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F.R.C.P. LOND., F.R.S.

CONSULTING PHYSICIAN TO ST. BARTHOLOMEW'S HOSPITAL

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STRAIN.

GENTLEMEN,—The subject I have chosen for my address to-night is that of strain. We are quite familiar with strain in inorganic bodies. If we tie one end of a string to a fixed support and load the other with increasing weights the string will become more and more tense and by-and-bye will break altogether. If we twist a piece of wire it yields to a certain extent, but by-and-bye breaks off. If we lay a bar of wood or iron upon solid supports and then compress it by increasing weights, or by a hydraulic press, it will bend somewhat and will finally break. If we pass a current of electricity through a wire we will for a time observe no change, but as the strength of the current increases the wire will become hot, and presently, if the current is too powerful, it will melt altogether. In every case the final breaking of the string, wire, bar, or conductor is due to an excess of the work which each of those bodies is naturally intended to perform.

STRAIN OF TISSUES AND ORGANS.

The same holds good with the tissues and organs of the human body. In a railway accident, if a limb is caught between two pieces of woodwork and its ends are pressed in different directions, the bones are snapped just as they would be in a testing machine. If any one of us were to slip on a greasy sidewalk, so that our foot twisted to one side and the whole of our weight were thrown upon the ligaments of the ankle-joint, they would be strained, or, as we usually express it, sprained. Now, I think there is a certain difference between strain and sprain. It is one of degree and not of kind. If the twisting of the ankle were only slight there would be a certain amount of pain on using the joint, but there might be no swelling and little or no tenderness on pressure, whereas both of these symptoms usually are present when the twisting is so severe as to produce what we term a

sprain. Yet even a slight strain, which gives no other evidence of its presence than a little pain on exertion, may last for a long time, and each time a fresh demand is made upon the ligaments the pain is again felt.

A severe and sudden strain may cause complete rupture of a muscle. A less severe strain causes muscular pain and tenderness, sometimes very acute, and usually lasting two or three days. This condition gradually passes off, and in a short time the muscle becomes inured to greater exertion, and is then capable of more powerful and long-continued contraction without fatigue. Indeed, repeated exertion within moderate limits causes a muscle to grow, or, as we ordinarily term it, to become hypertrophied. Its contractile power and its nutrition are both greatly increased by the exertion it is called upon to make, but if the exertion be too great, and especially if it be too long continued, a different result ensues, and atrophy of the muscle takes place. Its nutrition is impaired, its size diminishes, and it becomes feebler.

Strain and the Nervous System.

The changes which occur in consequence of strain to the ligaments, to the muscles, and to the bones are readily perceptible, but changes in the nervous system are not so easily appreciated. Nevertheless, they do occur, and these changes may be even more important than those in the coarser tissues. It was formerly supposed that the nerve cells of the central nervous system were connected together by definite fibrillæ, which were constantly present, but it is now generally believed that the connexion occurs rather by means of processes which are capable of elongation and contraction. At one time they connect the nerve cells together, while at another connexion may be broken, just as in a telephone office the various subscribers may have their wires connected at one time, while at another they may be switched off altogether. In the nervous system, just as in the muscles, regular exercise, without overstrain, tends to increase both nutrition and functional activity, but excessive exercise rather leads to functional weakness and atrophy. Moreover, just as a sudden severe strain may entirely snap a muscle, so a sudden severe strain may snap some of the nervous connexions in such a way that they never again join. The analogy between the effect of a sudden shock or strain upon the nervous system is indeed very much like what we see from the melting of a fuse by an overcharge of electricity. The fuse may be repaired and the connexion again made, but it is possible that this may not occur, and in such a case the connexion is destroyed for ever.

Many instances are on record where sudden shock has for ever destroyed the mental balance and left the sufferer

hopelessly insane for the remainder of life. In other cases sudden shock may have a beneficial effect, and there is the well-known instance of the son of Crœsus, who, after being dumb from birth, recovered his speech when he saw someone about to murder his father. Cases are recorded also of the cure of epilepsy by the patient falling into water and being in danger of drowning.

Effects of Emotion.

