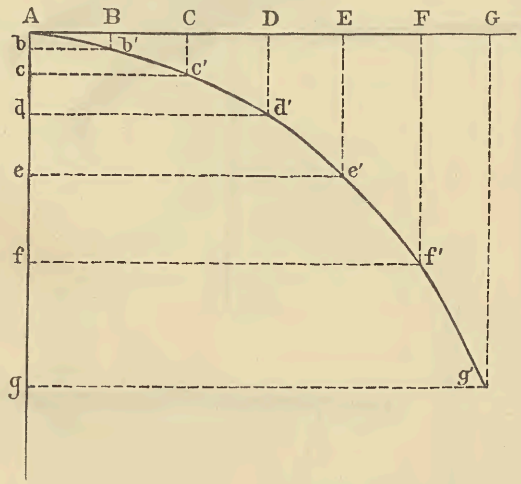



Fig. 254. Line of flight of a missile flung horizontally.

Morally, Jumping—e.g., Brook-Jumping, as at Rugby School—is decidedly an Exercise of Pluck and, in this instance, of Hardening.

HINTS ABOUT JUMPING.

A good light is necessary. We often see a handkerchief on the piece of wood in the High Jump, and this is a great help, though its fluttering is undesirable.

Great care should be taken to avoid shocks, sprained ankles, etc., when one reaches the ground again. The Heel-bone may be seriously damaged. A Mattress is regularly used in the Gymnasium, but it is generally too full of dust.

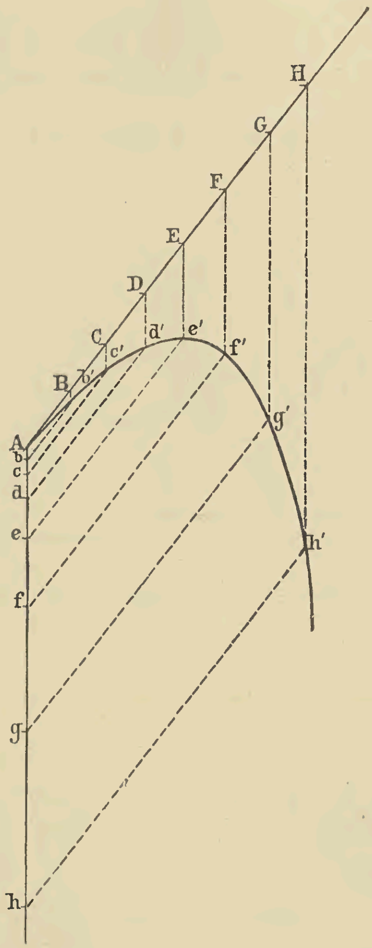



Fig. 255. Line of flight of a missile flung obliquely upwards.

As to Breathing, the Jump should be taken with closed mouth, at one Breath, after a deep In-Breathing. The Extended Chest will thus give a firm hold to some of the Muscles tor Jumping.

## 7.—THROWING, PUTTING THE WEIGHT, BOWLING, ETC.

### THE DIRECTION OF THE THROW ETC.

The Curve in fig. 254 will show the line of a 'straight' (Horizontal) Throw.

The Arm gives a certain vital force to the thing which is thrown; the Air resists, and the thing itself tends to fall by its own weight.

If the throw is straight up, then the fall is far more sudden than in 254.

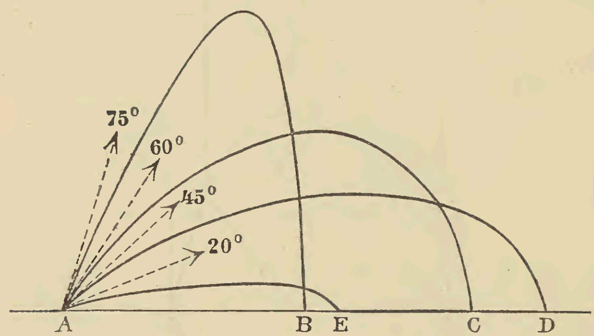



Fig. 256. Lines of flight of various missiles flung obliquely upwards, with equal force, but at different angles of elevation.

In 255 we shall see the Curves of the commoner Throws (Oblique Throws).

The thing to be thrown must not be too small [like a pea], nor too large [like a Weight], if full justice is to be done to the throw. Nor must it be too light, like a Cotton-Wool Ball for golf-practice.

### VARIOUS THROWS ETC.

These need not be described at great length. Some of the differences between Throwing, ('Underhand') Jerking, Quoit-throwing, 'Underhand', 'Overhand' and 'Round-arm' Bowling, Bowling (of Bowls), Spear-throwing, Putting the Weight, etc., are very fairly marked. The German names for throws are of course hard to render into English.

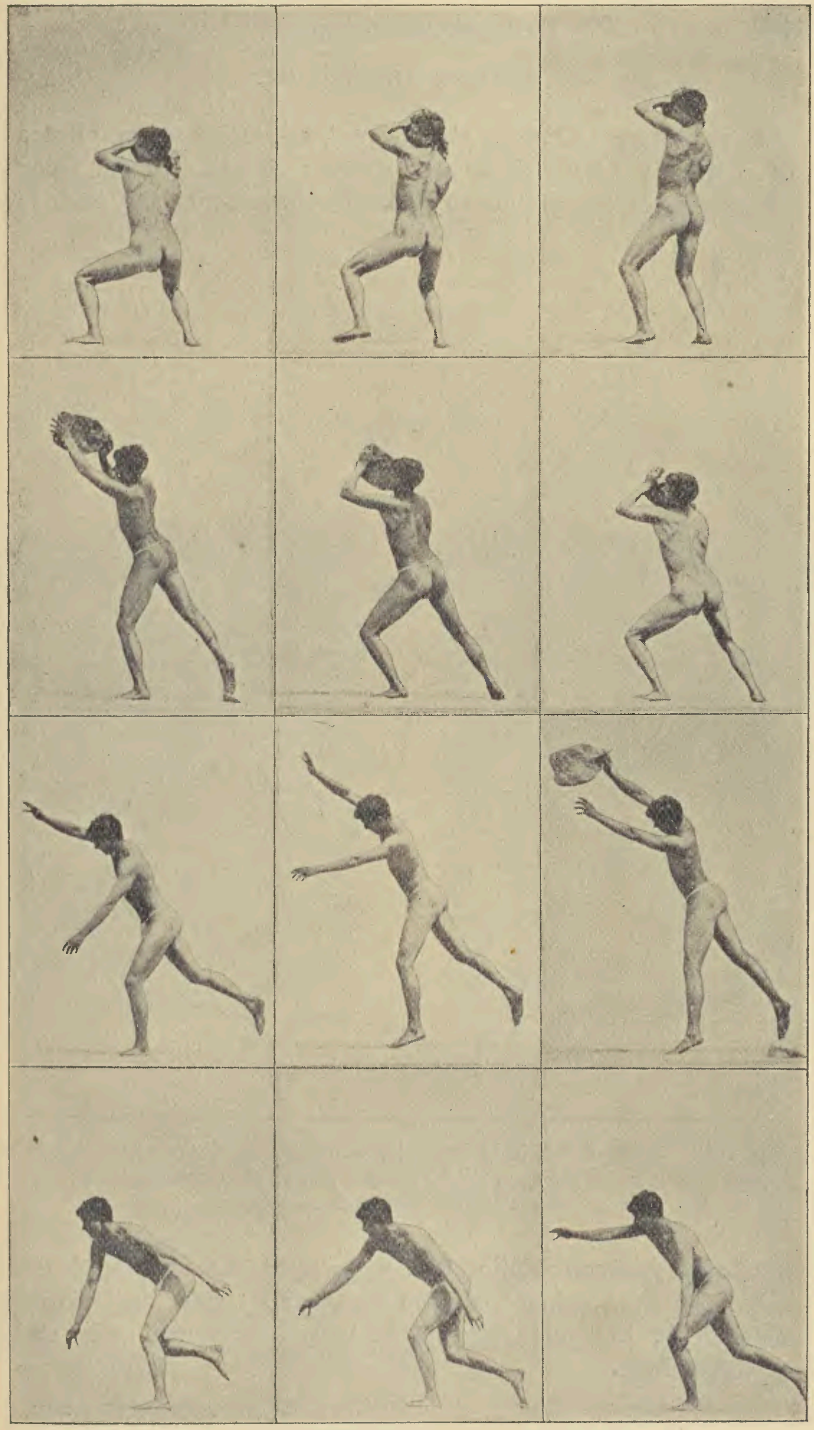


Fig. 257. Putting the weight with a heavy stone. (The photographs go from right to left.)

PUTTING THE WEIGHT.

In 257 we have '*Putting the Weight*', *but with two hands* instead of with one as we do in our Athletic Sports. In our Sports we also have the preliminary practice-movements and then the

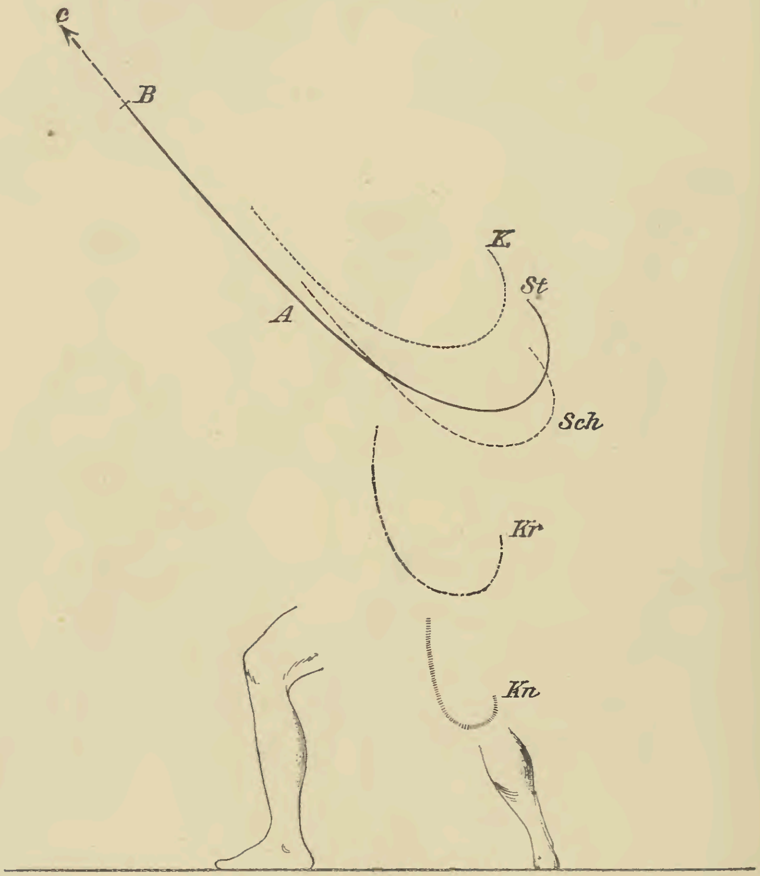



Fig. 258. Curves of the body in putting a weight. K, Curve of the motion of the head; St, of the stone; Sch, of the shoulder of the throwing-arm; Kr, of the sacrum; Kn, of the knee-cap.

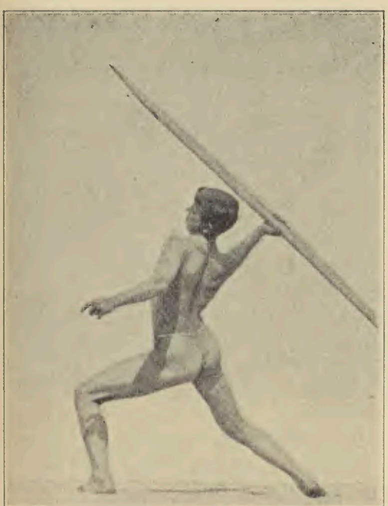
preliminary Run. Notice that the weight should pass close to the right Ear, and not straight forwards (at right angles to the Shoulders), but more across the body. Beginners often make mistakes here.

Fig. 258 will give the Curve of the body during the 'Put' of 257.

When only one Arm is used, as in Throwing, the other Arm, unburdened, simply helps to keep the balance of the body, or (if the thing to be thrown is very large and can hardly be held with one hand) in steadying it on the Throwing Hand (as in 257).

## SPEAR-THROWING.

Spear-Throwing might well be tried more often than it is at present. It is an excellent Exercise, and, especially if (as in 265) there be a mark to be hit, is not at all uninteresting.



Figs. 259-60. Spear or Long-Stick throwing.

Even mere Distance-throwing with a long Stick, is not really so dull as many might suppose.

Its movements are better seen from Figs. 259-64 than from verbal descriptions.

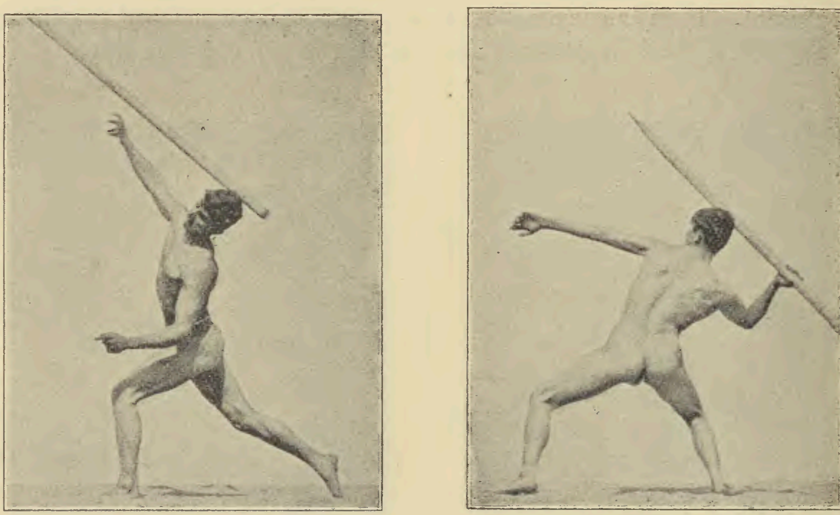
In Spear-Throwing an extra Rotating-movement at the last moment may help the directness of the Throw, giving a motion something like that which is given to a bullet by the lines in the gun-barrel.

THROWING.

What is said here will apply to *some* extent to Bowling also.

The trunk should rotate with the Throwing Arm, and should be also bent, so as *to bring the Shoulder of the Throwing Arm as far back and as far down as possible.* The widely-parted Legs should also be bent, with the same object: the Thrusting off by the Foot will help the Throw.

In a Throw, to the Body-movement and swing should be



Figs. 261-2. Spear or Long-Stick throwing.

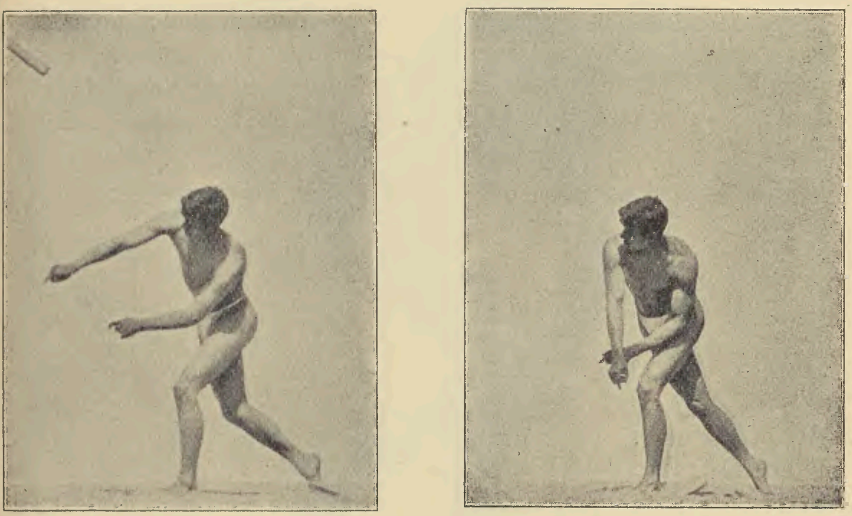
added also the Arm-movements, the Fore-arm movement, the Wrist-movement, and even some Finger-movement as well. Each factor must be made to add its contribution of pace.

In the Throw many of the Muscles of the Arm, Chest, Shoulder, Trunk, and Legs should bear a part, all co-operating to effect a single, sudden, and violent movement at a given time.

But *all these movements should be practised quite separately at first*, or else not one of them will be absolutely sure to do its work. The Body-Muscles should be made to work quite easily: a good Exercise would be to carry your right Shoulder as far back and as far down as you can, the weight of the body being now on the right Leg. Then (without moving the

Arm below the Shoulder) bring the Shoulder suddenly up and towards the left. Do this hundreds of times, for it will be useful for the Lawn Tennis Service also: see 'Lessons in Lawn Tennis'. As to the Right Foot, at first it might turn outwards or even backwards, but, with the body-swing, it should come round to the left and forwards.

Since a Throw is a momentary exertion of the full strength of the Muscles, there is hardly any Exercise in which a proper



Figs. 263-4. Spear or Long-Stick throwing.

*preliminary Stretching-movement* is of such importance and has so much to do with success.

A FEW NOTES ON BOWLING.

Much of what has just been said will apply to Bowling also: but here the Twist is also needed. How can it be acquired?

One or two Exercises may be suggested, though many others could be added. It is merely necessary to point out the types of such Exercises.

Put your Hand in front of you as if you were going to drink out of the hollow Palm: hold the Muscles stiff, and turn the Hand over towards the Right, as far as it will go. Now turn it over (at first slowly and with effort) towards the left, as if you wished to empty the water out. Do this hundreds and hundreds of times, at intervals, on the principles laid down at the beginning of this work.

Now so far you have kept the Fingers Stiff, and have only 'rotated' your Lower Arm; but this movement will be enough to give a certain Twist to the Ball, if you add it just as the Ball is going to leave your Hand.

But the Fingers and Thumb can do a great deal besides: and *if* you practise them *by themselves* you will find they will be able gradually to do more and more. For instance, put your Hand so that it would be grasping an imaginary Ball. Let the Palm face you, and let the Thumb be as far to the

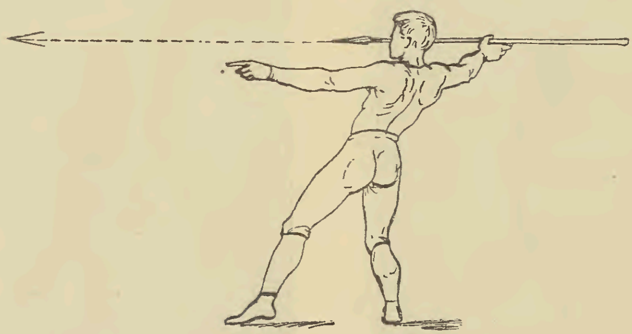


Fig. 265. Throwing a spear or a long stick at a mark.

right as possible: then move the Thumb across the Hand—e.g., towards the tip of the Little Finger: do this (at first slowly) hundreds and hundreds of times.

Various other Exercises would be to move the Fingers (by themselves) just as you would if you wanted to make a Ball spin round.

The great advantages of such Exercises over mere Bowling is that you will get each part to do its work: you know that, in a Game of Cricket or Football, the whole team cannot do itself justice if any part of it is slack or bad. And you must treat your Hand and its parts as a team. Practise each part separately in the special thing it has to do. And then practise two parts together, and so on.

Secondly, you can do these Exercises in many places and at many times of the day *and year*. You need never be idle.

A Finger-Exercise may give you something to do while you are waiting—e.g., for a train. *

Again, practise Wrist-Exercises at first by themselves. From the first position when you are gripping an imaginary or real Ball, bend the wrist upwards, and bring it back downwards;

Fig. 266. Myron's Discobolos.

repeat this again and again. Later on, when it has become quite easy, you can alter the *pace* of your Bowling by adding this to the Arm-movements etc., or by not adding them.

Also, practise the various Body-swings: if you have to do much Bowling, it is as well to use the great Body-Muscles as much as possible, because they are not only very safe, but are also less liable to be tired. See Part II.

* Macdonald Smith's system (of 'Full Contractions') is the most valuable for Piano-playing as well as for Athletics.

With these Exercises the Pace can be varied considerably.

QUOIT-THROWING.

Myron's 'Discobolos' (fig. 266) is familiar to every one: the

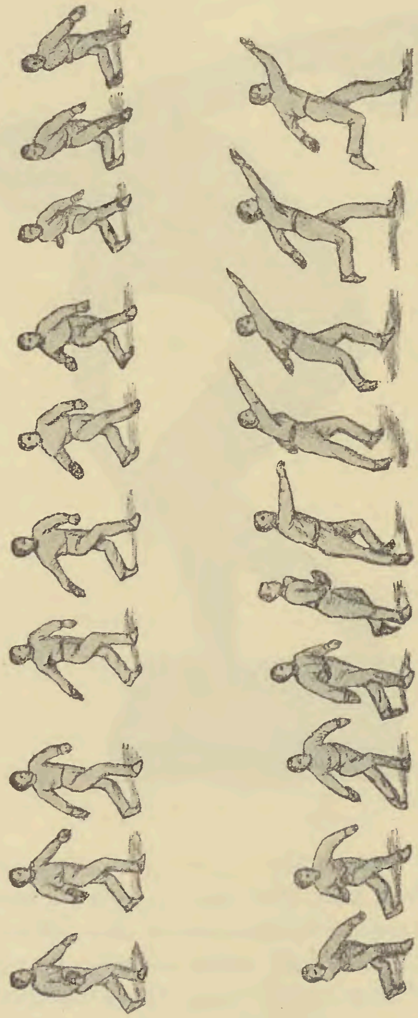


Fig. 267. Quoit-throwing.

Diagrams here will show Quoit-Throwing in more detail.

With Myron's Statue compare the modern Throw by the

American Carrett in 1896. Americans have thrown 37 metres: this was 29.05.

The Two-Handed Quoit or Missile Throw is given in 269-84.

Figure 285 gives some idea of the Curve when the Arm is straight and the Body is facing forwards. Of course in most throws many other Muscles would come into play. But in this the missile proceeds along the line of sight.

