SCIENCE:

A WEEKLY NEWSPAPER OF ALL THE ARTS AND SCIENCES

PUBLISHED BY

N. D. C. HODGES,

47 LAFAYETTE PLACE, NEW YORK.

SUBSCRIPTIONS.—United States and Canada.....$3.50 a year.
Great Britain and Europe..... 4.50 a year.

Communications will be welcomed from any quarter. Abstracts of scientific papers are solicited, and twenty copies of the issue containing such will be mailed the author on request in advance. Rejected manuscripts will be returned to the authors only when the requisite amount of postage accompanies the manuscript. Whatever is intended for insertion must be authenticated by the name and address of the writer; not necessarily for publication, but as a guaranty of good faith. We do not hold ourselves responsible for any view or opinions expressed in the communications of our correspondents.

Attention is called to the "Wants" column. All are invited to use it in soliciting information or seeking new positions. The name and address of applicants should be given in full, so that answers will go direct to them. The "Exchange" column is likewise open.

PHYSICAL DEVELOPMENT.[1]

GREAT interest has, I am happy to state, been taken in the results already obtained by the Polytechnic Physical Development Society. Their publication at the Leeds meeting of the British Association has caused inquries for further information to be addressed to us from all parts of the kingdom, the continent, India, Africa, and America. I mention this because it shows that the public are beginning to realize that the physique is something more than a matter of great interest to scientific observers; that it is, in fact, a subject of practical importance to each one of us; and that the time is ripe for the formation of an organization to deal with it as a science and an art.

It is, doubtless, pretty generally known that, broadly speaking, the difference in the physique of man in the highest centres of civilization and that of man in a savage — or, to be more accurate, in a lower state of civilization — is, with the exception of parts of the brain, greatly in the favor of the latter; that is to say, we have obtained the advantages of civilization, with the above exception, at the expense of the body; and inasmuch as we are continuously making further advances in knowledge, and applying that knowledge in the ordinary routine of daily life, the tendency of this progress still is to the further detriment of the body. This is not an agreeable fact to contemplate, and the reminder that the "fittest" will survive neither affords us compensation for the injury nor points out the means by which it may be obviated; for the class of the fittest for the circumstances of a generation ago is not the class of the fittest for the circumstances of to day, and the class of the fittest for the circumstances of to-day will not be the class of the fittest for the circumstances of the next generation. Hence this most important question arises, How can we obtain for civilized man a physique equal at least to that of man in a lower state of civilization, and make the further advances of knowledge tend to the advantage of the body? The answer to this question, I shall show, lies in the ascertainment of the effects of the conditions of our habits and surroundings upon the body, and the application of that knowledge to our own protection and advantage.

Nearly twenty years ago I commenced the investigation of this subject, and the results of that research I laid before the British Association in 1886–87. Then I showed that the size and shape of the chest varied as I varied the conditions to which it was subjected. For example, when I submitted a chest to conditions that tended to develop it, that chest increased in size, and its form or type changed accordingly. When I submitted a chest to conditions that tended to decrease it, that chest decreased in size, and changed its form or type accordingly. I ascertained that those results were absolutely invariable, and could be carried out within such wide limits that, on the one extreme, they embraced the class of the non-survivors, through consumption, and on the other, the finest physique of the class of the survivors or fittest. I pointed out the fact that we had an example of one type of chest forming a series of types that have varied precisely as the conditions to which it was subjected have varied. At birth the male child of all classes has the same type of chest, but at maturity he has that of the class to which he belongs. We have the same relationship between conditions and type; on the one hand, in those who use wind instruments, or who by their occupations require to greatly use their lungs; and on the other, in those who spend a great portion of their time in a stooping position, or who compress their chests either by the instrument they use in their work or by a corset. The great development of the muscles of the trained athlete and the wasted muscles of the paralytic are due to to the conditions of their use and disuse respectively. We know that the head has been altered in shape by direct pressure, and that the greater size and the more complicated arrangement of the brain of a European to that of an aborigine of Australia is produced by the greater mental training of the former. The difference between the hands and fingers of a pianist and those of a man accustomed to lift heavy weights is produced by the conditions of their occupations. Upon the presence and absence respectively of shoes depends the difference in the size and shape of the foot of a Chinese lady and that of a woman in the uncivilized state. The color and thickness of the skin vary according to the conditions to which it is subjected, and there is the same relationship between the size and shape of each part of the body and the conditions to which it is subjected. Therefore, the type of man after birth is solely produced by the conditions to which he is subjected. Hence the formation of race by man's continuance under the same conditions, and its subsequent division into sub-races and families by his migrations into new conditions and the minor differences therein. Hence also the difference between the same species of animals under the conditions of nature and of domestication, between the products of the same seeds when sown in different localities, between the same plants when placed under different conditions, and the return of man, animal, or plant to former types when subjected to the conditions that produce that type.