The effect of emotions on the body has been well studied by Darwin. Both in animals and in man there is the sudden tightening of muscles in the presence of danger, or in the effort to meet some unexpected event. This is, I think, particularly noticeable if one is riding a quiet horse and the animal is suddenly startled by an unexpected sight or sound. It gives a sudden jump, and not only the muscles of the rider's legs, but those of his arms and back, tighten at once in order to prevent his being thrown off. The depression caused by bad news shows itself in the general attitude: the limp muscles, the stooping posture, and the slow or even shuffling walk; while the contrary effects, erect attitude, agile walk, and active muscles, result from good news or anything that gives pleasure to the individual. The effect of emotion upon the vascular system was well noted by Harvey, who said:—

> For every affection of mind which is attended with pain or pleasure' hope or fear, is the cause of an agitation whose influence extends to the heart. ..... And what, indeed, is more deserving of attention than the fact that in almost every affection, appetite, hope, or fear, our body suffers, the countenance changes and the blood appears to course hither and thither. In anger the eyes are fiery and the pupils contracted; in modesty the cheeks are suffused with blushes; in fear, and under a sense of infamy and of shame, the face is pale, but the ears burn as if for the evil they heard or were to hear; in lust, how quickly is the member distended and erected.

In popular language we are accustomed to note the effect of the emotions on the circulation when we say: "His heart beat high with hope or sunk within him for fear." These emotions actually do alter the pulsations of the heart, hope and joy making them stronger, while fear makes them feebler. The effect of emotions upon the body is to a great extent produced through the pneumogastric nerves, which send branches to the lungs, heart, stomach, intestines, liver, and kidneys. Each of these organs is affected by the emotions. Thus, we say a man breathes more freely when some cause of anxiety is removed. The alteration in the heart is of more than one kind, for either the rate or the power of pulsation may be affected. Excitement of various kinds, and especially pleasurable anticipation, will very often quicken the pulse, but this quickening

frequently occurs from simple excitement, such as that of entering the room of a consultant. Bad news will depress the functions of the stomach, entirely destroy appetite, and even cause nausea, while compassion affects the movements of the intestine to such an extent that the term "soundings of the bowels" was used by the Hebrew prophets as a synonym for compassion. The increased activity of the kidneys by excitement is known to most men who have passed through an examination. If the emotional excitement be not too great and not too often repeated, and if all the organs affected by it are healthy, it will do no harm, and is likely, indeed, to be beneficial, just like intellectual work or muscular exercise. But here, also, too great or too prolonged excitement are apt to be followed by functional weakness, malnutrition, and atrophy. One of the most striking examples of malnutrition due to emotion is the neurasthenic condition which sometimes comes on in girls from some disappointment in love. They lose strength, they become emaciated, their pulse is slow and feeble, the hands and feet become cold, and the skin, instead of being soft and velvety, becomes dry, hard, and scaly. These are the cases which are usually so successfully treated by the Weir-Mitchell treatment of isolation, forced feeding, and massage.

Influence of the Nervous System of Glandular Secretion.

For a long time the connecting links between the nervous system and such emaciation were very obscure, and even now they have not been completely made out, but the knowledge which we have acquired of late years regarding the influence of the nervous system upon the glands and their internal, as well as their external, secretion has greatly helped us. One of the best-known evidences of the influence of the nervous system upon a gland is that of the secretion of saliva caused by the taste, smell, or even thought of appetising food, and Pawlow has shown that the secretion is not confined to the salivary glands, but that the stomach and pancreas react to the pleasant stimulus in the same way. The effect of the thyroid gland upon the general metabolism in the body is one of the most marked instances of the power of the internal secretions. With atrophy of the thyroid we find that the growth becomes stunted, the circulation languid, the mental powers feeble, the face swollen and expressionless. With hypertrophy of the thyroid, on the contrary, we find associated with the quick pulse a rapid circulation, hot and sweating skin, and an excitable nervous system. This condition is frequently brought on by a shock. The most rapid case that I have ever seen was that of a man who was frightened by a thunderstorm in the early morning, and the symptoms were

well marked within 13 hours. In this case the exophthalmos and swelling of the thyroid were both very great. I do not know how long it lasted, as the patient left the hospital. In another case the disease came on in a girl within four or five days of her brother accidentally shooting himself as he was crossing a hedge, and her death occurred in the course of about five months from a diarrhœa which nothing would stop. In another case, which I described 35 years ago, both exophthalmic goitre and diabetes appeared to come on after worry, and diabetes itself is, I believe, very often due to emotional strain. The strain which leads to diabetes is, however, I think not so much sudden emotion, like that which brings on goitre, as rather long-continued worry and anxiety.