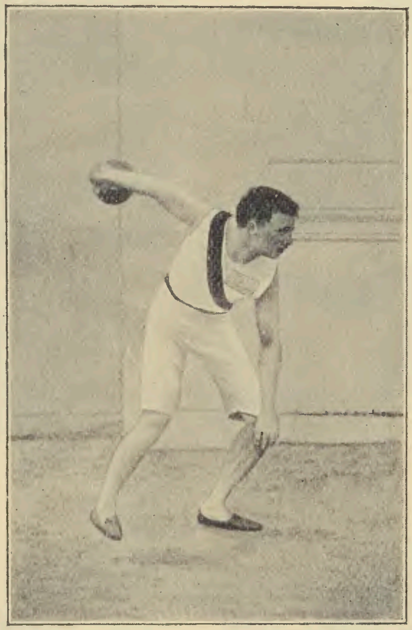


Fig. 268. Quoit-throwing.

THROWING A 'HAMMER', ETC.

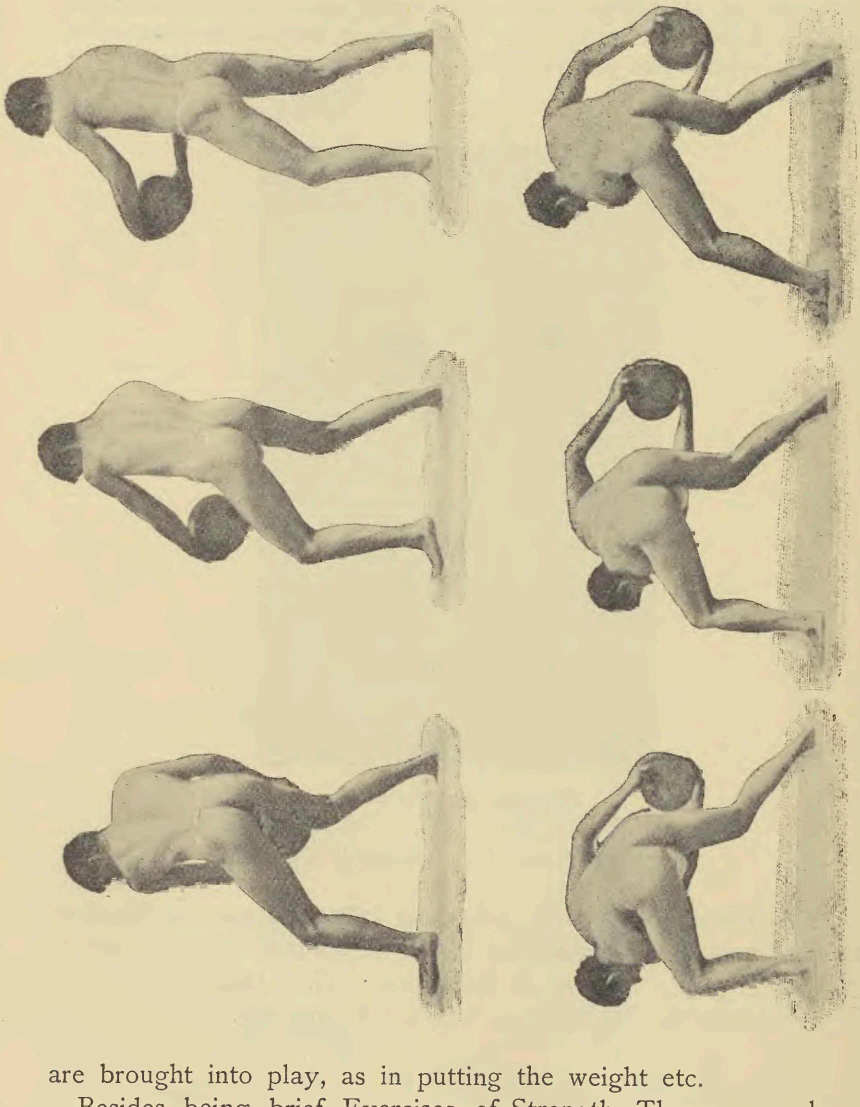
The Hammer in these Diagrams (286-7) is not the English and American Hammer, but has a far shorter 'handle' and a different 'grip'. So we do not call it '*The* Hammer'.

We leave the Diagrams to explain themselves.

VALUE OF THROWING AS AN EXERCISE.

Like Jumping, Throwing needs brief but powerful exertion of many Muscles in remote parts of the body.

But, in the Jump, the chief Muscles are those of the Legs; in the Throw, those of the Arms and Shoulders. In both cases, however, strong Muscles—e.g., those of the Back and Legs—

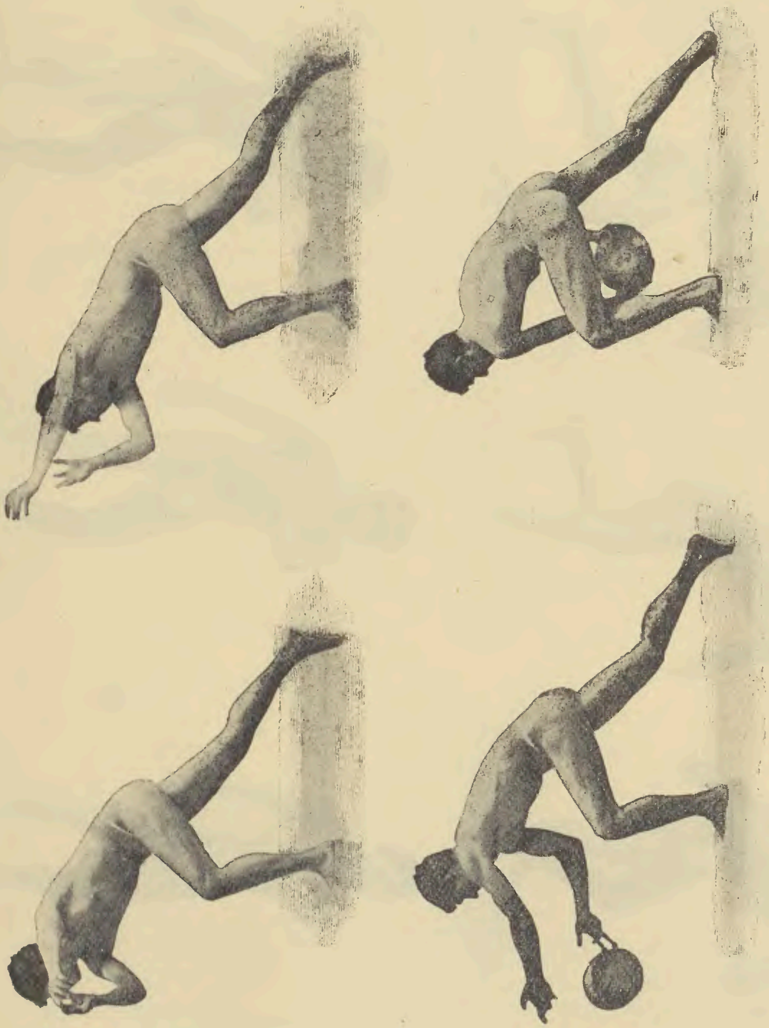


Figs. 269-74. The throwing of a quoit-like missile.

are brought into play, as in putting the weight etc.

Besides being brief Exercises of Strength, Throws can also be made Exercises in Rapidity. Bowling may become a good Exercise in Endurance also, and in Ingenuity and Skill. But, anyhow, Throwing needs many Muscles to work very nicely together.

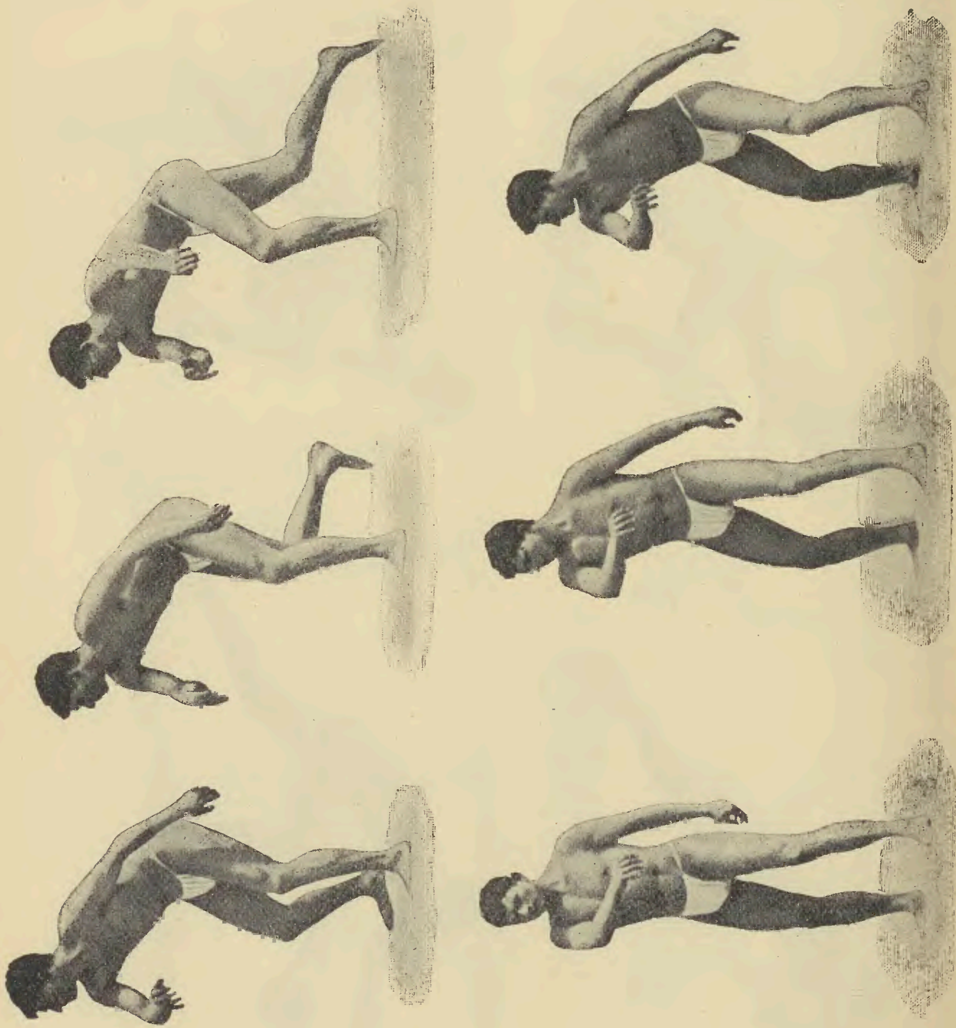
Throwing and Bowling have a great value because they help Games.



Figs. 275-8. The throwing of a quoit-like missile.

It may be mentioned that Left-Handed Exercises should be practised also, but only up to a certain point of skill, except perhaps in Bowling at Cricket.

We may notice here that when the Muscles on one side of the body are exerted violently, then the Nervous System is wont to send a stronger blood-current to the corresponding



Muscles on the other side, and this makes them grow; so there need be little fear that the Throw may cause a marked development of the right side.

Various Throws offer a great variety of movement, so that they by no means supersede each other, but deserve to be practised side by side.

Moreover, it is of great value for a player if he can bring a certain amount of acquired skill and certainty, ready-made, as it were, into his Games at the very outset. For this purpose Throwing, Catching, and Hitting the Ball, are worth special cultivation.

## 8.—SWIMMING.

### POSITION AND MOVEMENTS IN SWIMMING.

Swimming serves to keep the body from sinking and also to move it along in the water. It is 'natural' to many animals,

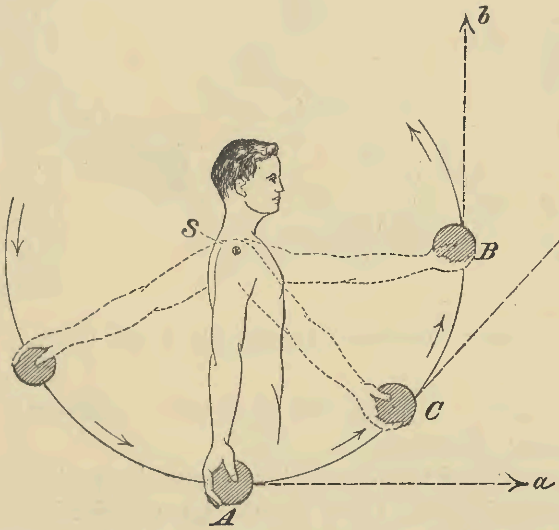



Fig. 285.

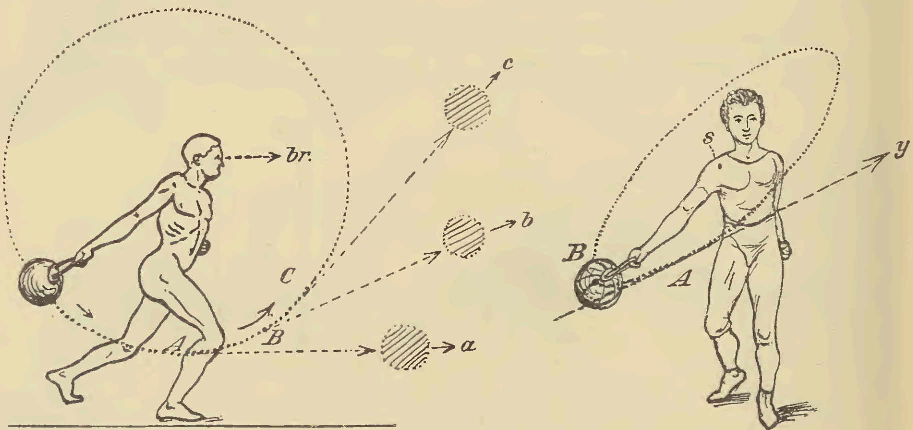
but is not usually learnt by the young; but it is becoming more and more common to teach it, and at Marlborough, chiefly thanks to my great friend Mr. F. H. Hewitt, every boy must learn to swim. This ought to form a part of the Education provided by Government.

It is Man's erect position which helps to raise him above the beasts, but at the same time makes it (as a rule) unnatural for him to bend his head far enough back to keep the water out of his Nose and Mouth.

The body, however, will naturally float of itself, and this becomes easier if a deep Breath is first taken, and of course if the right position is chosen—viz., on the Back, with the Chest high, and the Head bent back, so that the Mouth and Nose are above the water. Slight upward and downward movements of the Hands will help.

As an Obstacle-Exercise, the Swimmer should practise Swimming in his, or someone else's, Clothes.

So much for the keeping above water. And now as to the




Figs. 286-7. Throwing a Hammer with a short handle.

*Movements*, some of them will be seen in 290—293, though there are many varieties.

The Diagrams and the descriptions should be studied together, and also worked out. They should be practised separately, Part by Part, under easy conditions, on dry land—e.g., on a Chair or Stool; then, when the separate Parts have become easy, they can be combined two and two. There are many who say that Swimming can only be learnt by Swimming in the water; but this is wrong. It is quite true that Swimming can *not* be learnt *without* Swimming in the water, but that is a very different matter. The Muscles can be well trained beforehand and between times, just as they can be trained for any Game. There have been Schools started for Teaching Swimming

Exercises on land: and it is said that, when (after this Training) the pupils try to Swim in the water, they not only learn far more quickly, but are far less nervous.

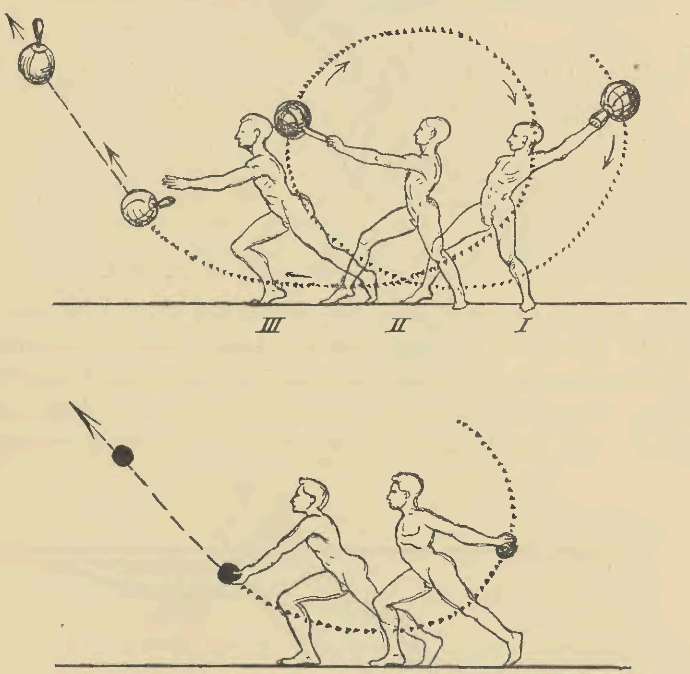
### Arm-movements.

1. The Arms stretched forward, are slowly spread out (close under the surface of the water) so far that they lie in a straight line (drawn through both Shoulders).

The Palms have their outer sides a little higher than the inner.

### Leg-movements.

1. After the first Arm-movement is started, the Legs, till then stretched out, are slowly drawn towards the trunk, so that the Knees are wide apart while the Heels are close together. The Toes are turned out.




Figs. 288-9. How steps may prolong the circle of the swing.

2. The Arms, stretched out and with the Palms downwards, are slowly moved down until the Palms (with the

2. The Legs are spread out moderately fast and are thrust side-ways by the stretching out of the Knees. The Feet

thumbs towards each other) meet below the chest. The Arms are then bent and the Hands, with their Palms together and Thumbs upwards, are brought under the Chin (290.)

3. The Arms, with the Hands pressed together, are thrust forward, close under the surface of the water. (In the Diagram, however, the hands are already rolled outwards for movement.)

are meanwhile turned out, and move against the water with the flat sole.

3. The outspread Legs are sharply brought together.

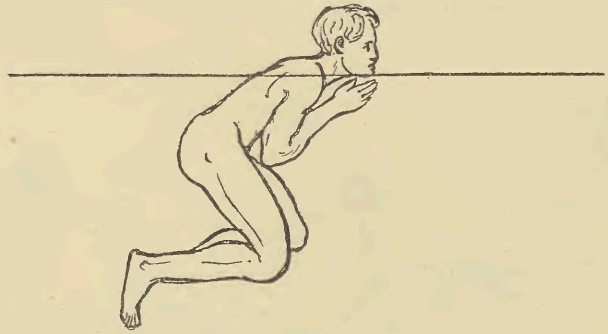


Fig. 290. Movements in swimming on the chest.

With regard to Breathing, the Breathing should be sent out while the Arms are outstretched and being pressed downwards; the Breath should be taken in while the Arms are being thrust forwards, and the Legs thrust outwards and then drawn together. For the bending of the trunk helps the In-Breathing,

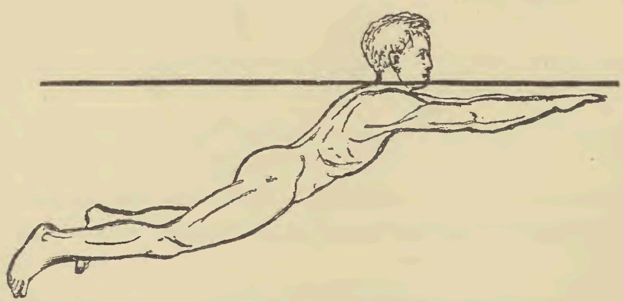


Fig. 291. Movements in swimming on the chest.

and the extension of the trunk helps the Breathing-out. In this way there is one Breath in and one Breath out at every stroke.

This Breathing must be practised as a separate Exercise.

The various movements in Swimming do not all last the same time. After each Stroke the body shoots forward, before one reaches out for a fresh Stroke. *The force given by every Stroke must be allowed to take its full effect. A person who swims hurriedly merely wastes Muscle-power;* he does not get on faster than the quiet swimmer, and is tired much sooner.

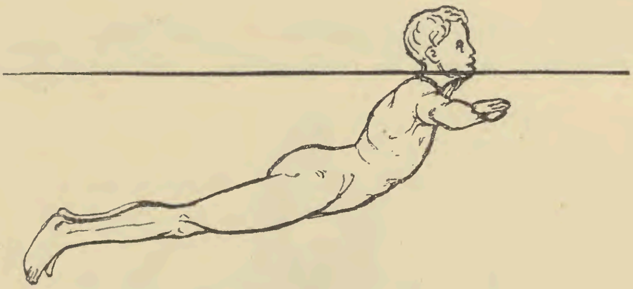


Fig. 292. Movements in swimming on the chest.

The first motion, that of carrying the Arms to the sides and bringing up the legs, is made quite slowly; but the forward thrust of the Arms and the sideways thrust of the Legs is made quicker, and the drawing together of the Legs is very sharp and forcible.

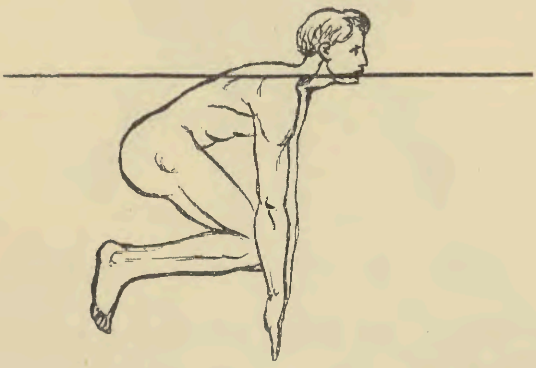


Fig. 293. Movements in swimming on the chest.

The correct and quick movement of the Legs is of very great importance in Swimming.

*After* Swimming on the Chest, in which the Swimmer can look straight ahead, the learner can also try Swimming first on one side and then on the other, Swimming on the Back, and so on. For these, as well as for Diving, we must refer to special treatises, except to notice that Swimming on the Back is generally less tiring than Swimming on the Chest, but also less rapid; and that Swimming on the Side exercises the Legs most.