It would be difficult to overestimate the immense importance of the facts just briefly referred to. They prove to us beyond the possibility of a doubt that man is what his habits and surroundings make him; that he is a member of the class of the survivors or fittest because the conditions, as a whole, of his habits and surroundings are favorable to him;

[1] Godfrey W. Hambleton, president of the Polytechnic Physical Developmt Society, London, in Physique.

that he is a member of the class of the non-survivors, those who prematurely disappear, because the conditions as a whole of his habits and surroundings are unfavorable to him; and that he can so order his habits and surroundings that they shall tend to his advantage. A great work and a great future lie straight before us. We have to ascertain the tendencies of all the conditions to which our bodies are subjected by our habits and environment, in order to apply that knowledge to our own protection and advantage. And that is the sphere of true physical development.

An important step towards the attainment of this great object has been taken by the formation of a society to apply the principles of physical development in the ordinary routine of daily life. Some twenty-five members joined at the first meeting of the Polytechnic Physical Development Society. Now, thanks to the courteous and cordial co-operation of Mr. J. E. K. Studd and the authorities, upwards of three hundred members have entered their names on the books; and when the society is better known and the great benefits it does confer are recognized, I do not doubt that that number will be considerably increased. At Leeds I gave the results obtained by a hundred members. The average increase of their chest girth was $1\frac{3}{4}$ inches. I divided them into three classes, the average increase of the chest girth of the third class being $1\frac{1}{4}$ inches, that of the second class being $2\frac{1}{8}$ inches, and the first class $3\frac{3}{8}$ inches. There has been a considerable increase in the range of movement of the chest, the average then being, I think, $4\frac{1}{2}$ inches. Hutchinson's standard of vital capacity has been greatly exceeded, and in the power of inspiration and expiration the majority belonged to or exceeded his "remarkable" and "very extraordinary" classes.

At the subsequent examination for the society's gold medals, the first medallist had obtained an increase of the chest girth of $6\frac{1}{2}$ inches, the second an increase of 5 inches, and the third $4\frac{3}{8}$ inches. The society's medals for the best physique were awarded to members who had exceeded Brent's "medium" standard by 3.67 inches, 2.42 inches, and 3.32 inches, and twenty certificates were given to those who had obtained and exceeded that standard.

I am glad to say that increase continues. We have just held our second general annual meeting, and I find the average increase of the chest girth of one hundred members is now two inches, that of the third class being $1\frac{3}{8}$ inches, the second $2\frac{1}{4}$, and the first $3\frac{5}{8}$. That increase has taken place in small as well as in large chests, whether the men were tall or short, under or over twenty-one years of age, and with or without previous gymnastic training. Our members are engaged from eight to twelve or fourteen hours daily in over fifty different trades and occupations, amongst them being clerks, compositors, printers, watchmakers, carpenters, engineers, drapers, warehousemen, etc. The variations in the chest girth and vital capacity that have taken place are most instructive. I have frequently noted a large decrease when the members were training too much in the gymnasium, or engaged in extra work, stock taking, cycling, and when they neglected to follow the directions given them. In fact, the increase or decrease observed has been in direct relationship with a corresponding change in the conditions of their habits or surroundings. It is satisfactory to note that the number of chest girths of from 38 to 40 inches and upwards is steadily increasing. We have also many members who have nearly attained Brent's "medium" standard, which is 5.40 inches above the average of the artisan class, and 3.17 inches above that of the most favored class. The importance of these facts will be seen when it is borne in mind that this is a new society, carrying new principles into practice, that its members are placed under more or less unfavorable conditions, that it is purely voluntary, and that its members leave us when they leave the institution.