How far the action of the central nervous system in producing glycosuria may be due to an effect upon the liver or upon the pancreas through the pneumogastric nerve has not yet been determined. Years ago the prevalent idea regarding diabetes was that it was chiefly due to alterations in the internal secretion of the liver and a more rapid destruction of glycogen, but now many cases are considered rather to be due to defective metabolism in the muscles, secondary to a deficient internal pancreatic secretion. The internal secretion of the pancreas is supposed to activate a glycolytic ferment in the muscles, and when this is deficient the sugar is not split up and consumed as it ought to be. I have already mentioned that Pawlow has shown that the external secretion of the pancreas is greatly affected by mental emotion, and it is probable that the internal secretion may be so also. But it is not only the salivary glands, stomach, and pancreas which are affected by the emotions. I have seen a case in which a young lady became quite jaundiced in a few days. She had presented no other symptom and the cause of it was apparently anxiety for her only sister, who was dangerously ill.

Intestinal Canal and Nervous Affections,

The effect of emotion upon the intestinal movements is a matter of common knowledge. It is probable that alterations in the secretion and movements of the intestinal canal may affect its bacterial contents and their products. On one occasion I went to see the wife of a young doctor who was suffering from pneumonia, and I was struck with the extraordinarily fœtid breath of her husband, which seemed to be due entirely to his anxiety, as it was merely a temporary occurrence. How far the toxins formed in the intestine by bacterial growth, unchecked and perhaps modified in kind by the disturbance of the digestive secretions, may react upon the central nervous system, peripheral nerves and muscles, it is hard to say, but I am inclined to

think that a great number of nervous diseases really have their origin, directly or indirectly, in the intestine. Some of the most common products of albuminous decomposition are toxic amines, or compounds of ammonia, and some of these have a very powerful paralysing action both on muscle and nerve. One of the most extraordinary actions that compounds of ammonia exert upon nerves is that of acting on the peripheral ends of the motor nerves in the same way as the charge of dynamite acts upon the electric wire by which it is discharged. The dynamite blows off the end of the wire and thus breaks any connexion. Many years ago I found in experimenting with salts of ammonia that when frogs were poisoned by them an electrical stimulus applied to the sciatic nerve would cause a contraction of the muscles in the frog's leg quite as powerful as normally, but that sometimes a second stimulus applied to it had no effect whatever, although the muscle still remained irritable to direct stimulation.[1] It appeared as if the ammoniacal salt had combined with the end-plate in such a way that the first discharge of nervous energy blew it off so that the connexion between the nerve and the muscle was completely destroyed. I think it is possible that these observations may have a bearing upon the sudden stoppage of the heart in certain cases. I think it probable, also, that toxins formed in the intestine may have much to do with the production of sclerosis in the spinal cord. When experimenting a number of years ago on the action of some benzine compounds in the frog, Dr. Cash and I found that some of them produced symptoms of sclerosis, so that the foot of the frog instead of being drawn up with a sudden jerk was drawn up in a slow and shaking fashion. Many years afterwards I had a patient at St. Bartholomew's Hospital suffering from disseminated sclerosis. In spite of all the ordinary remedies he was becoming rapidly worse, so that not only his extremities, his speech, and mastication, but also deglutition became affected; he could hardly swallow and death seemed very near at hand. In despair I bethought me of our experiments upon the frogs. It had occurred to me that if he were suffering from any toxic poisoning due to benzine compounds, sulphates ought to help him as they would form an innocuous compound with the toxins. I accordingly put him on sulphuric acid and sulphate of magnesia. In three months he was well enough to go to a convalescent home.