## VALUE OF SWIMMING AS AN EXERCISE.

Swimming includes the effects of a Cold Bath: e.g., besides being cleansing, it may be invigorating. But much depends on

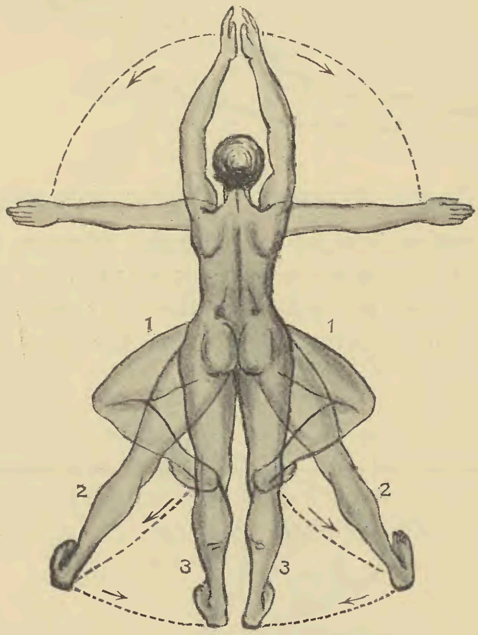



Fig. 294. Arm and Leg movement in swimming.

the temperature of the water and of the body, and on the length of the bath.

In Swimming, more than in any other Exercise, Health is a main object. Many swim merely so as to be able to stay in the water for a longer time, and so be invigorated for a longer time. But we should doubt if this is the object of the majority, who probably rather swim because they enjoy it, and for the sake of Exercise, and also because it gives a sense of power.

The vigorous movement of Swimming quickens the action of the Heart. Thus the Circulation of blood in the Skin is actively and steadily kept up.

More heat is lost, and to make up for this the Heart works harder, and so the cold is often scarcely felt, after the first shock, unless movement is absent; in such a case, the cold water may cause a feeling of numbness, and may make the skin pale and the lips bluish, till, after the bath, the skin has been well rubbed. If one Swims, this numbness etc. is put off rather than removed.

Regarded merely as an Exercise, *Swimming is a perfect form of the Exercise of Speed*, and can therefore become an Exercise of Endurance. Most of the skeletal Muscles, and chiefly the largest, are brought into play and strengthened by Swimming. *The muscles of the Legs*, more especially, are forced into vigorous action *in quite another way than in Walking, Running, and Jumping.* In Swimming on the Chest the Muscles of the Back are used to draw the head backwards and so keep the Nose and Mouth permanently above water. Evidently, *this strengthens the right Muscles for a graceful Carriage of the body;* the regular Swimming therefore does much to ensure a correct Carriage. Hence we were able to quote Swimming as one of the Exercises useful for correcting a Round Back.

As the Spinal Column is sharply extended during most of the movement of Swimming, the Chest or Thorax is arched forward and widened. Thus Swimming affects the Breathing very considerably.

Swimming, as an Exercise of Speed which requires the exertion of the largest Muscle-areas of the body, increases the volume of the Breath. But while in other Exercises of Speed (e.g., Running) the volume is increased, and the rate quickened more and more, *in Swimming Breathing should go with the movements on a regular plan*, so that the Swimmer may counteract the quickening of the Breathing if he Swims in good style, quietly and evenly. The volume of Breath must be increased in all parts of the Lungs, in order to meet the greater need of Breath, and the Breathing Muscles must be forced into, and must be practised in, an exertion not only regular, but also great. It must be remembered also that the water presses on the Thorax more than air would; the extra effort is small for each single Breath, but large in the sum total.

As to the effects of the movement, upon the Breathing-apparatus, when the Legs are stretched out, they help the Breathing-out: the walls of the Abdomen are made to press against the viscera, and so against the lower surface of the Diaphragm; the gathering together of the Legs helps the In-Breathing, for it releases this wall, and the Diaphragm can move freely downwards.

*The Heart* is affected by this as well, and also by the cold water: for the cold water not only acts as a Tonic and Stimulant, but also makes the Skin-vessels contract, and so causes a wave of blood to be dammed on its way back to the Heart.

Only by the most vigorous contraction can a sound Heart successfully do the extra work. But Swimming, being an Exercise of Speed, instantly increases the amount of Heart-exertion, in both the number of its contractions and the volume of blood. The action of the Heart, thus quickened by Swimming, helps to overcome the effect of the cold water on the Circulation. Fatigue of the Heart usually comes only after long Swimming, and it is then hastened by the additional work of the Heart in making up for the loss of heat (through the cold water).

If the Heart is not likely to be dangerously overstrained by vigorous Swimming for short or moderate distances in a cool stream, it is because the signs of Heart-Fatigue are only partly due to the actual Muscular effort of Swimming; they are partly due to the cold of the water. There are not so many 'Waste-products' circulating in the blood as after other exhausting Exercises. The Heart therefore recovers more quickly and better.

But the case is different in long exhausting swims over great distances. Here the effect of the 'Waste-products' at last makes itself paralysingly felt, the strength gives out, and life may be lost unless help is at hand.

The Heart-Exercise is therefore great, but, as a rule, helpful and invigorating.

As to pace, the greatest pace seems to be reached in a Swim of a little over 50 yards.

## 9.—ROWING.

### ROWING AS AN EXERCISE.

We find boats and ships in quite early times, from the hollowed trunk to the light canoe, the heavy barge, the graceful pleasure boat, and the merchant-ship or ship of war: but Rowing as an Exercise to strengthen the body is apparently quite a modern idea.

It is curious that a skilful seafaring people like the Greeks, with their extraordinarily keen perception of the value of different movements, overlooked Rowing as an Exercise. Rowing was to them not an exercise, but a labour, a labour held in some contempt, because often the labour of slaves and criminals. At all events, Boat-races were unknown among the Greeks, and among the Romans; for the Naumachia of the Roman Emperors consisted merely of gorgeous representations of sea-fights on a small scale, and were performed by gladiators.

In Venice, in the 14th Century, Guilds of sailors and fishermen used to compete, as fishermen did, later on, in Germany.

It is the *English* who have almost invented Rowing as a health and pleasant Exercise for Amateurs. In the 18th Century Amateur Boat-Races became popular in England, and for long the Oxford and Cambridge Boat-Race, and the Races and Regatta at Henley and elsewhere, have been great National features.

In Germany the practice of Rowing is comparatively young, for most of the Boat-Clubs have been founded since 1880.

Rowing in a small boat or skiff, e.g. for any traffic on the water, for moving small loads, for fishing, etc., goes on in a *regular Rhythm*, *calls large Muscle-areas into play*, and can be altered with a view to either the greatest speed or the longest continuance. To go on the water and merely to move a fishing-boat about has a very great charm in itself for many people; and some of the boats on our rivers and lakes are just fishing-boats lightly built.

### FIXED-SEAT ROWING.

It was once an opinion as common as it was false that most of the exertion in Rowing falls upon the Muscles of the Arms. In correct and graceful Rowing the forward and backward swing, a pendulum-like movement performed *from the Hips*, is a matter of much greater difficulty.

(a) *The seat* of the Rower. The Rower sits with his trunk fully extended, his head high, his eyes to the front, his Chest thrown forward, the small of his back hollowed, and the weight of his trunk equally distributed upon the two sides of his seat. The Feet rest against the Stretcher, with the Heels close together and the Toes turned out. The two hands should be a very short distance apart, and should be held symmetrically at an equal distance from the body.

(b) *Stretching.* The body and the extended Arms are brought forwards as far as possible. The Spinal Column should not be bent now, so as to make a crooked back: the trunk should rather be thrown forward *from the Hip-joints.* When the stretch has reached its forward limit, the oar is dipped into the water just deep enough to cover it. Then immediately the pull begins, and it must continue quite evenly to the end.

(c) The *Pull.* The body rises erect (again from the Hips)

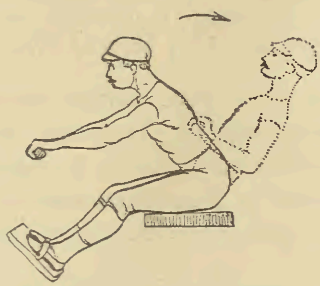


Fig. 295. Movement of Rowing on a fixed seat.

and swings backwards. The hands should not reach the front of the Chest until the body has passed the perpendicular and is already sinking back. When the Pull is finished, the hands are dropped and suddenly bent back towards the Wrist. This lifts the oar out of the water and keeps its lower surface parallel to the water: during the stretching forwards (see above), it is kept parallel to the water, so that it has not so much resistance to meet from the air.

The forward stretching is of course far slower than the backward-swing.

If we now ask which Muscle-areas are chiefly brought into play in these movements, we find that in the trunk they are, above all, the long Back-Muscles in the backward-swing, and the Abdominal Muscles in the forward-swing. The Pelvis-Muscles also have to move, and the Thigh-Muscles help. The Knee-joint also does work.

Fatigue will be felt most of all in the Muscles of the Legs and in Hips: the Muscles of the Arm, Shoulders, and Chest are of course exercised.

That which Rowing lacks (e.g. as compared with most Ball-Games) is the side-way movement or twisting of the trunk, which is so valuable for Health etc.

With regard to Breathing, it should be harmonised with the motion, as in the case of Swimming. During the Pull, which takes $\frac{1}{4}$ of the time of the whole movement, the Breathing stands still: the act of Straining takes place, so as to give a firm hold to the Muscles of the Arms, Shoulders, and Trunk. For the rest, the In-Breathing is taken at the point of leaning forward for the stretch, the Breathing-out is taken at the backward-giving after the pull.

## SLIDING-SEAT ROWING.

The *Sliding-Seat* was a great invention. Even in Rowing with a Fixed seat the Rower slips forward, that is to say, while he is reaching out for his Stroke, if the seat is smooth; and he slips back again as he draws the oar towards him and swings back. It was soon found that this sliding to and fro helped the movement and made the Stroke longer and more effective. This led now and again to the smearing of the seat with fat or soap and sitting on it with breeches of goat's leather on! Then the seat itself was made movable, and *this gave the Legs an important share in the work.*

Nevertheless, Fixed-Seat Rowing should probably be mastered thoroughly before Sliding-Seat Rowing is learnt.

As to the chief differences between the two kinds of Rowing, with the Sliding Seat (a) the Legs do different work and more work, and (b) the swing of the trunk need not be so great.

While one is stretching forwards, the Knees are bent to an angle of 60 degrees, and, at the limit of the stretch, the Knee is above the level of the hands and in front of the Chest.

The trunk, on the other hand, is bent forward at an angle of 70 degrees with the edge of the boat, instead of 40 (as with the Fixed Seat). This often leads the Rower *to bend the upper part of his Spinal Column* so as to get a longer Stroke: instead of the graceful and erect attitude of the trunk, we then have an ungraceful hump.

It is chiefly for this reason that the good 'habit' of the Straight Back should first be acquired by Fixed-Seat Rowing, before Sliding-Seat Rowing be tried.

On the Sliding Seat, as we have seen, the Legs do most of the work, which (when we remember the strength of the Leg-Muscles) means that the labour is far smaller. On the other hand, the exertion of the Muscles of the trunk is slighter than in Rowing on a Fixed Seat, which has the advantage here.

With the Sliding-Seat the Pull is longer; and the whole Slide is also quicker. Hence for Racing, and as an Exercise in Speed, the Sliding Seats are the better. On the other hand, Outriggers with Fixed Seats are usually cheaper and

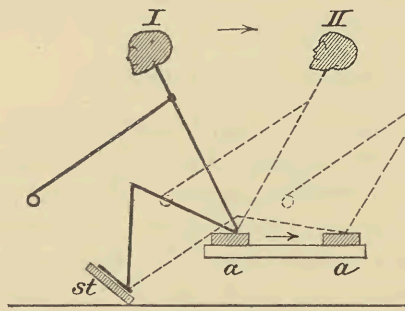



Fig. 296. The movement of Rowing on a sliding seat.

stronger, and are probably far better, at least for the great majority of learners.

## ROWING AS AN EXERCISE OF SPEED.

The effects of Rowing are very far-reaching. No other kind of Exercise brings so many Muscles of the body into action to the same extent. Since the exertion is well distributed, it causes no great Local Fatigue in the Muscles chiefly employed, that is to say, no more than other Exercises of Speed or Endurance; among which, therefore, Rowing must take a high place.

Of course it makes a great difference whether Rowing is practised as an Exercise of Speed (e.g. in a Race), or with a view to a moderate speed for a long time. The effects on the Heart and the Circulation, and on the Lungs and the Breathing, will differ very considerably.

We shall here consider Rowing first as an Exercise of Speed, taking Kolb's estimates (from a Berlin Rowing Club).

In quick Rowing, we can exert, to the very utmost, large Muscle-Areas, in fact, the largest Muscle-Areas in the body—e.g., during the Pull, those of the trunk, the Legs, the Shoulder-Blades, the Arms.

Then the Rower returns to his first position: and the body is completely bent again. Now, in Racing, the number of strokes in a minute may be from 32 upwards, and the speed attained may average 5 yards in the second. On the course of over 200 yards the number of strokes would therefore be nearly 300 in 8 minutes; i.e, in this short time, the complete contraction of the largest Muscles of the body would take place nearly 300 times. This amounts to an enormous total of exertion.

The effect on the Heart and the Breathing is therefore enormous also: after even a short course, the Lungs may be almost exhausted, although in ordinary Rowing the Breathing can be arranged so as to lessen this exhaustion. The Breathing may rise to 120—140, and the Muscles may give way because of the excess of Carbonic Acid in the body, as in a Foot-Race.

Of course a practised Rower or Crew will not get 'pumped' in this way: though there may be paleness and a feeling of Fatigue just at first, soon perspiration may come and give relief for a while. Then real fatigue may come, and the Lungs may be so over-filled with blood that the extra Muscles of Breathing may be badly needed.

| Suspended Respiration: seconds | Carbonic Acid contd. in air exhaled. |
|---|---|
| 20 | 5.1 per cent |
| 40 | 5.7 ,, |
| 60 | 6.3 ,, |
| 80 | 6.7 ,, |
| 100 | 7.4 ,, |

But, with rest, the signs of exhaustion may practically disappear very soon, and only a quiet feeling of satisfaction may remain. Within an hour the Rower may even be ready to do the course again.

Rowing as an Exercise of Speed taxes the Breathing more than any other function of the body, on account of the large number of large Muscles which are exerted. The total amount of Carbonic Acid produced is enormous. Kolb calculated that the exchange of Gas is *nineteen* times as great as in repose. The 'Changes of Matter' are therefore enormous.

The Heart's action is also quickened. The Pulse-rate rushes up at an immense pace, reaching even 240 beats in a minute. But the strain on the Heart is partly relieved because there is much blood in the large Muscle-areas which are being used. Yet people with weak Lungs or Hearts should not row—at any rate in Races.

ROWING AS AN EXERCISE OF ENDURANCE.

Just as Quick Running differs from the quieter Long-Distance Running, or from gentle Mountain-Climbing, so Quick Rowing differs from the quieter Long-Distance Rowing.

This second kind of Rowing has admirable results, results which give to Rowing, on a river or on the sea, a value beyond that of most other Exercises.

First of all, a long Row will strengthen the Muscles, and the large Muscle-areas in particular—e.g., those of the Trunk, the Shoulders, the Arms, and the Legs. The strengthening of the Muscles of the Back and of the Abdomen is of very great importance.

Rowing will also improve the carriage, making it erect and graceful, and giving a powerful arched Chest, if the Rowing be practised in the right way.

With the activity go great 'Changes of Materials' in the body: the volume of Breath increases, and with it the exchange of Gases: the Circulation is quickened, and more 'Waste-products' pass into the urine. The activity of the Skin will do something to relieve the Kidneys. The Fat also will be reduced, and many people find Rowing good for them even for this single reason.

As to the Breathing during Long-Distance Rowing, it may be helped by the action of Rowing, and may go on more strongly and quickly without losing its regular Rhythm.

But we should notice particularly the character of the surrounding air in Rowing. The air just above the water is absolutely *free from dust*, and is purer as we go further from the bank. We breathe it with actual enjoyment, and we feel that this exquisite air on the water is a refreshing bath for the Lungs.

Moreover, the air above the water is wont to be cooler, in hot weather, than the air above the parched ground; and, on the other hand, chill is but slightly felt on the water, even apart from the fact that in colder air one is especially ready for the warming exercise of Rowing.

It is hardly necessary to remind English or American Rowers that 'Flannels' are far healthier than ordinary clothes, for Rowing as for other athletic purposes: but it is necessary to remind Rowing men that the Flannels should be clean. To put on again the Flannels filled with the 'Waste-products' of past exertions is not only disgusting, but also—like most disgusting things—bad policy.

As to the Moral qualities which Rowing helps to develop, watchfulness, coolness, pluck, endurance, and the art of Co-operation—these are among the chief.

The Enjoyment also, not only of the Exercise and air, but also, as a rule, of the scenery, must not be left out of account.

## 10.—BICYCLING. THE GROWTH OF BICYCLING.

Among the wonders of the latter half of this Century will be reckoned the development of Railways, of Steamers, and of Bicycles.

There is no doubt that many means of transport, valuable as they are, increase in many the love of comfort and the dread of physical exertion. Of those who once went on Walking-tours many now travel by Steamer or by Train, and scarcely walk at all. On the other hand, the Bicycle is a quick means of travelling, it is a very cheap means, it enables the Cyclist to travel and see the country, and—*if* it is practised rightly—it is, as we shall see, a splendid Exercise for large numbers. But one cannot help feeling that it has done and is doing much harm to our nation: in so far as it does anything to stop Walking or Running or the best Games, it is not to be commended. Those who can walk or run or play Games should use Bicycling as a means to help them to walk or run or play Games under better conditions; they should never give up the above Exercises *for* Bicycling, as so many thousands have done in the case of Cricket, Lawn Tennis, etc. Let them bicycle to the Lawn Tennis Court, by all means, but don't let them give up Lawn Tennis. Those who know something of what Games have done and can alone do, for a nation, cannot urge this too earnestly.

We do not here propose to give a history of Cycling, which started with the Running-wheel of Freiherr von Drais (1814). The rider could touch the ground with his feet.

Then the Legs were made to turn the wheel by pedals, and soon the High Bicycle was invented.

Then came the Modern 'Safety' Bicycle, which is growing more and more perfect every year, with high gear, Pneumatic Tyres, etc.

A ride of a hundred miles a day used to be a great feat: to-day it is no longer a rarity. Fifty miles is a mere trifle to many women who would hate to walk even five.

As an Exercise Bicycling may, *in some respects*, be of no great value, for the movement is monotonous and mechanical; but there is no doubt that it *is* the Bicycle which induces countless people to take regular and often very active and strenuous Exercise in the open air, people who would otherwise have stayed indoors. For the Health, the endurance, and the vigour, and the opening of the minds of very large classes of the population, this latest kind of Exercise means an enormous gain. No unprejudiced observer can deny it.

### CARRIAGE OF THE BODY ON THE BICYCLE.

The Cyclist should divide his weight equally between the two sides of his saddle, which should be somewhat hard.

The trunk should be upright: the handles have much to do with this, and should be chosen or arranged with a view to it. The height of the saddle above the pedals is also important, for it should allow the Leg to be slightly bent. If the distance is too small, power will be lost; if it is too great, the Pelvis will have to be lowered, first to one side and then to the other, and so the Spinal Column will be curved. Either error will make the Fatigue greater.

Round-Back should be carefully avoided, for, if it is usual in Cycling, it may be transferred hence to daily life.

The position of leaning forward, with the back rounded, is usual in very quick Racing, so that the resistance of the air may be lessened. The quicker a person cycles (and Racing Cyclists rush along at the speed of an express train) the more does he feel the resistance of the air, even when there is no wind. No great pace, generally speaking, can be kept up against the wind.

But this is not the only reason for the position; the Racing Cyclist actually does it so as to breathe at all. For the resistance of the air in front prevents the Breathing out, and in Cycling, as in all other Exercises of Speed, deep and free Breathing is necessary for the greatest possible pace.

Hence it is quite natural that this faulty attitude should be taken in Cycle-races and in Training for them.

The position requires that the hands of the Cyclist shall be lower than is good for a correct carriage. Hence Racing-Machines are made with handles bent down. On these it is not *possible* to maintain an erect and graceful attitude in Cycling.

Even if, then, we must allow low handles and a stooping posture to be necessary evils in Cycling in Races, yet it is monstrous to take such Machines into daily use.

Fortunately, Women-Racers and 'Scorchers' are rare: and as a rule Women on Bicycles have a more erect and graceful position than men.

Another fault, due to the Handles being too low or the Saddle being too high, is the forward-bending of the trunk at the Hips. This is not only bad for certain parts of the body, but it also strains the Arm- and Hand-Muscles.

A correct position is essential, not only for the sake of beauty, but also for the sake of Health. And here very special attention should be paid to the young, unless Cycling is to do more harm than good. Children before the age of puberty, while the growth of the Bones is vigorous and the Bones themselves are soft and flexible, so that faults of Carriage may easily retard the growth or lead to permanent distortion, have no business with Bicycles. The advantages of Bicycling could be much better and more fully enjoyed by them in other and more suitable Exercises, and the drawbacks of Cycling may be so serious and are so common that Bicycling should be unconditionally forbidden before the age of 10 or 12.

[Fig. 297. A cycle race. The Negro (Major Taylor).

There is a well-known saying of Mendelssohn that Bicycling is a 'going upstairs while seated': the Centre of Gravity is not raised, however; the Step is 'lowered'.

As to the Balance, it becomes half-automatic by practice: the regular rider on a Bicycle (or on a horse) seldom thinks of his balance at all. It is when this point has been reached that Bicycling becomes least tiring.

As to the part taken by the Muscles of the Arm and Hand, it differs according to the amount of Practice and according to the attitude of the body. A practised rider, holding himself correctly, need only use a very small amount of Arm-energy. It is otherwise with the unpractised rider, who grasps the Handles convulsively, hoping thus to help the Balance; and it is otherwise with him who bends his trunk forwards, and lays upon his Arms the burden of supporting it.

## CYCLING AS AN EXERCISE OF SPEED AND ENDURANCE.

Here, as in Running, we must distinguish between the Race, where the Speed may tax the powers to the utmost, and the Long-Distance Ride which need scarcely tax the powers at all. Of course here, as in Running, the longer the distance the less the speed can be. It seems that the right distance for the highest possible speed is over 500 yards. In Running we saw that it was over 200 yards.