Perhaps the best way to explain the practical work of the society is to describe what happens to a new member on joining it. He is placed in an erect position, his shoulders are brought well back, and his clothing so loosened over the whole of the chest that it permits full and free movement. I find in nearly every case the clothing is from one to two inches or more too tight. Then he is shown the simple movements that are necessary to throw the weight of the shoulders on the spine, he is taught to inhale and exhale deeply through the nose, and to use the spirometer and manometer. We explain to him that the conditions of his habits and surroundings tend either to his injury or to his advantage. He is told to avoid those that tend to act injuriously, and where that is not possible or practicable, to ascertain their amount and to counteract their effects, and to place himself under those that tend to his advantage. We request his careful attention to these conditions, and deal first with those that have to be avoided. The habit of stooping, positions that cramp or impede the full and free movement of the chest, or a faulty carriage of the body, are very injurious. Habits that tend to the disuse of the muscles or to their excessive use are to be avoided. Breathing through the mouth, or breathing air that has a temperature much above that of the external air, or that is impure, or that contains dust, is very injurious. Wearing tight-fitting or too heavy clothes, braces, corsets, or shoes with high heels and narrow toes, tends to impede the full and free movement of the body and is injurious. And whatever of his habits or surroundings tends to act injuriously or to produce such acts must be avoided.

We tell him to acquire the habit of holding the body erect, the shoulders back, and the chest well forward; to breathe through the nose, and to take deep inspirations followed by full expirations several times daily; to develop the muscles, especially of the chest, by gymnastic exercise on Ling's system; to go in for the daily tub or swimming; and to have the clothes made quite loose at full inspiration, and to see that they do not impede either by their weight or shape the free movement of the body. We advise him to live in rooms that are in free and direct communication with the external air night and day, summer and winter, and to take care that their temperature is not too high; to spend as much time as possible daily in the open air, and to maintain the temperature by muscular exercise. We point out to him that walking is a most healthy exercise, and that broad toes and low heels tend to promote it. We tell him to practise singing, and to take advantage of some form or other of athletics whenever the opportunity presents itself. And whatever of his habits or surroundings tends to his advantage or to produce acts having that tendency must be adopted.

We are all of us at times subjected to unfavorable conditions that we cannot, under present circumstances, avoid. For example, it would be difficult to be present at any public meeting in a large building without having to inhale both impure and overheated air. But when we have obtained a certain amount of physical development, a few deep inspirations followed by full expirations in the open air will be sufficient to counteract that. Again, the occupation or business in which we may be engaged may necessitate a somewhat cramped position of the chest, but on leaving, a trained

man will soon obtain compensation for that by holding the body erect and taking proper breathing exercise. The main point is to ascertain our unavoidable injurious conditions, and to arrange the other conditions so that the tendency of the whole is decidedly in our favor, and it will take a well-developed man — and by that I mean a man having a physique between Brent's "medium" and "maximum" standards — but little time and trouble to accomplish that. These directions are very simple, easy to carry out, and in one form or other are within the power of each one of us. But they effect a complete change in the conditions to which the body is subjected, and to make that change with safety it must be slowly, gradually, and uninterruptedly effected.

I will now point out some cases in which physical development is urgently required, and where its adoption will render an immense public service. Take the case presented by the army. Considerable attention has recently been directed to the large amount of inferior physique that is present in the ranks. On the 1st of January, 1889, the army numbered 202,761 men, but of these there were 82,979 whose chest girth was under 36 inches, — that is, from 31 inches up to 36 inches, — and only 16,324 who had a chest girth of 39 inches and upwards. Now on Brent's "medium" standard there ought to have been none under 36 inches, and 67,236 ought to have had a girth of 36 inches and upwards. There is, however, another mode of showing the presence of this inferior physique, and that is by the great liability of the army to disease under ordinary circumstances. During the year 1888 there were 193,233 admitted into hospital, 1,845 died, 2,078 were sent home as invalids, 2,776 were discharged as invalids, and 10,715.97 were constantly non-effective from sickness. It is obvious that had the men been of good physique, and subjected to fairly good conditions, there would not have been anything like this serious amount of sickness, invaliding, and death. Why should not these men be placed in a position to successfully compete with the unfavorable conditions of their surroundings by the introduction of physical development?