[1] Lauder Brunton: Text-book of Pharmacology, Therapeutics, and Materia Medica, first edition (London: Macmillan and Co., 1885), p. 567.

Lapse of Memory.

How far the coöperation of toxins with mental shock or excitement may be responsible for curious lapses of memory I do not know. I have had three cases in which the identity of the individual has been completely lost for a time. The first was a stockbroker in Glasgow, who went out for a ride one morning, and being thrown from his horse fell upon a heap of stones. One of these stones caused a deep indentation just behind the left ear. He was taken up, carried home, and remained for nearly three months insensible. He then awoke to life, but it was not to the life he had before the accident. He forgot that he was a stockbroker, that he was married, and that he had several children. When he awoke to life seven years had utterly passed from his memory. He thought that he was a student at college. He could make Greek verses and remembered much of what he knew as a student and had subsequently forgotten. He had to be introduced to his wife and children and told that they were his. He still continued to have a sort of double existence. One morning when he was brought to see me he was seized with a sudden panic in alighting from the cab and fled away along the streets like a lunatic. That same afternoon he wrote an article on an abstruse financial subject which was printed next day in the *Times*, and was regarded with great admiration by all competent critics. Another case was that of a young man who suddenly disappeared from home, leaving no trace. For a fortnight nothing was heard of him, and then he wrote to his family to tell them that he had completely lost himself, until one day he awoke lying in bed in a house in Brittany and tended by a very kind French woman. It turned out that he had been pitched from his bicycle close to the house and that she had taken him in and tended him. The fall from his bicycle seemed to have restored his identity, but he never knew exactly when he lost it or how he had got to Brittany at all. I was not able in this case to trace a distinct relationship between mental strain and loss of identity. In the third case, however, such a connexion was easily traced. A young man had been working very hard for the Indian Civil Service and had just passed his examination. Instead of returning home, however, he disappeared and nothing was heard of him for two or three weeks when a letter came from Malta asking for money to pay his passage home. It appeared that he had completely lost his identity until one day in Mogador he suddenly awoke to find himself knocking another man down. He never knew exactly how he reached Mogador, but he learned that he had taken his passage from there to Malta and in coming out of the steamship office a man had tried to wrench his purse from his hand. The exertion of knocking

the man down seemed to have restored him to himself. He then knew who he was and communicated as soon as he could with his friends. The time which elapsed between his leaving London and arriving at Mogador remained a complete blank. The immediate cause of this curious loss of identity appeared to be the strain of examination, but the fact that this result is so rare, while examinations are so very common, appears to show that some other factor was at work. It is possible, of course, that this factor may have been simply the mental constitution of the patient, but it may also have been that this was aided by some toxin generated in the intestine in consequence of nervous disturbance of its innervation.

Eyestrain and Headache.

One of the most curious effects of nervous strain upon the nervous system is that of ocular strain in giving rise to headaches. Many cases of migraine resist medicines until the inequality in the eyes is equalised, while, on the other hand, glasses which will equalise the sight in both eyes will sometimes cure headache without any medicine whatever. But here again the production of headaches appears to be due to more than one factor. After a severe headache, accompanied by vomiting, and the enforced abstinence from food which the nausea entails, the patient is often able to strain the eyes by going to a picture gallery or theatre, reading small type, reading in bed, &c., without bringing on a headache, although any of those proceedings would certainly have brought it on a few days previous to the attack. It appears to me that the headache is due to the combined action of strain acting upon nerve centres poisoned by toxins, just in the same way as the failure of the frog's muscle to respond to a second stimulation of the nerve in a case of poisoning by ammonium salts. Very frequently, indeed, sick headaches are preceded by irritability, and the irritability may be often removed and the headache prevented if a dose of salicylate of soda, phenacetin, or antipyrin be taken when the irritability comes on, because it often precedes the headache by some hours. The removal of toxins from the liver by means of a mercurial, followed by a saline purgative, will also tend to prevent headache, even although the eyestrain be continued.

Irritability and Heart Disease.