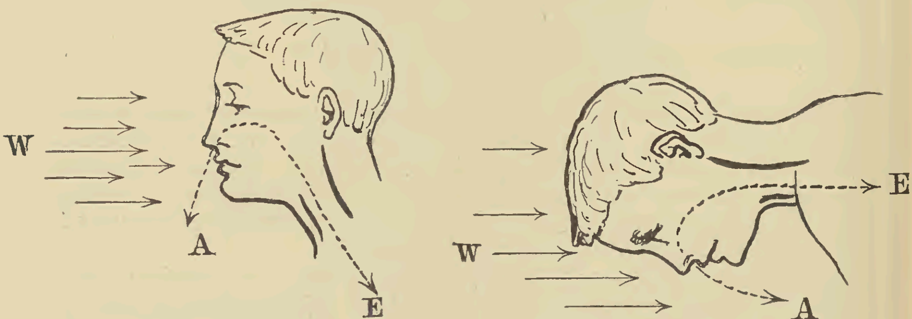
With regard to Record-Making, the smooth-track, the freedom from opposing winds, the special Training, and the Pace-makers, must all be taken into account. It would be a mistake for an ordinary Amateur to set these Records before him as his goal.

It is certain that, in Cycling at full speed, most of the Muscular force is used in overcoming the resistance of the air. And as the ship which moves quickly over the waves divides them right and left and leaves smooth water close behind in its wake, so the Pace-making Cyclist (or Runner) divides the air and leaves close behind him a space of rarefied air. This allows the Racer more energy to give to the actual Racing. In Cycling behind a quickly moving object, e.g. a train, the 'attraction' has also to be taken into account, as we see by the little pieces of paper that follow an express.

And, for both Cyclist and Runner, *the economy of Nerve-force* is of great importance. On the best tracks the Cyclist (and the Runner) must always keep a watchful eye on the course, must direct his attention to the way he ought to take, and must keep it fixed upon that. By the Pace-maker in front he is completely relieved of this trouble, and of the trouble of regulating his pace according to the distance, the Nerve-effort falling to the share of the 'steerer'. This makes the Muscles of the racer capable of far greater exertion, and less liable to Fatigue. This is especially valuable in Road-racing where the Course is not uniform.

*Emulation* of an example, and Competition, again, are needed if all the available force is to be used. And the Pace-maker helps to supply this. In a Race the Competitors themselves act as Pace-makers to the Winners.

There is no doubt that Pace-makers have done much towards the Records of Cycle-racing. Without Pace-makers the Records




Figs. 298—299. Breathing through the nose during races. The arrows mark the direction of the wind: E of breathing-in, A of breathing-out.

would have been unattainable. Great as is the *scientific* interest of these results, *Cycle-racing in its present form has nothing to do with Healthy Physical Exercises.*

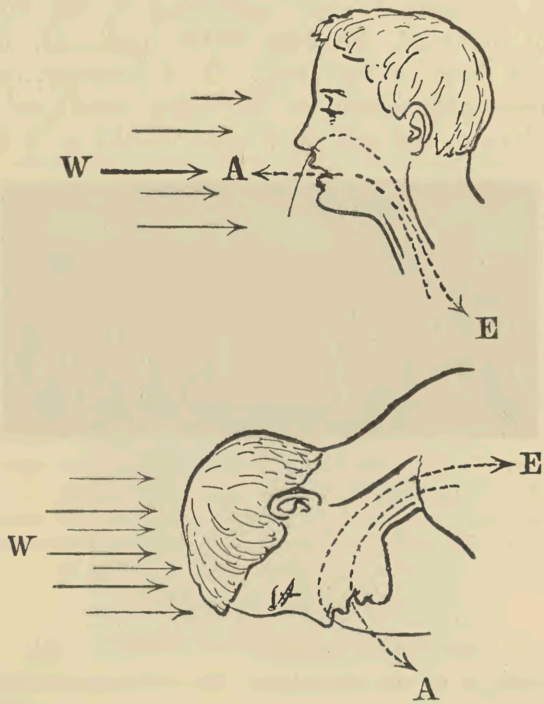
THE FORCE EXERTED IN CYCLING.

The quality and the amount of exertion depend on many things: on the Cycle itself (its friction, its tyre, etc.), on the track or road (smooth, dry, hard, level, or otherwise), on the air or wind, and so on.

As to the level, even in a slight ascent the exertion may be multiplied by three, whereas even in a slight descent the exertion may be reduced to next to nil.

As to the air and wind, the Cyclist offers a large surface to a favouring or to an opposing wind, and a side-wind is not to be ignored.

When the wind is against him, the Cyclist stoops forward so as to reduce the surface opposed to it. And the necessity of Breathing deeply and evenly also forces him to bend his head; for against the wind it is hard to breathe out.




Figs. 300—1. Breathing by the nose and breathing by the mouth in cycling against a strong wind. In 300 the head is held erect, the breathing-out by the mouth is directly counter to the wind, i.e. rendered very difficult. In 301 the crown of the head breaks the force of the wind, the nose divides the air above the mouth, so that breathing-out can proceed downwards and backwards without impediment.

This is not so much the case when both Breathing-out and In-Breathing are through the Nose, since, when the head is erect, the air from the nose goes vertically downwards. In fact, if the head is bent, the direction of the exhaled air is nearly that of the opposing wind: i.e. the Out-Breathing is actually helped. The figures will show the truth of this.

In an ordinary ride, the Breath should be taken in as far as possible through the Nose. In a very quick ride, or in a ride against the wind, the head should be bent forward: for thus the head will cleave the air, and the Nose will also serve as a breakwater, or rather a 'break-air' for the Mouth. The Breathing-out can now be done by the Mouth.

We find, then, that the amount of exertion in Cycling varies very much according to the mechanism of the Bicycle, the character of the road, the slope of the road, and, finally, the direction and force of the wind. It is, however, even under the most favourable conditions (faultlessly constructed Bicycle, smooth hard road, still air), very considerable, as is proved by

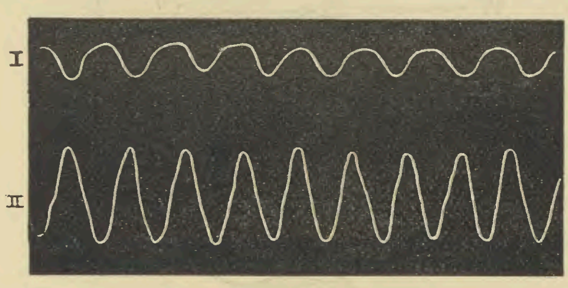



Fig. 302. Curves of respiration before and after a bicycle ride of about $12\frac{1}{2}$ miles (taken with Marey's pneumograph). The upper curve I, shows the volume of normal respiration; curve II shows how the respirations are increased (to 44 per min.) in number, and, above all, in depth. The descending line of the curve in each case shows the inspiration, the ascending line the expiration.

Rankine and Zuntz, who estimate the force as able to lift the body to a height of one-fortieth of the distance traversed.

## EFFECT OF CYCLING, ON THE BODY.

The physical effects of Cycling are like those of other Exercises of Speed and Endurance, since the Local Fatigue in the Muscles which are brought into action is tiny when compared with the extraordinary total of exertion: it falls into the shade beside the effects on the Breathing, the 'Changes' of Materials in the body, and the action of the Heart.

As to Breathing, in moderately quick Cycling the number of Breaths and the volume of each Breath are very considerably increased. When the position is correct, so that the upper parts of the Lung share in the extra exertion, and the full action of the Lungs is not hindered, the Cycling is an admirable Breathing-Exercise. Of course the beginner is apt to hold his breath in keeping his balance, but the practised Cyclist breathes quite regularly, except when Racing or riding up-hill or against a high wind: in such cases the effort may be quite exhausting, and may bring on short gaspings for air and other signs that the Lungs are too full of blood: this was also the case with Rowing. But in Quick Cycling the Breathing-Organs are not tired so soon as in Running or Quick Rowing which therefore demand more exertion.

These Diagrams show how the Curves are wont to alter in Cycling.

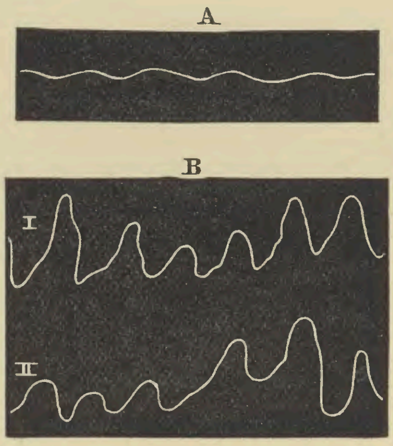



Fig. 303. Irregular breathing and breathlessness after a race by an unpractised bicycle-rider. A: Respiratory curve before the ride; B I: immediately after the ride came to an end; B II: 2 min. 10 sec. later.

On the Heart the effect of Cycling is more pronounced: there are more Pulse-beats, and each is a greater 'effort', in proportion as the blood-pressure becomes greater. It is not until the riding has gone on for some time that the vessels of the Skin-surface, and those of the Muscles, at length dilate, and the blood-pressure is lessened. The pulse then begins to sink. After Cycle-rides the Pulse takes a long time to return to the normal.

Mendelssohn observed, in one case, that the Pulse before the ride was 68; after half an hour's riding it was 152. Then it gradually dropped to 100, increasing to 150 as the rider went up hill. Then there came a pause of half an hour and the Pulse went down to 105. When the ride was resumed, it went up to 138 within ten minutes, and then dropped again to 70, because the blood-pressure was lessened and the Heart was getting tired. Next, in going up-hill, 140 was reached. After 3 hours' rest, the Pulse was still 98, after 7 hours 90, after 10 hours 80. In one case the Pulse was 200, after a rest of *three hours*, when the rider had come from Berlin to Brandenburg (Villaret).

If the exertion be continued too long (esp. against a strong wind, or uphill, etc.), the Heart may become exhausted, and

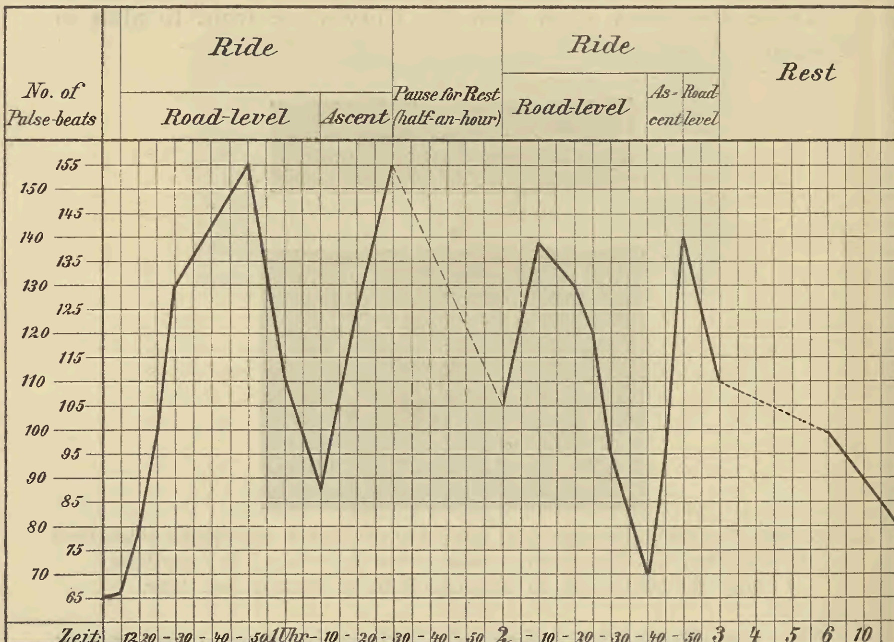



Fig. 304. Effect of a ride on a road with some ascents, on the pulse of a healthy young man.

enlarged either for the time or even (if the exertion is often repeated) permanently, as in Mountain-Climbing. In one case a fat man died of Apoplexy. But probably the Heart was unsound before the ride; and, on the whole, Heart-injuries are trifling compared with the great good which Cycling does to large masses of people.

It is worth insisting on that Cycling (like Mountaineering) when very *moderate* and when properly supervised, may be a good Exercise even for weak and fatty Hearts, because of the extra exertion it brings about; defects in the Circulation may by this means be remedied or removed.

In Cycling, the 'Changes of Materials' in the body are very brisk, according to the amount of the exertion.

As many people still go in for Walking as well as for Cycling, Leo Zuntz's Table (of the Oxygen consumed in Walking) will be interesting.

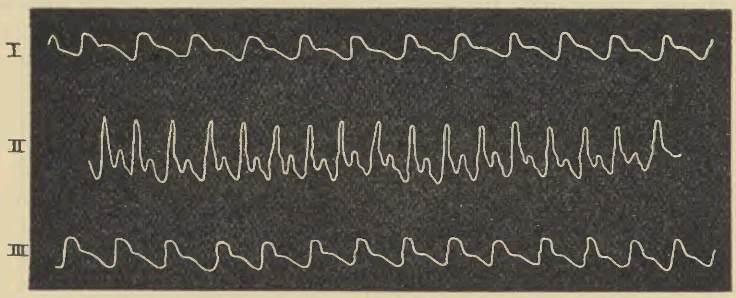



Fig. 305. Pulse curves of a fat man of 44 during moderate cycling: (1) in repose before the ride, (2) immediately after, (3) six hours later. (After Prof. Kisch.)

| 1. *Cycling.* | | *Consumption.* |
|---|---|---|
| 9 km. an hour (very slow) | . . . . | 4.5 ccm. a minute |
| 15 ,, ,, ,, (easy) | . . . . . . | 4.8 ,, ,, ,, |
| 21.5 ,, ,, ,, (quick) | . . . . . . | 5.76 ,, ,, ,, |
| 2. *Walking.* | | |
| 3.6 km. an hour (slow) | . . . . . . | 8.3 ccm. a minute |
| 6 ,, ,, ,, (touring) | . . . . . | 9.8 ,, ,, ,, |
| 8.6 ,, ,, ,, (quick) | . . . . . . | 16.34 ,, ,, ,, |

Leo Zuntz's figures show that Cycling at an easy pace of 15 kilometers an hour requires about 22°/$_0$ more force than a Walk of 6 kilometers an hour.

Similarly the amount of Urea in the Urine helps us to estimate the 'Changes of Materials' in the body, and the increase in them caused by Cycling; Figure 306 will illustrate this.

As the tissues of the body are used up, perspiration often comes, and water and weight are lost by the body. This, with the dry mouth (especially if the Mouth is kept open), produces thirst as well as hunger, unless the Fatigue has been excessive.

The movement in Cycling has for one of its results a (frequently very desirable) stimulation of the *Bowels*.

Painful pressure on some of the lower parts is due to an incorrect position of the saddle and of the rider, and is therefore avoidable.

As to the effect, of Cycling, on the Nerves, its refreshing character is probably not equal to that of other Exercises of Speed and Endurance, such as Walking-tours, Mountaineering, and Rowing. The Cyclist who whirls along the highway must pay constant attention to the character of the road, to any obstacles there may be—e.g., to vehicles coming in the opposite

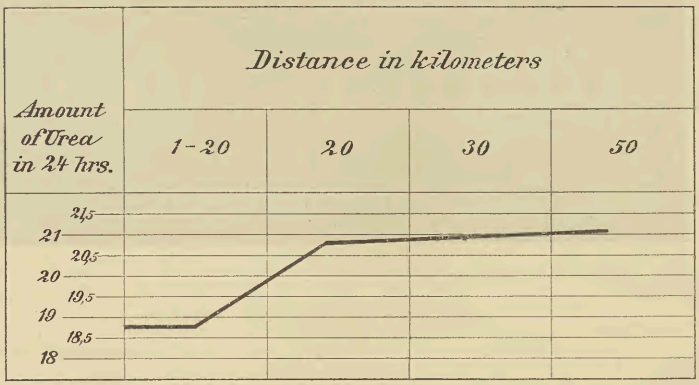



Fig. 306. Increase of excretion of urea during a long bicycle ride. The figure increases quickly during the first 20 kilometers and more slowly from that point.

direction. So the Nerves are almost bound to be 'on the stretch', particularly if the Cyclist is a beginner, or nervous by nature, or else short-sighted. But this very demand for attention is good for those who wish to (or ought to) turn their thoughts aside from work or worry for the time being. It is in this respect that Walking and even Running are inferior to Cycling.

'*Is Cycling healthy?*' is a very common question to-day, and the answer must be the irritating one, 'It depends'.

It depends on the person and his condition (e.g. his Heart), and on the kind of Cycling, and so on.

In considering this question we may here leave out of account Cycle-racing and the Training it generally involves. Enough has been said above, and there can be no two opinions as to its disadvantages and dangers, especially in Long Races. Here we shall only treat of Cycling in moderation, at a moderate pace, with quick or Long-distance rides as occasional changes.

With regard to different ages, we have already said that before puberty not only can Cycling be well dispensed with, since Games and other Exercises are far more suitable and wholesome for such years, but that in these years, when the growth of the bones is in full progress, a bad carriage in Cycling is particularly apt to be formed and to lead to lasting injuries. In the years of puberty, too, Cycling can well be dispensed with, or at any rate as the regular form of Exercise. Long rides lasting for several days are always hazardous in this stage of rapid growth, on account of the strong effect it exercises on the 'Changes of Materials' in the body.

For adults, on the contrary, Cycling is suitable even up to the very threshold of old age, apart from circumstances which we shall proceed to consider. Naturally, in the fresh and young life between 20 and 30, the Cyclist will have more liking for, and greater success in, feats of Speed and skill (e.g., trick and Figure-Cycling), while in the years from 30 to 50 he will lean rather towards Cycle-tours of longer or shorter extent.

Persons with Heart-disease should not cycle much, and certainly should not ever cycle violently, since Cycling affects the Heart extraordinarily. Even those who have no 'testable' Heart-disease, but who have lately recovered from illness—e.g., from Rheumatic Fever, Typhoid, or Scarlet Fever,—should be careful to rest directly they begin to feel out of breath. They should also have their Heart and Lungs examined at intervals. It is after Fever especially that the Heart is slow to recover from Fatigue.

Those who go in for Club-rides, or, generally speaking, rides with others, should be very careful in this respect. For the desire for 'society', a feeling of emulation, or a false feeling of pride, may easily make them over-exert themselves.

As to the manner of life during long rides, what has been said about Walking-tours and mountaineering (e.g., the greatest abstemiousness from Alcohol) is equally applicable here. So is what has been said about Clothing, which should be light and comfortable, and which, above all, must be chosen with due reference to the increased activity of the skin. The best habits in this respect are becoming popular, and the dress of most Cyclists is well suited to its purpose.

As to the dress of Ladies, of course what will look graceful on a young and slim girl will look terribly repulsive on a fat wide-hipped old woman. But, in spite of the occasional repulsiveness, the debt which Ladies owe to Cycling, because it has made their every-day dress 'rational', is inestimable. The blessing of the convenient dress (e.g. shorter skirts) has been extended even to those who do not Cycle.

As to the Corset, we have already seen its paralysing effects on the Diaphragm-movement, and how the interior cavity of the body is narrowed in the middle (as by stooping over a sewing-machine, for example) into the shape of an hour-glass. There can be no doubt that in Cycling, where the fuller and deeper Breathing is so important, the pressure of the Corset hinders the full use of the whole Breathing surface, and makes the breath give out sooner in going quickly or in going uphill for any distance. The Corset also hinders the activity of the Circulation.

Yet in many cases it would be wrong to give up the Corset altogether. In a girl who has always been used to wear tight stays, the Corset, supported on the wide Hips, helps to support the trunk on the Hip-Joints, and so relieves the long Back-Muscles. Partly from the fact that they are so relieved, partly from the direct pressure of the Corset, these Muscles stop short in their development: they become feeble and shrink. The Back (Dorsal) Muscles do not stand out in strong relief, as they would if the girl had never worn a Corset. Now the Balance demands a strong exertion of these (Dorsal) Muscles, especially for a beginner: without a Corset, therefore, the back would soon become very tired.

Nor is this all: for the feeling of weakness in the back leads to the forward stoop, so as to shift some of the weight to the Arms, which are supported by the Handles. The attitude thus becomes faulty. For this reason it would not be well suddenly to abandon the Corset in Cycling. For the early years of learning, an elastic-sided Corset gives a good half-way change, for it allows the lower parts of the Chest to breathe.

### II.—A FEW HINTS ABOUT BALL-GAMES.

In England we make a speciality of Ball-Games: other countries are bound to follow our lead more and more. I do not think we have yet got to the end of the list: the Games which we have already invented or adopted still admit of improvement, and other Games still remain to be invented. I believe that, given a ball and some Striking-implement (e.g. a wooden bat), the variety of excellent Games is almost unending. But the commonest Games are all that I shall consider here.

Nor can I do more than offer just a very few Hints, referring the reader to 'Lessons in Lawn Tennis' and to other special works, for further information. Before many years I hope to have treated numerous other Games (e.g. Cricket) in a similar way.

As I have already remarked, Dr. Schmidt makes practically no mention of '*a good eye*'. And the subject has been frequently misunderstood. Not only have many people 'with a good eye' failed to make the best use of it (e.g., they have stood in the wrong position, in spite of which they have often succeeded), but it has been confused with 'correct eye-sight'. It is true that the latter is necessary, but it is less than half the meaning of 'a good eye'.

Of all 'natural' gifts in Games, perhaps 'the good eye' is the most conspicuous: it is this that does so much to distinguish Games from mere Exercises (like Walking or Rowing).

And, being so often a 'natural' gift, it has been treated as a thing almost entirely dependent on 'Nature'. 'Either you have a good eye, or you haven't: if you haven't you'll never get one': this is what ninety-nine people out of a hundred think. I beg to throw doubt upon its accuracy.

I believe that, in many cases, a *fairly* good eye can be acquired, and I believe that, in nearly *all* cases, a good eye can be improved and can be used to greater advantage.