A reference to the tables in the supplement to the Registrar-General's report, showing the comparative mortality of those engaged in different trades and occupations, will show the necessity for the diffusion of the knowledge of physical development amongst those engaged therein. Life assurance and sick benefit societies would not only considerably add to their incomes and increase their stability by the recognition of this relationship between conditions and type, but they would also by that very act become powerful agents in the promotion of national physique and public health.

The introduction of physical development as a necessary part of the education of children is urgently and imperatively demanded. They have a splendid type of chest at birth, the proportion of chest girth to height being a little above Brent's "maximum" standard, but under the present system of bringing up children, they are, from the moment of birth, right through the whole course of modern education, submitted to unfavorable conditions, so that for a height of 51.84 inches there is a chest girth of 26.10 inches, instead of one of 35.18 inches, or a loss in about ten years of nearly nine inches. Here you have the best standard of chest girth. Is it too much to ask that the conditions of the child's surroundings, as a whole, shall be so arranged that it may be retained? Look at the poor, puny chests we meet with everywhere, and at the reports of the Registrar General, and then we shall see the grave responsibility that lies upon us for producing such a change and permitting it to continue.

The cases just noted evidently require the introduction of physical development, but where shall we find a man, a woman, or a child in civilized countries upon whom its adoption would not confer a great benefit? We are here face to face with a work so great that it will require all the intelligence, the energy, the influence, and the means of a well-organized body to accomplish it. The workers are here, an important section of the public is ready to co-operate, and the time for action has come. Why should we not have a national association to meet this great national want?

CONTAMINATED WATER SUPPLY FOR LIVE STOCK.[1]

THERE is no fact better known to the sanitarian than that one of the chief sources of danger to life and health is the contamination of drinking water. If a malignant form of fever makes its appearance in a family, which cannot be explained by the history of actual exposure to contagion, the water supply always comes in for an early and liberal share of attention. The instances are sufficiently numerous in which the investigator is enabled to trace the malady to this source, to warrant every reasonable precaution in procuring a pure water supply. Nor are these facts known to the sanitarian alone. The reading public have been sufficiently enlightened on this subject to enable them to avoid much of the danger from this source.

While we are beginning to take a fairly lively interest in our personal dangers and the methods calculated to avert them, we have yet hardly taken time to consider the economic question of how far our live-stock industry may be affected by the same class of causes. We drill down into the solid rock to procure a water supply of unquestioned purity for family use. We boil, or subject to other purifying means, all suspected samples before they can be used. This is well. But all this time our helpless dumb creatures may be compelled to drink from a shallow slough, foul with decomposing vegetation, or from a surface pond almost at boiling temperature under a summer sun, where the minute forms of animal and vegetable life generate in such profusion as to render the whole a mass of animate slime.

No one who has had a glimpse of the microscopic world would expect a human being to take a draught of such a beverage and live. But our animals are not only expected to live, but to thrive under such conditions. That these expectations are frequently disappointing, I will cite an instance or two in proof. During the latter part of the summer of 1890, I had occasion to investigate a severe outbreak of disease on a farm in one of the counties of Iowa. The animals, including horses, cattle, and pigs, were all affected in the same way. The local symptoms were largely confined to the throat. There was a swelling, partial paralysis of the walls of the air passages, and painful and difficult breathing. The animals attacked uniformly died after an illness of about two days. The disease I could not recognize as belonging to any of the well-defined types with which I was acquainted. Here were horses, cattle, and pigs sick and dying with disease showing the same symptoms in all.

There are few if any of the specific forms of disease that spread, as epizootic, among the widely differing species of domestic animals. I could not classify the disease, and at once set about the task of discovering, if possible, some common source of exposure. The pastures, buildings, and water supply were each in turn subjected to careful scrutiny.

[1] M. Stalker, in the May Bulletin of the Iowa agricultural experiment station.