There is a curious connexion between irritability and heart disease. The old steward at St. Bartholomew's, Mark Morris, told me that whenever a patient came to the office at 11 o'clock at night and wished to be discharged immediately, they knew it was a case of heart disease, and the high

tension of patients with gouty kidney is often accompanied not only by sleeplessness but by great irritability of temper. The condition of the circulation thus affects the emotions, and the emotions, again, have a most powerful action upon the circulation. I have seen a case in which a loud systolic bruit, both at the apex and base, appeared in a healthy heart within a few weeks after a great sorrow, and in another patient the worry connected with the disturbances in South Africa was followed by irregularity and weakness of the heart, to which the patient ultimately succumbed.

The effect of emotion upon the blood pressure is sometimes very great. In one experiment, which I made upon myself, I found that the irritation of being unable to keep an appointment raised my pressure from 120 to 160 millimetres—that is to say, by one-third of the normal amount; and it is this sudden rise which renders emotion so dangerous in cases of angina pectoris. It is well known how poor John Hunter rose up from a meeting of committee in a fit of anger and died just outside the door of the room. In all cases suffering from angina I advise the patients to abstain from excitement of every sort, and more especially to avoid anger and to give up attendance at committees, as on a large committee there is a great chance of some member being obstructive or irritating, and this, coupled with the increased irritability of which I have spoken, in a case of heart disease and in gout, may give rise to most serious or even fatal consequences.

Intellectual Strain.

Intellectual strain is much less injurious to the heart than emotional strain, but if the intellectual strain is great it is apt to be accompanied by more or less emotional disturbance, and also to lead to imperfect nutrition of the body, including the circulatory system. For it is to be remembered that the vagus nerve goes not only to the heart but to the stomach, and that intellectual strain may interfere with the digestion, either directly by its effect upon the digestive canal or indirectly by increasing the hours of work and diminishing the amount of time that ought to be devoted to rest or exercise.

Muscular Exertion, Digestion, and the Blood Pressure.

Muscular exertion tends to raise the blood pressure very greatly by compression of the arterioles during muscular contraction. When the exertion is not only severe but sudden the tension may rise very greatly indeed, but if the muscular exertion is begun slowly the blood-vessels in the muscular substance dilate, and thus the exer-

cises may be continued without materially raising the tension; in fact, at the end of the exercise it may be actually reduced. It is for this reason that patients suffering from angina so often tell you that the pain comes on as soon as they begin to walk, but after they have been walking a little while it ceases and then they may continue to take exercise, even severe exercise, for an hour or more without feeling any return of the pain.

There is another condition that tends to raise the blood pressure, and that is the ingestion of food. In his admirable book on the circulation Marey worked out the relationship between pulse-rate and resistance in the vessels and reduced it apparently to a simple mechanical problem—the greater the resistance in the vessels the slower became the pulse and *vice versâ*. Presumably there was no need for any nervous system either to the heart or to the vessels, the whole thing appeared to be mechanical, but there was one exception which he passed over and said very little about, and that was the rise both in pulse-rate and in arterial tension which he observed after meals, a rise which was quite independent of exertion. Now a rise in the pulse-rate is quite what one would have expected, according to Marey's law, because during digestion the vessels of the splanchnic area dilate in order to convey a free supply of blood to the secreting glands. The pressure, therefore, ought to fall very greatly, but it does not. On the contrary, it rises, and probably this rise is due to the effect of various products of digestion which are absorbed. What these are we cannot say, but we know that one of the products of pancreatic digestion is tyrosine, and from it may be produced an organic base which has the power of raising the blood pressure in the same way as the suprarenal extract, but more slowly and more persistently. This base has recently been introduced into medicine under the name tyramine. It is quite possible that other diamines are also formed in the intestine, and here I would like to draw attention again to the experiment I have already mentioned, that sometimes in poisoning by ammoniacal salts a muscle would respond by full contraction to the first stimulation of its nerve, but utterly fail to do so on the second stimulation. This whole subject requires a great deal of investigation, but it has seemed to me just possible that the sudden deaths which occasionally occur in elderly men who begin to exert themselves shortly after lunch may be due to the rise of pressure commonly associated with digestion and to the rise produced by exercise, combined, possibly, with the presence in the blood of some toxamine. Whether this be so or no, it is certain that in all patients presenting symptoms of angina the rule should be made, not only that they are to begin exercise very slowly, but that they should always rest for some time after a meal, and take especial care when beginning exercise of any

sort to go on for some time *very gently* before venturing on anything which may cause the least strain. It is very important also to prevent any accumulation of toxamines by keeping the liver as well as the intestines freely acting.