Dr. Schmidt says much about the correct position in Exercises, about the development of the Muscles, of Strength, of Speed, of Endurance, of Skill (or rightly Combined Movements); occasionally he speaks of Promptness and of Change. But he does not treat of the 'good eye'. What is it?

Let me begin by saying a few words as to what it is not.

It is not merely correct sight (for near or distant objects), nor merely strength or speed or endurance or correctly combined movements or even promptness. Nor is it even a combination of all these excellences. For you might find them all together in a single man, and yet that man might not succeed at Cricket, or Lawn Tennis, or in a Racket Court (one of the severest of tests).

For 'a good eye' means not only good sight, but also a quick *sympathy*, a tacit *understanding* and co-operation between

(a) the Senses and the Brain (through the 'Afferent' Nerves), and then

(b) the Brain and the Muscles (through the 'Efferent' Nerves).

'A good eye' can exist without very correct sight, and without very noticeable strength or speed or endurance or even correctly combined movements: and even without very noticeable promptness. But 'a good eye' *does* demand that the Senses, the Brain, and the Muscles, shall be acting in perfect concert and harmony.

And let us here notice two very interesting points:

(i) The eye is generally at its best either when the person is absolutely calm or when he is very excited, and either when he is in the strictest training or when he has been indulging freely (especially in Alcohol or Tea). Some day I hope to explain exactly why this is so: at present I have only worked out a part of the answer;

(ii) 'A good eye' may depend largely *on the touch, and on the hearing*, working together with the eye. The touch may tell a great deal about the pace and the spin of the ball, for instance, and the sound of the ball on the bat or racket may tell a great deal about the pace and the spin and the direction. I will put this to a practical use below.

Now, HOW CAN 'A GOOD EYE' BE DEVELOPED OR IMPROVED?

Apart from Health, and Training generally, pure blood, good food, fresh air, and good light (as opposed to bad artificial light, etc.), good sleep, and the absence of every kind of excess, the following hints may deserve attention.

1. Training of the sight must be begun even in the very *early years*. Otherwise, the 'good eye' will never be as good as it might have been.

2. Ball-Games and '*Sloyd*' are among the very best means. It is strange that Dr. Schmidt does not mention the latter at all, and tell how it may be made to encourage accuracy and judgment and a quick and sympathetic correspondence between sight, touch, and hearing on the one side, and the Brain and Muscles on the other.

3. The guessing and verifying of distances, paces, and directions, e.g. of birds, is not to be neglected.

4. The Lawn Tennis Exerciser, and the Punch-Ball are most useful; and so are

5. Boxing and Fencing and Singlestick.

6. *Drawing and Painting* are almost always liked by the young, but the teaching of these subjects is usually passed over in our Education-Schemes.

7. The *Imagination* should be employed as much as possible at odd moments. Imagine a ball coming to you at Cricket, and imagine yourself fielding it or blocking it or driving it. Imagine a Lawn Tennis Ball coming to your back-hand, and your opponent standing up at the net: imagine yourself lobbing it. And so on, *ad infinitum.*

This sounds chimerical: but as yet it remains to be seen whether, by such *Imaginary Exercises*, we are not actually exercising our eye and our Muscles, though of course to a smaller extent than in actual Practice or actual Games. Anyhow, this employment of the imagination is wholesome, and that is more than can be said for the reading of certain 'modern' Novels, or the seeing of certain 'modern' sights.

I direct the attention of Specialists to this topic. It may prove to be fertile ground.

8. The *Foundation-Positions and the Foundation-Exercises* are of great importance for a 'good eye.' Why? Not merely because they increase skill at Games, and thus make them more pleasant and interesting, but also because, if we do not have our attention distracted by them, if we do not have to ask ourselves 'How shall I stand for this Stroke?' we can then devote fuller attention to, and focus it more and more upon, the *sight* of the Ball.

In all the above remarks (except for 'Sloyd', which speaks for itself) I base my advice on personal experience: but I have only touched on the fringes of the problem, as it were, and I leave others to examine into it in detail. It will repay earnest attention on the part of Scientific men, and it were to be desired that their attention could be turned to such practical questions instead of being (as it so often is) misdirected to barren ground and wasted there.

As to the *Ear*, of which I spoke above, the sounds made by balls as they hit the gut or the wood of the racket or bat are to be studied carefully, and consciously, and treasured in the memory.

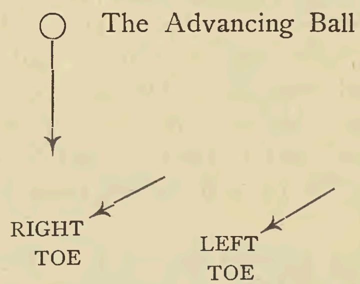
As to the *Touch*, especially of the Fingers, apart from 'Sloyd,' I should suggest Piano- or Violin-playing, Type-writing, etc.

A few very *General Hints* will conclude this Chapter.

In all Ball-Games, one great secret of success is CORRECT POSITION. It cannot be studied and practised too carefully *by the young*.

As I have tried to show, (e.g. in 'Lessons in Lawn Tennis,') it consists of many parts: each part can be found out by itself, if the Positions of correct players be carefully observed *part by part*. *The angle of the body* before the Stroke is of great moment: this will include the general attitude—e.g., whether upright or bent, the direction of the head and neck, the position of the Shoulders, of the Arms (Forearm, Wrist, Hand, Fingers and Thumb).

The position of the *Feet* is vital: they are the foundations. Not only their place, but also their distance from one another and from the ball, the way the weight of the body is distributed between them, and whether one or the other rests on the whole sole or on the ball of the Foot—all this and much more has to be considered. The Position of the Feet in Diagram (*Y*) may seem unnatural: but it is strictly scientific for certain strokes.




(*Y.*) Certain Backhand Strokes, at some Ball-Games, demand this position of the Feet.

The right Grip of the implement is also essential to success: it may differ according to the Stroke and according to the person. But anyhow it must be carefully studied and practised *all by itself*.

Then, again, the position and the movements of the implement (e.g. the ball) during the Strokes, and after the Strokes, is to be taken into account.

Of course the Movements of the body and its various parts, both before the Stroke, and during the Stroke, are equally important. For example, how few players get ready for a second Stroke directly they have finished the first. Scarcely one in ten is ready on the balls of his Feet and with his whole frame alert the moment after his first Stroke is over.

All this and much more demands great care outside the Game itself—I might almost say, inside the bedroom or ordinary room. All this needs special Exercises, constantly repeated under the right conditions. The more we study the subject from the point of view of the beginner, the more we shall be forced to subdivide it into small parts, and to insist on each small part being at first practised by itself, while the beginner is young. *Even the Thumb alone* must have its special Exercises, if you wish to succeed at Cricket or in fact at almost any Ball-Game that I know: how many have ever tried this for Lawn Tennis? And yet here it is quite an important Exercise.

Most English people are unwilling to practise such Exercises: well, the Germans and others are not unwilling, and, if they *do* practise them, they will reach a higher *average*-standard than we shall before many generations are past. It is well that we should be warned in time: that we should learn to *observe*, and to analyse, and to direct our attention to the various Problems.

It is not beneath the consideration of *any* Physiologist, and we might do well to encourage the study of this branch of Physiology. It is deeply connected with our National Health and prosperity—some day our very existence as a Nation may greatly depend on it.

## 12.—THE BEST EXERCISES AT DIFFERENT PERIODS OF LIFE.

We may, for our present purpose, divide up the ordinary life into

1. The years of childhood up to the beginning of puberty, viz., from birth to the 14th year. Within this period School-life, beginning perhaps at six, may form a subdivision;

2. The years of development, the time of puberty, from 14 to 20;

3. The time during which youth changes to mature manhood, from 20 to 30;

4. The time of full vigour in man and woman, from 30 to 40;

5. The years of over-maturity, from 40 to 50.

Let us, for the present, draw the line here, and consider these Periods a little more carefully.

1. *The years of childhood* (*up to 14*) include part of school-life.

We shall leave aside here the years before the child goes to school, referring to the book itself occasionally.

The school-years, from 6 to 14, may be divided into two parts:

(i) from 6 to 9 the Skeleton develops wonderfully: notice especially the growth of the cranium, and the change of teeth.

Within this period forms what may be called *a Storm-Period*, generally during the 8th year. An able writer in the 'Forum' (for June 1890) has called attention to this, as well as to some of the other facts which I shall add below. The child is apt to be restless and *gauche*. Personally, I should recommend an absolute abstinence from all stimulating foods, including Tea and Flesh-foods, not only in previous and later years, but now especially (see Appendix I);

(ii) the years from 9 to 14. Height and weight increase, the Bones become more capable of resistance, and the Muscles more capable of endurance.

2. *The years of Development, the time of puberty, from 14 to 20.*

The body now almost reaches its full height, and *the size of the Heart* increases immensely, and so does the size of the Lungs. These facts are of the greatest importance.

In childhood the Heart is comparatively small and the Arteries are wide. The Heart works more quickly, the Blood-pressure is less, and the Circulation casier. The 'Changes of Materials' in the body, increased now by the growth and the more active formation of substance, are thus made very easy in the body of the child.

With the time of puberty, with the beginning of the completion of the growth, these conditions are changed. The Heart increases to double its former size during these years, while the *growth of the Arteries begins to cease*. The consequence is an increased blood-pressure, and greater demands on the Heart. From birth to full growth the Heart increases to *twelve times* its original size, and the Arteries increase to only *three times* their original width.

The whole growth in the years of development is—

Height: (on an average) 1.17 fold

Weight: (on an average) 1.42 fold (Quetelet, Key, Beneke).
Volume of the Heart (on an average) 1.63 fold
" " " Lungs " " " 1.92 fold (Beneke).

According to Beneke the extent of growth averages—
during the period from 7 to 14,
for the Heart, from 5.6 to 7.5 ccm. annually;
for the Lungs, from 50 to 45 ccm. " ;
in the years of development,
for the Heart, from 19 to 30 ccm. annually;
for the Lungs, from 100 to 140 ccm. " .

From these facts it is clear that, physiologically, the most marked characteristic of the years of puberty is the enormous relative growth of the Heart and Lungs.

3. *The time during which youth changes to mature manhood, from 20 to 30.*

In these years full growth is accomplished, first as regards height, and then as regards breadth, the latter being particularly noticeable. This progress is generally complete in the female sex sooner than in the male, just as, in that sex, sexual maturity generally occurs sooner. The skeleton now receives practically its final development. The Ligaments are in the fulness of their elasticity, the movements are lightly and skilfully performed, the Muscles are vigorous, the joy of living and a daring amounting to rashness are at their zenith.

4. *The time of full vigour in man and woman, from 30 to 40.*

After the skeleton has almost reached the fulness of strength, and the Muscles have almost reached the perfection of development, the physical powers are at their highest. The body is never better fitted than now for feats of strength, whether momentary or of long duration.

Let us now briefly compare the effects of various forms of Exercise, according to the different times of life; let us thus see how best to distribute the various Exercises. In the course of this enquiry we shall briefly touch upon School-life, as well as on different occupations at later stages in life.

## PERIODS OF LIFE.

Dr. Schmidt asserts that 'the Ligaments, on the other hand, 'become stiffer, the Joints less capable of supple movement, 'the quality of Strength comes into the foreground instead of 'the quality of Skill, which latter is no longer capable of further 'development. Speed is also already on the decline'.

This I consider to be a very great error. I do not in the least see why skill should not increase very greatly after the age of 30. It is fairly easy to acquire fresh positions for the Feet etc., and fresh Muscle-Movements, one by one, which, when acquired one by one, can be combined. How this can fail to increase Skill, I cannot see. My own case is interesting. At 27 I had hard walls to my Arteries (this Dr. Schmidt assigns to the age of 40 to 60): I then changed my Diet, and my Skill at Games (e.g. at Rackets, Tennis, Lawn Tennis, etc.), and my general activity and endurance, have improved very steadily since. At the above-mentioned three Games I have certainly advanced considerably in the last two years, * i.e. between 30 and 32: if I do not advance still further, it will surprise me very much. I can therefore confidently contradict Dr. Schmidt's statement, and I say that, even if you have learnt a Game wrongly and played it wrongly all your life, then 30—40 is by no means too late for you to begin to learn it in the right way. If you are slow in starting, then 30—40 need not be too late for you to acquire quickness, if you are only content to Diet yourself carefully, and to do the right Exercises.

5. *The years of over-maturity, from 40 to 50.*

After the 40th year (in some cases sooner, in others later) peculiar conditions are wont to set in, making the walls of the Arteries harder, and so lessening the power of exertion on the part of the Heart when it is put to a strain by movements that need Strength and (more particularly) Speed. Exhaustion of the Heart and of the Lungs (i.e. breathlessness after exertion) sets in sooner than before.

This is more marked when the Fat, which increases in the Skin and Intestines during these years, becomes excessive. It is now more and more necessary to keep to the law of moderation in everything. This holds good of physical exertion more especially; for a moderate demand on Strength, Speed, or Endurance, can be well answered, whereas over-exertion in any of these directions is seldom borne without actual danger

* See the accounts of Tennis Matches in *The Field*, *The New York Herald*, *Outing*, etc.

to Health. In the female, the period between 45 and 50 is often accompanied by many Health-troubles.

From the consideration of further change and decay in old age we may well refrain in this book.

GENERAL NOTES.

In the Growth-Period, it must be remembered that the child grows in *Length* before it grows in *Breadth*.

Secondly, its larger Muscles develop before its smaller Muscles: the Shoulder before the Arm, the Arm before the Wrist, the Wrist before the Fingers. Hence to Exercise the Fingers in early childhood is a grand error. And yet, so unscientific is Education wont to be, it is common to see quite tiny children taught to use their fingers (in writing, sewing, piano-playing, etc.) long before they are taught to use their Shoulders or their Arms. In these years (as the able Article in the 'Forum' points out) the writing should be with huge letters—e.g., on a Blackboard. The Shoulder and Arm should be used more than the Fingers.

Small and fine work should not be attempted now. Things should be on a large scale.

The *young* should have Exercises in Quickness and Speed, and Simple Exercises: this is therefore *the* time for acquiring those Foundation-Positions and Foundation-Movements, of which I have already spoken. These could be arranged as a sort of game, with singing; for Rhythm is a great help. It is vital to remember that the young object to *repeating* Exercises far less than older people do.

The *young* should also have a great deal of Exercise that is not merely Quick and Simple, but also *Happy* and Varied. Games, especially those with plenty of Running and 'Chasing,' are most excellent for this reason, and also because they give intervals of rest.

For the young, Exercises of Endurance (e.g. Long Walks), Exercises of Strength and Strain (e.g. Weight-lifting), and most of the Complicated Exercises, are out of place. Long drudgery is necessary: but it should be lessened as far as possible by Music etc.

In *middle* life there should be less Speed, and more *Endurance* and more *Strength*. The Simple and Varied Exercises should be continued, but they should also be *Combined* in more *Complex* Exercises, such as Lawn Tennis or Cricket involve. Skill should come to the front.

Games are of great value here as well as in the earlier years: but here there may be more specialisation. One or two Games should be taken up as specialities, and *especially* those Games (such as Squash Tennis, Lawn Tennis, and a little Golf) which can be kept up till quite late in life. They should be *begun* before they are absolutely 'necessary'. For, if this is done, if the foundations are laid now, the Games will be a far greater pleasure as life goes on beyond prime. Increasing Experience will do a great deal to make up for the decreasing Activity. Mr. G. E. A. Ross, the Tennis-player, occurs to my mind among those players who keep up their standard of play in spite of advancing years and decreasing activity and endurance, because they have laid good foundations in earlier years. 'W. G.' among Cricketers, and the father of the Allen brothers among Lawn Tennis players, also suggest themselves.

As age advances, the Exercise should be less and less Quick, and probably less and less Varied. A few quiet forms of Exercise should be adhered to as a rule, with intervals of change, however. There should be less Exercise in Speed and in Strength: whereas quiet Endurance (e.g. a long and moderate-pace Walk) and more Complicated Exercises (e.g. a Four at Lawn Tennis, or a round of Golf) are in keeping. Billiards is good as a quiet Exercise, with digestive and other advantages; but the Billiard-room should always be the best-ventilated room in the whole house. It is usually the very worst, for its gas alone makes the air bad enough to satisfy the very poorest family in the slums.

In old age it is a grand error to decrease the Exercise and to increase the Food and Stimulants. The Exercise should be abundant, though very quiet and with intervals of rest, and the Food should be gradually diminished and, if possible, simplified.

## NEED OF EXERCISE IN EARLY SCHOOL-LIFE.

The growing child needs above all things *a stimulus to growth; and this is given by movements* which stimulate and quicken the Circulation. These Movements should be *distributed* as widely as possible, and should not tax or strain separate and special and small Muscle-Areas. For we have seen that Local exercises of Strength soon exhaust a Muscle's store of energy (and this is the case still more with the weak undeveloped Muscles of a child) and then call upon the reserve-substance of the tissues. But the growing child stands in pressing need of these very same reserve-stores for the growth and the building-up of the body.

Thus for children severe muscular exertion has not, as for the adult, increased Strength and bulk of Muscle as its first result, but rather a hindrance to growth and to the whole process of nourishment. Children who have been too early trained to Gymnastic feats are generally far behind others in growth, proper development, and nutrition.

This is a familiar experience.

Further, the peculiar influence of School-life comes into the consideration. The many sedentary hours of School to which the child is tied down, from its 6th year onwards, are not without their effect, especially on the Organs of Breathing and Circulation; and, with these, on the formation of blood.

Breathing is impeded by *the sitting still* at a School-desk, and it becomes chiefly Abdominal, i.e. a Breathing with the *lower* part of the Lung alone, while the important process of Chest-Breathing, the ventilation of the apex of the Lung, is almost discontinued.

Similarly, any strong stimulus to the Circulation is lacking, especially that which is given by deep Breathing and abundant movement of the Muscles. The Heart, therefore, finds its work far more laborious.

Another influence against the formation of blood and the 'Changes of Materials' in the body, is the atmosphere of the Schoolrooms, which, especially when the rooms are small and insufficiently or unscientifically ventilated, is often simply execrable, and cannot be compensated for by the fact that the learner now knows the name of the Capital of Rutlandshire!

In fact, poverty of blood and Anæmia are a very common malady among School-children, and often continue in later life.

And so the best Exercises for School-life will be those in which *plenty of movement is distributed over large masses of*

*Muscle:* Exercises which have a strong stimulating effect on Breathing and circulation. And these *are Exercises of Speed.*

*Gymnastic Exercises on the spot would lack the proper effect on Heart and Lungs;* the same is the case with Exercises with apparatus, with the further objection that the chance of strain is far from remote, when they are performed by unskilled and inexperienced children.

The best forms of Exercises of Speed are *par excellence* the Games that involve movement.

First of all they give the strongest impulse to movement by the tonic effect of pleasure on the Nerves; and then, unlike Exercises of Speed 'at the word of command', they avoid the extremes of under- and over-exertion. The child who has run about till he has reached the limit of the power of his Lungs and begins to lose his breath, stands still and lets himself be caught. (This is rather doubtful in Games: the reverse is often the case, viz., that the child who would stop if there were no Game goes on too long because he or she wants to win. E. H. M.)

Moreover, the size of the Heart as compared with the size of the Arteries in the child fits him very well for Exercises of Speed, and enables him to recover extraordinarily quickly from loss of breath. To race and run for hours together, as a child easily does in Games, is a feat no longer possible to the adult; in him the conditions of blood-pressure have become quite different.

Another point in favour of Running-Games in the early School years is that they leave scope for the child's own free will, so that there is not the routine of dull discipline.

Games should be pursued in the open air as often as possible. Every person of experience knows that the best kept and best ventilated Room or Gymnasium cannot make up for the loss of the effect of open air and sunlight on the 'Changes of Materials' in the body and the formation of blood. The effect of Light alone is being realised more and more every year.

Of course for wet weather well-lighted and well-ventilated rooms will be indispensable: but even here I believe that Open-air Exercises, with bare feet and bodies, in a special fenced-in meadow, would be of enormous value, *if* they were gradually led up to by bare-foot Walking and Air-Baths. I believe that those who hardened their bodies thus while they were young would seldom or never suffer from chills and colds as they grew older. (E. H. M.)

NEED OF EXERCISE FROM 9 TO 14.

From the 9th to the 14th year growth must be 'stimulated', and the hurtful effects of sedentary work in School and at home must be counteracted: these are pressing necessities of Health.

The value of Exercises of Speed remains the same, except that Games become more varied and begin to give motives for developing skill and readiness, as well as opportunities for movement, and much pleasure.

The Games of Ball are legion, and need not be mentioned here. It is a pity that Rounders is not commoner in England. It is also a pity that Cricket is not more *adapted to the sizes and ages of the young players.* On Parker's Piece at Cambridge, for example, I see little boys of 10 playing with full-sized bats and balls, and with the wickets at the regulation distance of 22 yards. This is ridiculous—nay, more, it is dangerous. The strain of bowling a good length ball under these conditions is very great. I should like to see the managers of these Games (Schoolmasters, etc.) introduce the smaller ball, the smaller bat, and the shorter pitch. Everything can be in perfect proportion and quite 'regular', so as not to 'offend the susceptibilities of the young.'

Not only Games, but also systematic Exercises in Running take their rightful place here: chief among them is the long-distance run at a moderate pace, the length being increased by cautious degrees. Moderate exercises of Endurance, in the form of Walking-tours, *if* they can be made enlivening without being too fatiguing, are now of growing value.

From the 10th year, *Swimming* is borne without injury if it is not practised or persisted in to excess. And in winter Skating is most excellent.

In Gymnastic Lessons proper, the chief point is to acquire a correct carriage of the body and to develop a free graceful walk by Exercises in Walking, Running, and Jumping. Next, skill is developed by free Exercises with Weights (light Dumb-bells or sticks) held in the hands.

Of Exercises with Apparatus, the easier Exercises of Skill on the Parallel Bars, Horizontal Bar, Ladder, Climbing-pole, Spring-board, Horse, etc., are all suitable. On the other hand, Exercises which are rather Exercises of Strength, and thus impose a strain, should be avoided. The real value of exercises with apparatus does not begin to tell fully until the skeleton has become stronger and the Muscles better fitted for exertion, i.e. until the beginning of the 12th year. The Gymnastic practice of Walking, Running, and Jumping certainly stands in the foreground as most important and beneficial at this time of life.

### NEED OF EXERCISE IN THE TIME OF DEVELOPMENT (FROM 14 TO 20).

In the years of development Exercise is important in two respects. Firstly, the vast growth of Lungs and Heart now takes the foremost place in the processes of growth. These Organs need a very vigorous 'stimulation' to growth. The Quick Run now takes its rightful place beside the more extended long-distance run, and Walking-tours may be partly accomplished in quick marching time; but exhausting feats, and especially exhausting feats of Endurance, are still hazardous, and should be avoided.

These years, however, are especially good for Exercises of *Skill*, whether they be the Foundation-Exercises combined with one another, or more intricate Exercises of smaller Muscle-Areas—e.g., of the tourist. In fact, at this age it is only the trying Exercises of Strain that need be avoided.

It is here that Football, Cricket, Fives, Boxing, and other Ball-Games are most appropriate. I should suggest also the Punch-Ball as good for wet days. Almost every Ball-Game is to be recommended.

Girls should most certainly practise Lawn Tennis or Fives or Squash-Rackets or Squash-Tennis (e.g. up against a wall).

Of course Matches help much: they are a grand incentive for self-improvement, to say nothing of their moral and social effect.

In England we are wont to trouble little about what the boy or girl is going to do or be in after-life: and yet this age is none too early for the question to be considered. If the boy is going to lead an active life (e.g., with lots of Games or outdoor sport), then he should receive a special training to develop suppleness and skill.

For the handicraftsman, the mechanic, the merchant, the clerk, whose days are passed in the workshop, the factory, the counting-house, or the office, what is especially necessary is Exercise of Speed and Endurance in the open air. Our social habits, the extension of working hours to the fall of darkness, the unsatisfactory kind of 'recreation' to be had in the bars of public-houses etc., still run too much counter to this demand.

But the movement in favour of afternoon and evening exercise on certain days of the week, is spreading rapidly in England and in America.

Mere Gymnastics will never be enough for the 'Sedentary' Classes; Games, Running, Walking, Cycling, Boxing, etc. should be added. If only the 'Sedentary' Classes would realise the value of such Exercise, even for the quality of their work itself, they would surely alter their ways of spending their evenings. But the following point is to be remembered also.

As has already been explained, mental work continued for several hours is wont to affect the motor Nerves and the Muscles: these may become less responsive to 'excitation' and may lose the power of instantaneous action. Thus a larger amount of Will-power has to be used to perform arduous physical movements than when the mind is perfectly fresh. A schoolboy with four hours of severe mental labour behind him is not ready for Gymnastic Exercises which demand tension and Will-power: he cannot bear them without finding them a further tax on his tired Brain. In such cases Gymnastics and Exercise should be a relaxation: the Half-automatic movements of Walking, Running, etc., and, above all, Games, are here in place.

But since we cannot give up the important physical Exercises which develop attention, will, and Skill, all such Exercises must not be relegated to the fag-end of many hours of mental exertion. The pupil should enter on some part of it at least with full vigour and capacity. Otherwise Gymnastics and Exercise are apt to be no relief, but a tax upon the Nerves.

NEED OF EXERCISE FROM 20 TO 30.

The years between 20 and 30 form that period of life which allows the greatest feats in Speed, Skill, Promptitude, and daring. The culminating point of Speed is indeed reached somewhat earlier, at about 17. It is almost a matter of indifference now, as compared with other times of life, whether the individual gives the rein to his own particular preferences or not: whether he gives the first place to Gymnastics with Apparatus, or whether he prefers Football, Cricket, Rowing, or Cycling. This must not be understood as licensing a one-sided pursuit of Physical Exercise: it only means that at this time the consequences to Health are less serious.

Excess will bring its own punishment, whether it be excess in Speed, in Endurance, or in Strength and Straining. Over-Training also is not without its dangers, however much we may admire its moral effects.

A very vital point should not here be omitted. The excess, whether it be in exertion or in other directions, does not necessarily begin to tell at once. There are some who have defied the laws of Health for years. It is one of the greatest mistakes on earth to assume that Excess has no ill-effects because the ill-effects do not appear at once. I should say that, in average cases, they would hardly appear before the age of 25 or 27 or even 30. The man who habitually over-eats and over-drinks and smokes his dozen or more cigarettes, day after day, need not find his Games or his physical fitness suffer for it till he is the above age. With an exceptionally good constitution the bad results may keep off even till 15 or 20 years later. But I would ask such people to consider a few points:

(i) think of the Brain as well as of the body. I have studied many such cases, and I have found that the standard of Brain-work is *generally* despicably low;

(ii) think of the years when the prime is over, and you will long for your good Health in vain; it is a pity to sacrifice perhaps thirty years for the sake of five;

(iii) think also of the example. *You* may be able to play Games in spite of excesses, but if others try to imitate you, it may be their ruin. I have seen hundreds of instances of this.

### NEED OF EXERCISE IN THE YEARS OF FULL VIGOUR.

From 30 to 40 the body is best fitted for feats of Endurance and Strength. Skill, on the contrary, declines or at least cannot be so much increased by Practice. Speed is also on the wane.

As I look round me in Cambridge or in London, or in New York, I cannot but think that instead of 'is' we must write 'should be.' A College Don or a business-man is not usually best capable of feats of Endurance and Strength between 30 and 40.

Of the extraordinary and fatal error about Skill not increasing after 30, I have already spoken. It is Practice of the right kind that will—nay, *must* increase Skill. I look forward to improving at Lawn Tennis more and more for another five years at the very least. [E. H. M.]

Fatness may now begin to develop, and Exercises of Strength and Endurance may attack this evil: they may melt and consume the Fat. Exercises of Strength, it must be remembered, involve some strain on the Heart. They are only too easy to carry to excess, and the lifting of heavy Dumb-bells, for example, may disturb the Breathing and Circulation, and the nutrition of the Heart, very considerably.

### NEED OF EXERCISE FROM 40 TO 60.

After the 40th year is past, the physical powers soon begin to decline. The Arteries become more rigid, and the Heart loses some of its vigour of action. If there is great Fatness (which is most apt to begin in the Intestines), the volume of Breath is limited because the movements of the Diaphragm are hampered. Hence all movements involving sudden and severe demands on the Heart and Lungs quickly cause these organs to fail, that is, they bring on Breathlessness. For this reason, *Exercises of Speed should be prohibited at this age.* It is the same with arduous Exercises of *Strength, the dangers of which increase* from this time onwards as far as the Muscle of the Heart is concerned. On the other hand, the capacity for Exercises of *Endurance,* such as vigorous Walking-tours, protracted Mountain-climbs, long spells of Bicycling or Rowing, is often present in a remarkable degree. The Exercises suitable to this age, so as to keep up the suppleness and flexibility, are easy kinds of Gymnastics with and without Apparatus, such as require no special dexterity or strain.

# PART VI.

## SUMMARY, AND FINAL HINTS.

# SUMMARY.

[BY E. H. MILES.]

PART I shows how the individual may learn and practise games and exercises. After the commonest faults have been pointed out, and some general pieces of advice have been given on p. 6 foll., we come to the method of practising 'Part-by-Part,' on p. 16 foll.

This is the general principle of learning, whether the subject to be learnt be essay-writing, or piano-playing, or a foreign language, or any form of game or exercise. Perhaps it is the most important section for athletes. It shows how the complex whole may be split up into simple parts—for instance, in Lawn Tennis and Golf. It urges the athlete to practise these simple parts one by one, especially at odd moments. The Second Appendix, near the end of the book, gives a few of these simple parts, which may be called Foundation Exercises for Games and Athletics. These exercises are suitable for all ages, and cannot be begun too early in life. To make the suggestion more practicable, a simple lesson is offered on p. 24 foll., and on p. 29 foll. the objections to this system are answered. And now the reader will see how to correct his faults. The method is explained on p. 23 foll.

Most people, under modern conditions, need a great deal of exercise, but they are often too tired to take exercise, or at any rate to take as much as they need, so on p. 35 foll. I have shown when exercise is least tiring. The laws are so little known that this section should be read several times.

Part II gives the advantages of games and exercises when they are practised rightly. But first of all it is necessary to expose certain fallacies with regard to games, and also with regard to the right way of practising them. It is shown that games and athletics are not only a single side of education, viz., the education of the body as well as its recreation, but that they are also an education for the intellect, the character, and so on. And the fallacies about the right way of learning them are also exposed. These two fallacies are the most fatal, since, if we imagine games to be not essential in an education, we are little likely to take the time and trouble to learn them properly. P. 48 foll. gives their advantages when rightly practised, and these advantages apply equally to games or to mere exercises, such as gymnastics. But on p. 55 foll. attention is called to a point often neglected, especially abroad, viz., the advantages of games over mere exercises, especially their social advantages, their commercial advantages (e.g. in teaching fair competition and co-operation), and the pleasure that they give, which has a definite chemical effect upon the blood. In fact, they are a more complete education than mere exercises. But the value of exercises (e.g. in supplementing games) is also emphasised.

A natural sequel to this section is the advantage of many special kinds of games (for instance Football or Fives), on p. 62 foll. Here also attention is called to the need for hanpicaps, so that any two players or teams may be brought together. Even Lawn Tennis has not yet a scientific system of handicaps. The advantages of special exercises are taken next (on p. 68 foll.): Boxing is among the best.

Thus far the work is almost entirely my own. The rest of the book, except the Appendices, is adopted, with additions, from the work of Dr. Schmidt.

Part III treats of bones and joints, and certain exercises of balance, etc. Pp. 75 foll. explain bones and joints rather by diagrams than by words. After this introduction, it is easier (see p. 86 foll.) to understand the principles of balance. Various exercises are suggested and various remedies for faults of balance. These apply not only to standing, but also to sitting. The right position for sitting becomes more and more important every year (see p. 101 foll.).

The chest and breathing are treated next, and in this section something is said about the corset, p. 114 foll. Then come the lower limbs and the exercises for them, (on p. 125 foll.). On p. 135 foll. the foot and the right kinds of boots or shoes and of stockings or socks are suggested (see p. 138 foll.). Pp. 142 foll. give the nerves and muscles in general, their action (p. 145 foll.), and their fatigue (p. 149 foll.). Athletes should all know the scientific facts about the waste-products which are the result of exercise, so that they may not only practise properly, but also breathe and eat properly.

The different classes of exercises for various members and organs are given on p. 155 foll. Pp. 164 foll. contain some statistics. A great deal is left to be told by illustrations, especially on p. 168 foll. On p. 176 foll. come the most important exercises for the abdomen. These exercises should be learnt and practised by absolutely everyone. At the end of this section the hand and arm are treated (on p. 183 foll.) chiefly by diagrams.

In Part IV we have the heart and the lungs, feeding and training, the nerves and nerve-fatigue.

P. 197 foll. describes the circulation, and the different uses of the right and left sides are shown on p. 204 foll. Then follow some details—for instance, about the pulse (on p. 211 foll.); and then come the effects of the state of the blood upon the state of the heart (on p. 220 foll.). The cause of heart-fatigue is explained on p. 222 foll. and exercises for the heart are suggested on p. 227 foll.

We come now to the lungs and breathing. After p. 235, when the nose is described as the right channel for breathing, breathlessness and its effects are treated on p. 240 foll. Then follow the effects of oxygen and of moist air (on p. 244 foll.), Tuberculosis (p. 247 foll.), and lung exercises (p. 249 foll.). Here the most important page is 255, where certain exercises are given to help correct breathing. This section ends with some notes about the skin (p. 257 foll.), and the clothing (p. 261 foll.). Colds, etc., and the use of various baths will be found mentioned on p. 264 foll.

We now pass to the subject of food, on p. 74 foll. The digestive organs and the digestive juices are described, and with the common principles of feeding is given a list of liquors, and of alcohol in particular, on p. 278 foll. The First Appendix deals specially with the question of food. On p. 282 foll., training is described as it should be rather than as it is. Principles are laid down, and means of reducing fat appear on p. 286 foll. The value of training is set forth on p. 288 foll. Then the nerves are considered, and the value of good nerves for promptitude. On p. 295 foll. is suggested the cause of nerve fatigue, and its effects on promptitude and rapidity.

Exercises for promptitude are given on p. 312 foll., where it is shown that some exercises must have been already made half-automatic in order that the full promptitude and rapidity may be assured. Brain-fatigue is described on p. 311 foll. and fatigue in general is illustrated by diagrams. A short account of the eye concludes this Part of the work.

Part V gives positions and movements, and special exercises for them. The positions and movements apply to standing, sitting, and moving, (on p. 337 foll.). Walking is treated on p. 343 foll., its effects on p. 348, and its various steps on p. 356. Walking with bent legs is shown to be far more valuable than the ordinary walking, at any rate for long distances. The system and its merits are outlined on p. 358 foll. Climbing and its effects, and various hints on climbing, will be found on pp. 367-378 foll.; running, on p. 380 foll.; the effects being illustrated by diagrams on p. 385 foll., and the advantages being enumerated on p. 389 foll. It is here shown how the changes in the body—for instance, in the relative size of the heart and arteries—must determine the kind of exercise which we should take (p. 389 foll.). Sprinting and running with bent legs come on p. 393 foll. Diagrams show the latter method and its advantages. Hints on running in races are concluded on p. 402, where the value of running in games is suggested. Then follow Jumping (p. 403 foll.), and Pole Jumping (p. 414 foll.). Throwing and bowling begin on p. 418 foll. They include Putting the Weight, Throwing a Hammer, hurling a spear, and Quoits. The value of throwing is estimated on p. 427 foll. P. 431 foll. deal with Swimming, p. 239 foll. with Rowing, p. 445 foll. with Cycling, and p. 458 foll. with a few hints on Ball Games. The eye, in the sense of 'a good eye,' as distinct from mere eyesight, finishes up this section on p. 460 foll.

At the end of this Part (p. 464 foll.), will be found the exercises appropriate for different times of life; the earliest years requiring many exercises of speed, and the latest years few moderate exercises of no great speed or endurance or strength. But the need of exercise throughout life is emphasized on p. 468 foll.

Part VI, which is the present Chapter, gives a summary, and some final hints, which will follow directly.

The First Appendix is on the proper diet for training, a subject which has been dealt with more fully and with full answers to objections elsewhere (in 'Muscle, Brain, and Diet'). The Second Appendix outlines some foundation-exercises for games and athletics—for instance, the twisting of the body upon the hips. The Third Appendix is the most important of all, and treats of the art of relaxing and reposing, an art more neglected to-day than the art of exercising is, yet really an integral part of physical training.

### FINAL HINTS.

It may be as well to sum up the most vital principles of advice which I can offer as to the training of the body.

Lay the correct foundations of exercise carefully, when you are young. Pay especial attention to the breathing, which should be tried with exercises. See that the large muscles work well and easily; an example would be the turning of the body, in various directions, on the hips. And practise promptness also: for instance, exercise so that you can start on your toes in any direction at a moment's notice. These, and the many movements recommended in the book, can all be practised at odd moments of the day. See Appendix II.

Afterwards, these correct foundations can be tested by games and athletics; but the exercises should still be continued, so that they may supplement the games. First, many forms of sport should be tried, though not to excess; then a few should be chosen, and these should gradually be made hobbies. Games and athletics should be a real hobby throughout life, for the reasons that I have given in Part II. Their ideal should be rather self-improvement than victory over others. The best games and athletics are those which are played in the open air.

Fresh air is especially valuable in the early morning, when air-baths and light-baths should be taken daily, combined with exercise and massage.

Sleep, again, is another necessity for health, and among the best means of inducing sleep are cold water and hot water, used alternately.

Water should be drunk in the early morning and late at night; although, for the early morning water, fruit may be a good substitute.

But the most important help to health, because it is easiest to regulate, is the diet. Some of us have more control over what we eat and drink than over any other part of our daily lives.

First and foremost I should urge that every one should try the fleshless foods, to find out whether they suit him or not. Let him be sure to take enough proteid. He will probably find the milk-proteid to be the best; perhaps partly because it lies between the animal and vegetable worlds, without having any of the disadvantages of the flesh foods. Each person should allow a fairly long trial, let us say for four weeks, adopting the simpler foods at first for lunch or breakfast. He must not condemn them until he has tried them, if it only be for the sake of economy. Partly for the same reason, he should also give up stimulants. I have recently made a long experiment with stimulants, but I cannot say that they have done me any good in any way, except that they have convinced me that every form of stimulant is a mistake.

These seem to be a few of the main laws of health. The details will be found in the pages of the book itself.

# APPENDIX I.

## FOOD FOR TRAINING.

[BY E. H. MILES.]

A SPECIAL work on the subject of Food * enters into the details of this most important topic. So here I need only give a few notes, especially with a view to answering criticisms which reviewers have kindly offered to this work. I wish to thank them here for their valuable suggestions.

Interest in the food question is extending gradually all over the world. The Americans are as keen on it as the English are, and I have constantly received inquiries from all parts of the United States and Canada.

The present training-table is expensive, it may cost from $7 to $8 a week in America, and perhaps a pound or thirty shillings a week in England, for food alone, even when a number of men feed together and thus lessen the prices. This expense is chiefly due to the flesh-foods (fish, flesh and fowl), which Dr. Schmidt recommends as indispensable. It was on these foods that I used to train till a few years ago, when I adopted the simpler or fleshless foods.

The flesh-foods seem to me to be against Science, wherever Science speaks with authoritative voice. They are against chemical analysis, which has never yet proved that we need the waste-products which are to be found in flesh, and which proves that the fleshless foods, if eaten properly and in proper proportions, contain all the elements that the body and brain require. But it is chiefly personal experience that has led me to recommend the simpler foods as worth trying; for during all these years I have kept in incessant training without having to give up work. My training has been so constant that I am always ready to play a match, even if I have had no exercise for a week. At Brighton I played a hard match, then had a

* 'Muscle, Brain and Diet.' (Sonnenschein, London; and the Macmillan Company, New York.)

week of sedentary work of perhaps eight or ten hours a day, and then I had three or four hours of hard match-playing in one day at the end of the week, without feeling tired; besides, my standard of play has improved.

Nor have I found the American climate to make the flesh-foods necessary. In Montreal, New York, Boston, Philadelphia, and Tuxedo, during the terribly severe winter, and the terribly hot summer, I did not deviate from fleshless foods, and I see no reason why I should have done so.

The fact is that *very little is known* on the subject at present, *certainly not enough to warrant emphatic general assertions such as Dr. Schmidt and many others make.* We know that *some* Proteid is essential to life, and so far I quite agree with them. But when they say that it is better to take this Proteid in the form of Flesh-food, Science and the experiences of myself and others flatly contradict them; when they say that you *must* take Meat to get Proteid, even their own Tables of Food refute them.

My general objections will be found in 'Muscle, Brain, and Diet'. Here the reader must be content with a bare outline.

Let me begin with **the A B C of Food-Education.**

1. When the nourishing material which we take into our bodies exactly corresponds to that which we have used or given out—for we give out a great deal that we have never used at all—then there is said to be a balance. The new nourishment helps to re-build the worn-out tissues, and to supply energy, etc. It is important that we should try to find the balance by *prolonged* personal experience.

2. But *the amounts* which are used up *differ at different times:* thus

*a.* in cold weather we use up more fatty and starchy and sugary materials. Harder exercise and harder brain-work also use up more Proteids etc.;

*b.* during the period of growth and 'filling out' we need a great deal of extra food to help us to grow and 'fill out';

*c.* the size of the body, and the conditions of its health, etc., make a great difference;

*d.* Habit—a factor little taken into account by theorists—has much to answer for. If we get into the habit of eating three times as much as we need, and still feel not up to the mark, we may be inclined to think that we are taking too little! There will be a dreadful habit of excess, and not only this, but the overtaxed organs of digestion and of excretion (e.g. the kidneys), will be tired. To do their work they will seem to need a stimulant of some kind.

*e.* Foods, again, affect one another. Experimenters with test-tubes and human stomachs, stomach-pumps being used, have said that tea, for example, prevents about a third of our Proteid from being used as nourishment at all.

3. If we had a balance, however, for ordinary occasions, it would still be necessary to find out the best foods. Let us for the present accept Dr. Schmidt's amount, which seems to me likely to err on the side of excess.

He says:—'It has been proved by experience that the best Mixed Diet is that in which from 3½ to (at most) 4½ parts of non-Proteid substances are allowed to one part of Proteids.

'In callings which require very little physical exertion *the need of food would be correspondingly less; and this is very noticeably the case in advanced age.*'

Now, *if* you needed 4½ *ounces of Proteid* a day, and *if* you were an average individual taking a good deal of exercise, you would then need, according to this, about 18 *ounces of starchy or fatty foods.* Water, 'Salts', and fibrous matter, would be easy to add.

*But in what form had you better take these?*

Here is your Table, and you will see that at present the choice appears large.

# TABLE OF FOODS (Dr. Schmidt).

| | I Water | II Albumen or Proteid | III Fat | IV Carbo-hydrates | V Chemical 'Salts' | VI Fibre |
|---|---|---|---|---|---|---|
| I. ANIMAL FOODS. | % | % | % | % | % | % |
| 1. Lean beef. | 76·5 | 21·0 | 1·5 | — | 1·0 | — |
| 2. Very fat beef. | 55·5 | 17·0 | 26·5 | — | 1·0 | — |
| 3. Lean veal. | 78·0 | 20·0 | 1·0 | — | 1·0 | — |
| 4. Fat pork | 47·0 | 14·5 | 37·5 | — | 1·0 | — |
| 5. Very fat mutton | 48·0 | 15·0 | 36·0 | — | 1·0 | — |
| 6. Game | 75·5 | 22·5 | 1·0 | — | 1·0 | — |
| 7. Lard | 0·7 | 0·3 | 99·0 | — | — | — |
| 8. Cod | 81·0 | 17·0 | 0·4 | — | 1·6 | — |
| 9. Herring | 46·4 | 19·0 | 18·1 | — | 16·5 | — |
| 10. Hen's eggs | 74·5 | 13·5 | 11·0 | — | 1·0 | — |
| 11. Cow's milk | 87·5 | 3·4 | 3·6 | 4·8 | 0·7 | — |
| 12. Butter | 14·5 | 0·6 | 83·3 | 0·6 | 1·0 | — |
| 13. Some cheeses. | 43·2 | 27·2 | 23·7 | 1·5 | 4·4 | — |
| II. VEGETABLE FOODS. | | | | | | |
| 1. Fine wheaten bread. | 36·0 | 7·0 | 0·5 | 55·2 | 1·0 | 0·3 |
| 2. Rye bread | 42·0 | 6·0 | 0·5 | 49·5 | 1·5 | 0·5 |
| 3. Beans (and peas) | 14·0 | 23·0 | 2·0 | 53·5 | 3·3 | 4·0 |
| 4. Rice | 13·6 | 8·0 | 1·0 | 76·5 | 1·0 | 0·5 |
| 5. Wheatmeal | 13·0 | 10·0 | 1·0 | 75·2 | 0·5 | 0·3 |
| 6. Potatoes | 75·5 | 2·0 | — | 20·7 | 0·8 | 1·0 |
| 7. Spinach | 88·0 | 2·5 | 0·5 | 6·0 | 2·0 | 1·0 |
| 8. Root vegetables (carrots etc.) | 88·0 | 1·6 | — | 9·0 | 1·0 | 1·0 |
| 9. Salad | 94·0 | 1·5 | 0·5 | 2·0 | 1·0 | 1·0 |
| 10. Fresh fruit | 85·0 | 0·5 | — | 10·0 | 0·5 | 4·0 |
| 11. Vegetable oil (olive). | 1·0 | — | 99·0 | — | — | — |
| 12. Nuts | — | — | — | — | — | — |
| 13. Gluten of wheat | — | — | — | — | — | — |

| | Of the dry Substance | Of the Albumenoid Contents | Of the Carbo-hydrates |
|---|---|---|---|
| | % | % | % |
| 1. Meat | 5·3 | 2·6 | — |
| 2. Eggs | 5·2 | 2·6 | — |
| 3. Milk | 8·8 | 7·1 | — |
| 4. Milk and cheese | 6·4 | 3·8 | — |
| 5. Peas | 9·1 | 17·5 | 3·6 |
| 6. Macaroni rich in albumen | 5·7 | 11·2 | 2·3 |
| 7. Bread of the finest flour | 4·0 | 20·0 | 1·1 |
| 8. Bread of coarser flour | 6·7 | 24·6 | 2·6 |
| 9. " " " " | 12·2 | 30·5 | 7·4 |
| 10. Maize | 6·7 | 15·5 | 3·2 |
| 11. Rice | 4·1 | 20·0 | 0·9 |
| 12. Crisped cabbage | 14·9 | 18·5 | 15·4 |
| 13. Carrots | 20·7 | 39·0 | 18·2 |
| 14. Potatoes | 9·4 | 32·2 | 7·6 |

This Table will show you that you have your choice: will you take your **Proteids**

(a) from *Milk and Milk-Products* (of which 'Protene' Biscuits may contain 60 per cent., and some Cheeses 30 per cent.); or

(b) from *Pulses*, such as peas, lentils, and some beans, (which may contain over 20 per cent.); or

(c) from *Grains*, such as wheat and wheat-products (Hovis or Graham Bread and Gluten Flour are among the very best), oats (e.g. oatmeal porridge), barley, etc., (which may contain 10 per cent. and over); or

(d) from *Nuts*, where, however, as in the case of Grains, the Proteid (over 15 per cent.) is as a rule, not all digested (except in such foods as those of the Sanitas Food Company, of Battle Creek, Michigan); or

(e) from *Roots*, e.g. potatoes and turnips: but these are very very poor in Proteids; and so are

(f) most *Leaf*-foods or Vegetables, e.g. lettuce, cabbage, etc.;

(g) most *Fruits* are poor in Proteids also: Bananas are among the chief exceptions?

Or will you get your Proteids *indirectly*,

(h) from *Flesh-Foods* (fish, flesh, and fowl) which contain Proteid richly (20 to 10 per cent.)?

Here is a great problem that has vexed mankind for ages. Let us clear the ground by saying something which Science dictates with no uncertain voice.

4. 'Water we must have,' Science says, 'and also *some* "Salts", and *some* fibrous matter to give bulk. Fatty and heating substance we must also have, but most of us possess stores of this inside us, and for long periods of time we can use up our very selves: we can burn up our own fat. *But*,' she says, **'Proteid we must have, or else we die.'**

Michael Foster, Bunge, Gamgee, and the other high authorities, are all agreed here.

Now is it better to get this Proteid, let us say 4½ ounces a day (so as to err on the safe side), from the Milk-Pulse-Grain-world, or from the Flesh-world? *If from the former, then we might well live on less than three pence a day;* but does the latter add anything vital? Or does it add anything injurious?

Let us remember this: fatty and heating substances, fibre, 'Salts', water—all these are easy to get: but whence shall we get our *Proteids?*

Let me offer a few considerations.

Once I used to get Proteids—without which I should have died—chiefly from Flesh-foods. I began to suffer from depression, head-aches, increasing tiredness after hard exercise, constipation, and albuminuria: the latter made it necessary for me to give up Alcohol, but I felt a strong liking for it, and the struggle was hard. I was fond of what was called 'good living'.

Then I tried the Simpler or Flesh-less Foods. Before long, away went my depression, my headaches, my tiredness after hard exercise, my constipation, and—the symptoms of albuminuria. Away went my desire for Alcohol too.

This is not all: though I was over 27, and am now over 32, my activity and litheness increased, my skill increased (as my games show), my Food-expenses went down; I had more time to spare; I felt more inclined for work. In fact, since then I have worked almost incessantly. Above all, I was (and am) as near to being happy as ever I expect to be. Physically, intellectually, morally, and economically, my condition has improved.

For over four years I have lived almost without Flesh: when I have returned to it, partly as an experiment and partly owing to exhaustion (for I used every now and then to take too little Proteid, through ignorance), back have come *all* my old symptoms. My power of work, even my skill at games, goes rapidly down: and back comes the liking for Alcohol.

Let the reader bear in mind that I am in constant physical training: I will play the hardest Tennis or Racket Match at a day's notice (see above). But all the time I am hard at work with my brain. At Cambridge University I coached over 200 Honours candidates in various subjects, besides writing articles, writing books, and reading articles and books by the score.

I do not stand alone: on my side stand many of the old Greeks, including the greatest (perhaps) of all of them, Epaminondas, and including (practically) the Spartans and Athenians when they were their best. On my side stand the sturdy Roman and English commoners when they were at their best. On my side come thousands of others in many countries and in many ages.

What do I live on, you will ask?

For Breakfast I like 4 or 5 Milk-Proteid biscuits *; for Lunch some Hovis or Graham Bread and plain Cheese and Fruit; some Gluten Biscuits (see 'Muscle, Brain, and Diet') in the afternoon; and in the evening let us say peas or lentils, stewed fruit, bread and cheese, and fresh fruit. This is my most luxurious fare. For some menus see the above-mentioned book.

And do I enjoy it? I, who have gone through many great and splendid dinners—including City Dinners and Dinners in College Halls,— I give my word of honour that I enjoy the very taste of these present meals far more.

I grant that many 'Vegetarians' have failed and broken down: but let us see why. Let us look at Dr. Schmidt's example of 'the enfeebled workman whose staple diet is potatoes and butter'. Why should he feel 'failing energy'? Why, probably because he does not, by this Diet, get enough Proteid (? $4\frac{1}{2}$ oz.). Potatoes contain about 2 per cent., and butter less than 1 per cent., as Dr. Schmidt's own Table shows. Besides this, those who adopt a fleshless Diet are for the most part invalids. They start at a disadvantage, and often start quite rashly and unscientifically.

But this is no proof that a Diet of good bread, peas, lentils, cheese, milk-proteid. nuts, etc., should be inadequate. I have known *no case* where a Diet including these things has failed: I have known many cases where it has succeeded. At least it is very cheap, and, if the best foods for *the individual* are chosen and are *eaten slowly* and at the right times, then they might well suit *most* people.

In no case has anyone the slightest right to decide against the Simpler Foods unless he has given them a fair trial *in his own case*—and 'fair' includes 'having the proper amount of Proteid'.

Let the reader study the Table above, and try to get his $4\frac{1}{2}$ ounces (or less) from the Simpler and Cheaper Foods. Make the experiment for a fortnight: eat slowly, and, at least to begin with, discard those foods which disagree with *you personally*: perhaps sugar or oatmeal may, perhaps cheese may, —I cannot possibly say beforehand.

* I know of only two English Companies that sell Milk-Proteid; though I should be glad to hear of others. The Protene Company is in Welbeck Street, and the Plasmon Company in Duke Street. Protene Foods can be obtained from S. S. Pierce & Co., of Boston, Mass., in America.

Above all, be sure to take enough 'Proteid'.

Dr. Schmidt rightly speaks of *the Waste-products as one cause of fatigue;* now the flesh of animals is likely to contain similar waste-products. Surely, then, if we eat flesh, we shall be adding the animal's waste-products to our own, shall we not? Why else should I invariably feel pains in some of my joints (e.g. in my legs) when I eat Flesh-foods, but not otherwise?

Pulses, grains, and nuts, however, seem to have no such waste-products. Chemical Analysis shows them in the Flesh-foods, but not in the Simpler Foods. The Simpler Proteids have none.

Therefore, I would say, try these Simpler Foods. But do not call them 'Vegetables', as many do, or else you may forget that the Simpler Foods include the pulses and grains. Do not think of 'Vegetarianism' as 'a Diet of Vegetables'. The name is bad, for it *must* suggest Vegetables, and Vegetables only, to nearly every outsider. Consider the Diet as 'the Simpler and Cheaper Foods', including Vegetables as one part.

And now as to some **details**.

1. Do not be misled by the word *Nitrogenous*. Urine is to some extent Nitrogenous, but it is not nourishing; it is not Proteid. Beef Tea and many Meat-Extracts are to some extent Nitrogenous, but they are not nourishing; they are not Proteid,

The fact is that '*Nitrogenous' has two senses*, one of which is that of Proteid or Albumen, i.e. nourishing and *essential* food, while the other is that of a different element. This second kind is stimulating, and is very closely akin to Urine.

So far as I can tell from personal experience, the Chocolates I have tried do not contain any great amount of Proteid, but are mostly Nitrogenous in the second sense. This second kind of 'Nitrogenous' substance is *not* essential to human life: Proteid *is*. This second kind, however, may have its value, *a.* in emergencies, and *b.* in the absence of other known remedies.

2. For *fat* we may substitute an increased amount of Carbohydrates (*starch* etc.) to produce heat and force, and, on the other hand, fat may be substituted for these. The amount of Food-stuffs may vary occasionally as far as the amount of fat and Carbohydrates is concerned, though the Diet must never fall short in Proteid. If you want to get rid of fat, don't eat

fatty or heathing substances (such as starch and sugar). Burn up your own store by degrees.

It must be noticed that sugar has not the same effects as starch, at any rate in all cases; it almost invariably disagrees with me, whereas starch (when I eat it slowly,) practically never does.

3. *Cooking* is of importance with certain foods, e.g. with the grains. For instance, it is a mistake to eat porridge uncooked, for then it will probably remain undigested. But it is also a mistake to eat it very moist, for then one is only too apt to swallow it down without mastication and saliva. Good Cooking will actually help the digestion; e.g. it will excite the saliva.

4. *Drinking during meals*, especially the taking of cold or iced drinks, is bad for many reasons. Drink at least half an hour before, or at least 1½ to 2 hours after, a meal. The flood of cold water *during* a meal is apt to weaken the digestive juices, and also to lower the temperature of the stomach. To eat fruit at meals is quite a different thing.

"At the right time, the preference we feel for coolness in many kinds of drink may be safely satisfied. A drink of pure cold water has much the same refreshing effect on the mucous membrane of the stomach as a cold Douche has on the skin. But the ruling fashion or folly decrees that ices are an indispensable adjunct of a grand dinner, and people are hardly conscious of the extent of their perversity. To the above drawbacks we must add another; the sudden change from heat to cold makes the enamel of the teeth brittle, and hastens their decay." I quite agree with Dr. Schmidt.

5. As far as is possible, **avoid luxuries, especially stimulants.** I should here class tea, coffee, and to some extent cocoa, and alcohol; of Flesh-foods we have already spoken—their waste-products often have a stimulating effect at first. Most Meat-juices and Meat-soups must come here also.

Irritants, such as pepper, mustard, ginger, and certain sauces, should also be avoided.

As to the disadvantages of tea and coffee etc. I cannot speak at length here, much as I should like to. My own personal experience is that the *immediate* effect of tea is often most pleasant and excellent, and that it may enable one to work at high pressure for huge stretches of time; but that its total effect on training, on brain-work, on the nerves, in fact on the whole system, is bad—very bad. I found, as the result of one experiment, that it took six weeks for the bad effects of tea-drinking to develop themselves.

'Desire' is no safe guide. If an instance were needed, the desire for Alcohol in an Alcohol-'maniac' would be sufficient proof.

To the question of luxuries, we shall return directly.

The habit of taking tea, coffee, and cocoa, has spread among civilised peoples in a few centuries, and these drinks are now often regarded as almost a necessity in life. That they are peculiarly suited to stimulate and refresh the mind, and to render possible a higher degree of mental and physical exertion, for the time being cannot be denied. But it does not follow that the people who wish to make such increased exertion cannot do without these stimulants. Dr. Schmidt says that 'the complaints of the supposed ill-effects (of coffee in particular) on the human race, are without justification in fact; the friends of humanity who make them are often desirous of blessing the world with malt coffee, grain coffee, or some such substitute'. But thousands of experiments have been made in America, in England, and even in Germany itself. The immediate effect of tea upon the digestion of starch and proteid, upon the heart's action, upon the tissues of the stomach, etc., and its ultimate effects when its poison becomes *accumulated* in the body, these are too serious to be passed over.

6. Variety seems to be of no little importance. But there is little doubt that the taste can be so perverted by 'rich' flavourings as to lose its finer sense. Among the Simpler Foods is material for constant change, if the question be studied carefully; after they have been tried for some time, their finer flavours come out wonderfully. In America the wealth of pleasant vegetable foods is amazing to an Englishman.

7. To neglect the *fibrous* elements of food is a great mistake: it seems that the bowels require a certain amount of fibre for the motions. We might include here the pips of fruits (such as figs), of which the aperient effect is well-known.

8. *Water* is perhaps best taken in the form of fruit or (unfermented and unsweetened) fruit-juices. It should not be

too hot nor too cold, though, as a *cure*, a glass of boiling water the last thing at night has been found very useful. Its continuance after cure might not be advisable. Another simple cure is a tumbler of cold or warm water with ordinary table-salt, sipped slowly and followed by a walk the first thing in the morning.

9. As to the '*Salts*', as yet we know little which are best: there are plenty in the Grains and Fruits and Vegetables, as well as in the Flesh-foods. It seems that Hovis or Graham Bread, for example, contains all the 'Salts' we need for ordinary purposes. Bran is rich in Phosphates and Potash, and Bran Tea might occasionally be good. Oat tea has actually been found a useful cure for dipsomania.

In conclusion, my views on this most important topic for athletes and others differ radically from those of Dr. Schmidt. Whereas he advises flesh-foods, or rather, a mixed diet, as essential to training, I have lived for over four years in constant training every single day, and, though I have seldom felt fatigue at all, I have very rarely touched any flesh-foods at all. Hundreds of men are finding that their experiences coincide with mine, which I have stated at length elsewhere. I must refer to my book for details. Here let me give the text of it. The Fleshless or Simpler Foods have suited *me* three times as well as the ordinary foods; they *may* suit you better than the ordinary foods. Anyhow, they save much money and much time, and they are worth a trial—nay, they demand a trial, for that reason alone.

But the trial must be a fair one: enough Proteid must be taken (Milk-Proteid may be the best), and at least a few weeks must be allowed. *I* cannot say that the Diet *will* suit you; *you* cannot say that the Diet (with alterations according to your individual differences) *will not* suit you. You must try *both* Diets before you prefer the one and reject the other. By their fruits ye shall know them, and not by the voice of custom. Study the Science of Food and Food-Values, and see where, if anywhere, the Simpler Diet seems to be open to objection. But trust to a fair personal experiment with enough Proteid rather than to Theoretical Science and Chemical Analysis.

# APPENDIX II.

## SOME FOUNDATION-EXERCISES FOR GAMES AND ATHLETICS.

[BY E. H. MILES.]

THERE can be few 'Anglo-Saxon' people living to-day who would not like to excel at some one or more of the many forms of athletics. I am firmly convinced that the number of men and women who go in for athletics would be doubled or trebled, if men and women could succeed and could improve their play enough to make them enjoy it. I need not say a word here as to the value of athletics for every nation to-day: that is a commonplace. I shall confine myself to pointing out what I believe to be one of the best ways of making nations athletic; and I hope it will not be long before every civilised Government considers some training in the foundations of athletics to be essentical to the education of every male and female. I prophesy that it will not be many years before a Committee of Athletes * will have met together to work out more thoroughly and carefully what are the movements shared by the majority of forms of games and sports. These will be then tabulated, and the result will be published, with illustrations. A short book on the subject, translated into various languages, would sell by the hundreds of thousands all the world over.

Elsewhere I have suggested examples of Foundation-Exercises for certain groups of games; for example, in games played with the ball and racket, it is important to have the feet facing towards the right-hand side when a ball is coming towards the right-hand side, so that the racket may have a full swing; but to have them facing forwards while one is waiting for the ball to come. In this Appendix, I wish to suggest a few exercises which are of a more universal character, and which seem to underlie many varieties of games and athletics. It would be

* Since I wrote the above, I have been asked to become a member of the International Commission of Physical Education, for Great Britain. This Commission was started at the Paris Exhibition of 1900. See below.

easy to add to the list, but I will not do so, because this Appendix is only tentative.

The correct standing position, with the shoulders back and the chin back, etc., is too familiar to need mention here.

The second of the foundation-positions and exercises will be breathing. It should be practised first of all with helping exercises, then without exercises at all, and then with 'obstacle-exercises'. It is needless to say that correct breathing lies at the root of every form of sport. The proper movements have been given elsewhere. I quote two of them here, from p. 255.

| While breathing **in** | While breathing **out** |
|---|---|
| Raise the shoulders, and set them back, and set the elbows back. | Lower the shoulders, and bring them forwards, and bring the elbows forwards. |
| Rise from bent knees. | Bend the knees low. |

Running, again, will be a foundation-movement in most forms of sport. With running should be practised rapid 'dodging', for football and one or two other games; and dodging is an exercise that demands correct balance. It is easy enough to dodge if one is allowed to tumble over afterwards! And one should dodge with the arms in all kinds of positions, as they have to be in football, for example. Running itself is best practised in the form of the alternate walk and run. The running with dodging involves the body-twisting (see below), and weight-shifting, which are vital parts of the art of Boxing etc.

And with this should also come another essential movement —namely, the quick starting in all directions. Athletic Sports train people to start quickly in one direction; but we ought to be able to start in *any* direction. Fielding (at Cricket etc.) demands this, as well as the racket and ball games.

Then, again, we ought to be able to move quickly in any direction, taking short steps on our toes, as Peter Latham (the World's Professional Champion at Tennis and Rackets) does in his play, or taking long strides as Burke (the World's Professional Champion at Lawn Tennis), does in his Lawn Tennis.

There should be quick moving in all positions and in all directions. Position is often nine-tenths of the play, especially in ball games; and he who can form the right position and move about rapidly *in* that right position will have a great advantage over any one else.

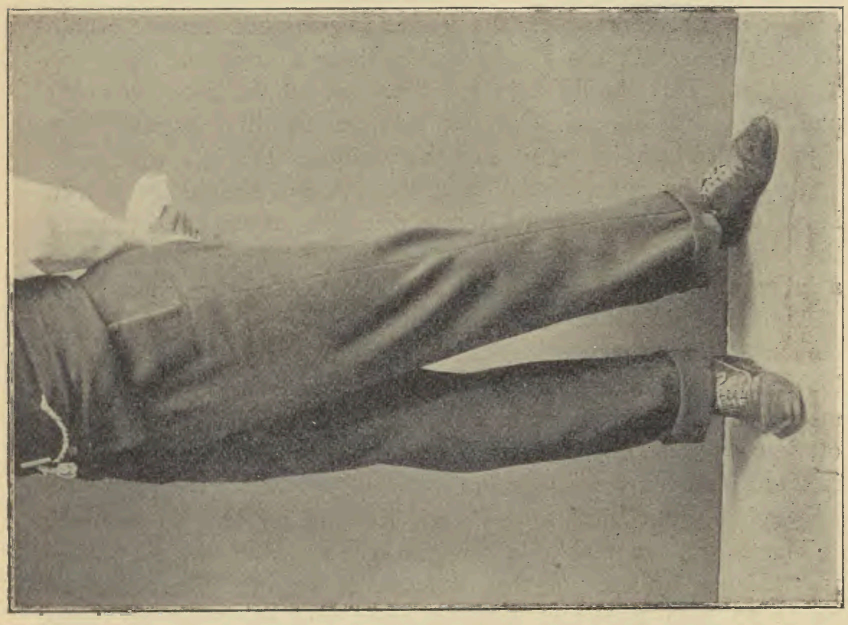
Then a player should practise bending his body till he reaches a squatting position. This is useful for the lawn tennis player when he is up at the net. Keeping his feet firm, he should bend his trunk, now backwards, now forwards, now to the sides, now with a rotating and now with a twisting movement. A movement down to the sides, with a twisting movement, will be useful for polo and other games, and it has this advantage, that it uses a very large set of muscles. The largest muscles are not only the healthiest to use, but also the safest for play, and the least tiring, as we have shown elsewhere.

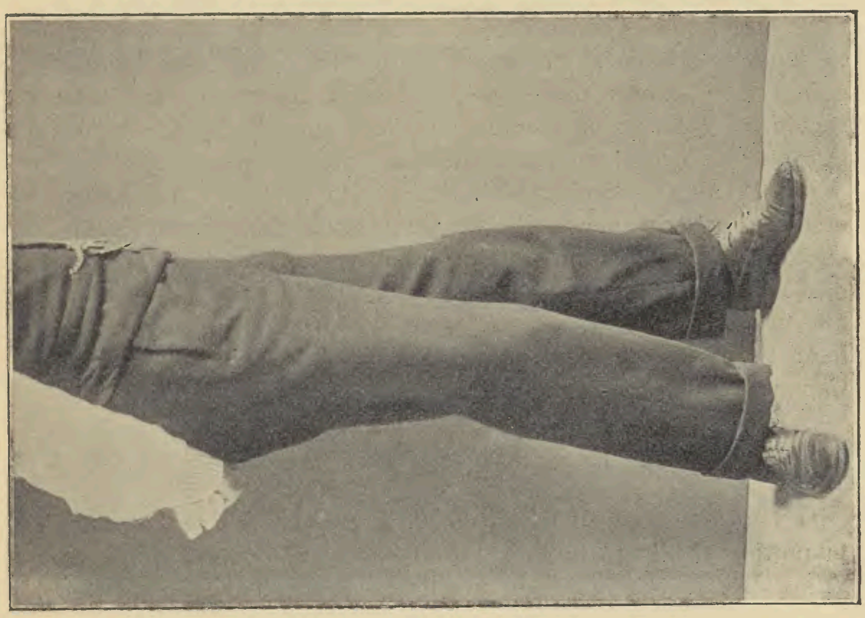
Again, the feet should be kept firm, and the shoulders should be twisted round, first to the right, then to the left, the body moving upon the hips. And the hip turn should be occasionally practised also without the shoulder movement, but rather for the sake of health than for athletic purposes. The swing of the body about the hips, from right to left and from left to right, is a common movement in a vast number of games—for instance, in golf. I should imagine it to be one of the most important of all foundation-exercises, apart from the fact that it is excellent for the bowels and for the health in general. The player should practise it later on with his head facing to the side, as it would be at cricket, baseball, and the games played with the racket, such as lawn tennis and squash.

The neck-exercises are likewise valuable. The neck should be turned round to one side and the other, then it should be bent up and then down, and then moved in various curves. Many games involve neck-movements, which are too little studied. Thus football needs a good many neck-movements.

Kicking is an exercise that should not be confined to football. It is an exercise invaluable for brain workers; and kickers should learn to kick with both legs. They should kick an imaginary ball at different heights.

The arm movements, which are essential to so many games, are too numerous to mention. Both arms should be exercised, though not to the same extent. The left arm was never meant to be used for such fine exercise as the right, excepting by a small percentage of people. The left hand was rather intended to help the right, somewhat as the two work together at cricket





Figs. 307—308. BODY-SWINGING.

and golf. In racket games the two can work together, although only one of them holds the racket. A good exercise would be to sweep with the two arms, as though one were swinging a scythe. This should be done first without the shoulder-swing and then with it, and it should be done in all directions; first with the left arm to help, and then without the left arm.

To take the parts of the arm, the forearm should be moved in all directions, especially in the direction of the hand towards the shoulder. This swinging up and down comes in useful for a large number of games, and forms a part of throwing.

Throwing also, like a number of games, demands wrist-movements. Wrist-movements should probably first be done with loose fingers and not with a tightly gripped hand, so that the movements may be quick and lithe. A book on 'The Game of Squash' recommends various wrist-movements, one of which is there shown by a diagram.

Waving 'good-bye' to a friend, gives us an idea of another.

There are innumerable finger-exercises, the fingers being moved one by one, or two or more at a time. They can be made to grip things of different sizes, and they can be made first to grip and then to relax the grip.

The above movements can be combined, at first two at a time. A Lawn Tennis stroke, when it is at its fastest, seems to have a combined movement of the hip swing and shoulder swing, the forearm movement, and wrist movement, and even sometimes a finger or thumb movement as well; by docking off any one of these, one can somewhat vary the pace etc.

Mr. Macdonald Smith, of Steinway Hall, London, has discovered an entirely new principle which is of the utmost importance to all athletes and indeed to everyone. It is the system of *Full Contractions practised briskly*. He has carefully worked out a scheme of 30 exercises, of which samples are quoted here (from his excellent paper read before the International Congress of Physical Education, Paris, 1900).

### *a.* Exercise of *Latissimus Dorsi.*

'ON RIGHT SIDE. The movement is very much like that made in putting the hand to the bottom of the tail pocket of a coat. Stand erect, twist the body a little to the right and somewhat backwards, as if for the movement described, and bring the right arm round in such a manner that the fingers of the hand are made to project round and beyond the left hip as far as possible, the back of the hand being of course against the body. The criterion of the exercise being done properly must be a feeling of strong contraction in the broad muscle of the back situated below the right shoulder-blade.

'ON LEFT SIDE. The corresponding exercise for the left side produces symmetry. Make these movements thoroughly once with the right and once with the left arm alternately, eight times each.'

*b.* Exercise of *Trapezius*.

'RIGHT SHOULDER-BLADE Place the right hand behind the back, keeping the palm turned towards the body, and brace the right shoulder-blade towards the spine. The hand must be kept behind the back and the shoulder-blade braced to the spine throughout the whole of the exercise. Now push the right hand straight downwards as far as is possible, which is effected by the full contraction of muscles that pull down the shoulder-blade (first position). Now, keeping the arm still behind the back, and the shoulder-blade braced, raise the shoulder-blade as far towards the neck as possible, bending the head backwards till it feels to be meeting the top of the shoulder-blade (second position). You will observe that this second position is precisely that made by a child on being tickled in the neck. Pass quickly from the first to the second position and back again, and repeat the double movement eight times.

'LEFT SHOULDER-BLADE. When you are quite familiar with the above exercise, it will be found easy to perform it similarly with the left shoulder-blade, repeating the movement twelve times as before.

This muscle has, I believe, never been satisfactorily dealt with by any apparatus or drill hitherto used, and if military men have ever acquired good development of it this is due to the fact that they are constantly thinking of holding themselves straight, thus training the nerves of the *trapezius*, and indirectly, at the cost of much time and trouble, improving the muscle.'

The system can be most heartily recommended for many reasons, not the least being that it demands only a few minutes of exercise, and involves no strain.

The brisk Full-Contraction are a fine nerve-tonic. They remove the waste-products that clog the blood and tissues, and fresh blood flows in to feed the tissues. Mr. Macdonald Smith rightly holds that a muscle is healthy, not according to the amount that it is *exercised*, but according to the amount that it is *nourished*. He was chosen at the Paris Congress to form a Commission on Physical Education to represent Great Britain. He has asked me to help him, and I hope that the Commission will try to arouse the British public to the importance of the subject.

The pushing and pulling exercises need not be touched upon here. They are important, but not in early life. One can push against a wall, and one can pull against a rail or a solid piece of furniture.

Balancing has been mentioned above. It is scarcely less important than any other large movement in games. It should be done in the correct position, at first with exercises (such as the extended arms) that help the balance, and then with exercises that actually hinder the balance. A good test of balance is to walk along in a straight line, or to walk along a narrow piece of wall.

We now come to a foundation-exercise which hitherto has been almost entirely neglected in training—namely, the exercise of relaxation; this should be used at intervals in nearly all forms of games and athletics. Instead of this, we see people exert themselves and strain every nerve, and look restless and anxious long before the crisis comes. I have described this exercise elsewhere; for an exercise certainly it is, although it seems to be a rest. It is an exercise because it is a change. The book called 'Power through Repose' should be studied for further details. It is sufficient here to mention the value of relaxation for endurance and for success. A person should smile contentedly, should relax his legs at the knees, and should let the arms and hands and fingers hang down heavy and limp. See further Appendix III.

These are but a few of many of the movements and positions, but they will show a new line of inquiry, which I hope will be followed up by those who have leisure to devote to it.

I will conclude with a few hints to those who wish to practise these and other foundations for play.

The exercises should be done at odd moments. They are so simple that they require no apparatus at all. A minute or two at intervals between hours of work will not be wasted. They should be practised in the open air, and, if possible, with the figure stripped, so that with the exercise may come the air-bath and light-bath. In a room the windows should be open top and bottom.

Strength and strain should not be the object at first. Rather there should be a seeking after correctness, and this will mean slowness and conscious deliberation at the outset; and the movements should be rhythmical, and might be accompanied by singing or humming. As soon as you can exercise correctly, then exercise briskly.

Rhythmical movements are less tiring than irregular movements. The heart is a good instance of this. The amount of work done every hour by the heart almost passes belief. The reason why the heart does not break down a hundred times a day is that it works rhythmically and is a practised organ. The lungs also can do a great deal of work, owing to similar reasons.

One exercise should be taken and repeated frequently, though not until it becomes monotonous and fatiguing. It will be found that each time the movement is tried it will become easier and quicker, if only at the beginning you throw your whole will-power into the muscle, and, as it were, make your mind run down your arm, for example. It is curious how you can get a control of all sorts of little muscles by this concentration. The pace will increase itself. As a rule, people should do a number of exercises, as briskly as is consistent with correctness, at intervals, rather than a few exercises to the verge of exhaustion.

The endurance as well as the pace will increase itself with practice, when once the muscles have found the best way of co-operating. Then, when each one movement is easier by itself, the movements may be combined—at first two at a time.

After this, exercise in promptitude should be attempted. At a word of command, or at one's own word of command, one should immediately start a movement—now this movement, now that. This is not the same as doing a thing quickly when once it has been begun. A football player who runs quickly is often less valuable than a football player who starts quickly.

You can add other exercises which seem to you to lie at the basis of your particular form of sport.

By practising these short movements you will soon get over the drudgery under easy conditions, since you will never practise for very long at a time. Anyhow, you should make these movements automatic and unconscious, or, rather, *sub*-conscious, before you try the form of sport itself. An ordinary lawn-tennis stroke should already be part of the player before he plays a game. Skill, of course, can only come by experience, i.e. by experience during the games and athletics themselves, and especially by experience in timing and judging.

Strength and strain should only be exerted in later life.

All that I suggest here is that the foundation movements should be mastered each by itself. I do not maintain that this would produce skill at the games, nor do I set this forth as a complete list of foundation-exercises. For others I need only refer to many books on gymnastics. These also mention valuable apparatus for exercises of strength, such as the Sandow or Whitely Exercisers. Macdonald Smith's system is the least exacting and the most scientific and complete.

In conclusion, let us review a few of the advantages of these foundation positions and movements. Each is easy by itself and takes a very short time, so that it can be practised for short spells during idle moments. It needs no apparatus. It can be practised at any time, in any weather, in any season. It does not need a teacher, except, perhaps, at the outset. Besides this, we here have a basis for most games. This basis or foundation becomes natural, instinctive, and half-mechanical. It remains for the various games and athletics to combine these basic positions and movements and to add a few special positions and movements of their own.

A player who already possessed, as part of himself, a set of these foundation-positions and movements, would be more likely to find which forms of athletics suited him best, according to the modern 'elective' system. On the same principle, if the boy learns a little about a number of subjects, he is more likely to find out which subject suits him best. And he will have more chance and more inducement to keep up many games in after-life. The social importance of this cannot be over-estimated. For, undoubtedly, the person who can play fairly well will be more likely to continue to play than the person who can hardly play at all. It is easy for a person who has mastered the fundamental movements to devote his mind to, and to concentrate his attention on, his opponent. A lawn tennis player who has acquired them will be able to think of his opponent, of his own next stroke, and so on.

But these movements are most valuable of all for health—for the health of the whole body, because of the health of the many parts of it. This will be especially the case if left-handed exercises be tried as well. Of course, it is needless to say that many of them, and especially the particular exercise for relaxation, will be a good relaxation from brain-work.

## APPENDIX III.

### TRAINING IN RELAXATION AND REPOSE.

[BY E. H. MILES.]

IF physical culture in the sense of exercise is often neglected, the other half of physical culture, viz., repose, is neglected a thousand times oftener. And yet without repose a man cannot be truly a gentleman, nor a woman a lady. Without repose we must fail to do ourselves justice in anything that we attempt. When Miss Call speaks of Power through Repose, she seems to be using a strange phrase; but really the greatest power is seen in repose. Emerson and others have shown how night and day, white and black, heat and cold, etc., are halves of nature, each of which supplements the other. The same may be said of exercise and repose of body and brain. If we neglect to exercise our body or brain, we lose the full blessing of repose, as large numbers of the Indians do. They take so little exercise with their bodies, that they cannot fully appreciate what rest means. For we must learn by *contrast*. If, on the other hand, we exaggerate the exercise of our body or brain, we also err. Nevertheless, *the best cure in this case is to exaggerate* the other half, viz., relaxation and repose. It is by such exaggerations alone that we can restore the balance. I cannot help thinking that the best remedy for hurry on the brain, that terrible and contagious disease of New York, would be a year spent in India and in imitation of the Indians.

But, you will say, 'How can we exaggerate relaxation? Relaxation is a negative thing, meaning the absence of movement or strain.' This is a fallacy. Relaxation is something positive, or rather it can become so, as has been proved in thousands of cases. While we are relaxing with our bodies, we may be needing as much real mental power to do this as if we were engaged in solving the hardest problem.

One of the commonest evils in cities is the exaggeration of brain work; and this, with the nervous strain it brings on, cannot but affect the body. As fear and anger change the chemical composition of the blood, as fear will actually whiten the hair, so worry will also change it. And, on the other hand, calmness will change it for the better. Hence the body is injured by this nervous strain, the actual effect of worry being to weaken the blood, and to fill it with poison, and often to tie up the body and its various muscles into knots. It is interesting to look at people in church, or while they are sitting elsewhere, or while they are walking, or while they are taking exercise in other forms. They will use many muscles where they might use a few. The same applies to sitting, especially to sitting in a cab. People will use many muscles where they might use practically none. They will not let their full weight rest on the seat, They will not leave their nerve-channels open, so that the blood may flow quickly from them. This state of the body in its turn harms the brain and the mind. I have met many people in New York who simply could not rest. They have not the will-power to throw aside the worries of money-making. They have enough money and to spare. They have no real cause for worry. And yet they are perpetually restless and dissatisfied.

One cure for this has been found in Christian Science or Mental Science or whatever we like to call it. This begins with the mind. For example, a person asserts and affirms to himself or herself some such sentences as the following:—'I have a right to be calm and quiet, for God is everywhere and He is perfect and therefore perfectly calm and quiet. I am one with Him and His own son or daughter.' The speaker must realise the truth of this as far as possible. The world and the universe are the expression of God, and therefore in them there is nothing to worry about. The assertion must be often repeated with full concentration of thought. Or the assertion may take the more positive form, viz., 'I am calm and quiet.' Christian Science prefers this to the negative form, 'I must not worry,' since the positive is more easily understood than the negative.

But this method is exceptionally hard for the great majority, at any rate of the 'Anglo-Saxon' race. They want to be doing something with their bodies. Hypnotism or suggestion by another might be employed, but 'Anglo-Saxons' naturally object to this; they want to do something for themselves, they will not submit to another. Besides, their body, that is to say their nerves and muscles, are at full tension, and will not untie themselves. It is possible therefore that there may be a better beginning. They may start with the body and practise exercises of relaxation, knowing that the feeling of relaxation will be bound to follow. A friend of mine, who played Full-back at Football, found that he was nervous even when the ball was nowhere near him; but he got over this by putting his hands in his pockets and whistling and smiling. His nervousness then went of its own accord. Let me suggest one simple exercise, or rather position, which may be practised for a few seconds or for a minute at a time at intervals during the day. This may be better than long practice. It is essential that the position should first be tried in privacy and when you are still fresh and happy. Do not wait till you are tired or miserable, for then it may be too late. After constant practice you will be able to get into position when you are tired and miserable, and the feeling of repose and contentment will follow immediately. Other helps may be added, especially the singing or humming of some quiet tune, and also quiet breathing. Mrs. Archer, of 9 Fitzroy Square, London, and Miss Call, of Arlington Street, Boston, Mass., have a series of exercises which help to bring repose. The will must as far as possible be as it were taken away from the brain and put into the limbs of the body. Sandow advises people to throw their will into their muscles when they take any form of exertion. It is equally important to leave the will to go or to make the will go into various parts of the body while we are relaxing them. Stand with the legs slightly bent, with a smile on the face as if you were watching little children at play, that is to say a smile of quiet contentment and enjoyment. Let the arms hang down loosely, the upper arm hanging down like a dead weight from the shoulder, the lower arm hanging down similarly from the upper arm, and the hand from the lower arm, and the fingers from the hand. Everything must be quite limp, and you must imagine that all the arm is a dead weight. The fingers are a heavy weight hanging to the hand, the hand a heavy weight hanging to the lower arm, and so on. After a short time, shorter or longer according to the individual, a feeling of quiet and contentment will follow the position and expression of the face. This exercise should be practised, of course in solitude, as often as it can conveniently be practised, but especially the last thing at night.

Several positions are suggested by Miss Call in her book called 'Power from Repose.' I will not give quotations here, for everyone should read the book many times. Miss Call is at present lecturing with great success in America. Mrs. Archer is one of her former pupils.

When the body has thus learnt to repose part by part, then, or even before this, the will may be practised also. This side of the personality should never be neglected. The above assertions and affirmations are only a few out of many, but I think there are many who would find them really valuable and practical if they had once learnt the art of relaxing the muscles and nerves of their bodies. Anyhow, the relaxing position, which of course is very different from mere laziness, is the right position in which to study nature, or art in the form of pictures etc., or music, or in which to listen in church or elsewhere, or to talk, or to pray. It is also the right position for intervals between times of exercise, and between times of work, and even during work.

As a rule, when we have a problem to solve we use many of the muscles of our body and of the face in particular. We only have a certain amount of energy to spare, and much of this energy is thus dissipated. We ought to concentrate it and fix it upon the problem, and not to let any of it be lost through our clenched hands or tightly set jaws, or through any other channel. The mind needs every atom of energy or magnetism or whatever it may be, that we possess. Of course at first it will be impossible to think hard without straining of the body also, but with repetition of such exercises we shall be able to employ, as it were, all our thoughts without showing the straining by any outward signs. The ideal of brain-work is that all the force should flow into that brain-work, and that none of it should be wasted elsewhere in the body. But here, as in the case of games and athletics, we must first practise constantly under the easiest conditions.

For athletic purposes, and indeed for all purposes, relaxation is most valuable if it alternate with some forms of movements, whether these forms be games, or exercises which prepare for games and supplement them. Some of these are described in the Appendix II, where it is suggested that the best system of exercise is that of full contractions. Mr. Macdonald Smith, of Steinway Hall, London, is the exponent of this system, and Mr. Swoboda, of Chicago, has I believe, a somewhat similar method, though I believe that the latter method does not insist on briskness. If this be so, then it seems to me to be inferior.

It is bad economy to let an engine blow off a large quantity of steam by means of its whistle when the engine is not moving at all, yet it is not unlike what we do when we tie up our muscles in knots. We seem to be doing a great deal, and we may be making a great fuss also, and such exercises may be good in so far as they get rid of the excess of acids, etc., but, in so far as they waste steam that is required for other purposes, they are bad. We have little or no energy to spare. What we have we must concentrate for the most useful purposes.

Unless we become like little children, we cannot succeed. This is true, not only of the mind, but also of the body. As a matter of fact, to show anxiety in the face proves a lack of faith. However frequently we say our Creed, 'I believe in God the Father Almighty,' if we worry we show that we are merely talking words. Our action is refuting our own statement. A little child holding its father's hand does not worry, but trusts. This is how we should live, and this life of repose is as urgent a need in England as in any other part of the world except New York and a few other American cities. For most Anglo-Saxon people—we cannot repeat it too often—it may be next to impossible to remedy the want of faith, and the habit of worrying, by means of the will alone. The body must be the starting-point and then the mind will follow. This does not apply to exceptional cases; it is only a general statement, for in almost every nation there are individuals who are not typical of it.

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# INDEX II

## ILLUSTRATIONS AND DIAGRAMS

## WORKS ETC. BY EUSTACE H. MILES, M.A.

**The Training of the Body.** By Dr. F. Schmidt and Eustace H. Miles (Sonnenschein).

**Lessons in Lawn Tennis** (Upcott Gill; & Scribner, New York). Second Edition.

> '*An invaluable help*' (Bristol Athlethic News.). '*An excellent little manual . . . an admirable coach*' (Sporting Life). '*Well worthy of attention*' (Lawn Tennis).

**The Ball-Game Excerciser:** for the cheap and easy Learning and Practising of various Ball-Games. (Prosser & Son, Pentonville Road, King's Cross, W.C.; and Wright and Ditson, Washington Street, Mass.).

**The Game of Squash: A Practical Handbook** (Ward & Lock; and J. F. Taylor & Co., New York). To be ready before April, 1901. Other Volumes to follow, on Rackets, Tennis, etc.

**Muscle, Brain, and Diet: A Plea for Simpler Foods** (Sonnenschein; and the Macmillan Company, New York). Second Edition.

> 'A remarkable book. Mr. Miles makes out probably the best case for a kind of vegetarianism that has ever been stated' (*Andrew Lang* in *Longman's Magazine*). 'A splendid text-book' (*Health Culture*). 'Mr. Miles, while an enthusiast, is no fanatic' (*Judge Crosby* in *The Conservator*). 'Honest, manly, and scholarly' (*St. James' Gazette*). 'Exceedingly lively throughout' (*Literary World*).

**Avenues to Health.** In Preparation.

**How to Learn Philology** (Sonnenschein; and F. E. Grant, New York).

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*In connection with this Book:*

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**How to Remember, Without Memory Systems and with Them** (Warne; London and New York). In April, 1901.

**A History of Rome, up to A. D. 500 with over a Hundred Essays, Introductory and Supplementary** (Grant Richards; and F. E. Grant, New York).

**The Teaching of Jesus To-Day: The Sermon on the Mount in Simple Modern English** (Grant Richards; and F. E. Grant).

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