Effects of Over-exertion on the Heart.

The effect of continuous exercise in a case of high tension is to lower it by dilating the vessels supplying the muscular system, but a similar dilatation occurs in healthy people and is good, provided it occurs only in moderation. But if the blood is pouring rapidly through the muscles from the arterial system into the veins and the return of the venous blood to the heart is accelerated by muscular action, the right side of the heart is apt to become overloaded. Probably there is no one here who has not felt the distress due to over-exertion at some time or other in his life, and who is unacquainted with the relief he experienced when he got what is known as his second wind. I am not certain that I am right in my pathology, but my own belief is that second wind is neither more nor less than the accommodation of the pulmonary vessels to those of the general circulation. I well remember a good many years ago crossing the Col de Theodule in a frosty autumn morning. The guides walked somewhat quickly and I began to get shorter and shorter of breath. I felt a great oppression over the chest, and as I was walking without my coat and with my shirt thrown back, I put my hand where the apex beat of my heart ought to have been. To my astonishment it was not there, and I found that it had travelled round to the epigastrium, showing that the right side of my heart had become much dilated. I shouted to the guides to go more slowly, and in a short time the apex beat had travelled away from the epigastrium and back to its normal position. The over-exertion had led to the right ventricle becoming distended, and slackening the pace removed the distension by allowing the blood to escape through the lungs into the general circulation, and thus restored me to comfort. A good many years afterwards I read a paper by my poor old friend von Basch on "Lungen-starrheit" (pulmonary rigidity). He observed that much pressure in the right ventricle caused the capillaries surrounding the air vesicles to become stiff, so that the vesicles themselves could not readily contract during expiration. The consequence of this condition is that in this circulatory emphysema, as I may term it, the expiration becomes greatly prolonged, just as in ordinary emphysema, so that if we were to represent ordinary breathing as "ahhh ha" we might represent this prolonged expiration as "ahh haah." After I had read this paper I had occasion to run after a friend through a wood in America a good deal faster than I liked, as he was in much better training than I, and I found that

my respiration very speedily acquired the characters described by von Basch, the expiration being prolonged and gasping. By slowing down this condition of respiration also disappears, just like stitch in the side, which often comes on also before a man has got his second wind. The stitch in the side, I think, may be possibly due, in some cases at least, to a pull of the lung upon some old pulmonary adhesion, but this is merely a supposition. As a rule, after over-exertion of this kind, both the pulmonary capillaries and the right ventricle quickly return to their normal condition, and may be little, or none, the worse for it. Indeed, if the exertion be not carried too far and is repeated at proper intervals, both heart and vessels will be the better for it, just as the proper use of the biceps will produce in the muscle greater contractile power. We see, indeed, in athletes a physiological hypertrophy of the heart which appears to be productive of no bad consequences, and which, after some years of quiet life, may disappear and probably generally does do so. But if the strain be too great and too often repeated a more or less permanent condition of dilatation is produced, which leads to shortness of breath and symptoms of discomfort in the cardiac region even in young people, and which in elderly men may have the most serious consequences. One of my patients, a man of 86, was extraordinarily strong and healthy. It seemed as if he ought to live to 100. One day he was out in the country, and seeing some harriers running over a ploughed field he must needs run after them. The exertion was too great; he managed to get home, but his heart failed and he died after a few days.

Schoolboys and Cardiac Strain.

There is an old proverb that "What is one man's meat is another man's poison." What is true of food is true also of exercise. What is barely enough for one may be a great deal too much for another. Some time ago several doctors, of whom I was one, drew attention to the mischief that might result from cardiac strain through over-exertion in schoolboys. Our action was rather severely criticised, and a good many doctors said they had not seen cases of the sort that we deprecated. But in a court of law negative evidence is not always of much value, and although there may be no other evidence than that of A to show that B hit C with a stick, B might bring a thousand witnesses to show that they had not seen him do it. I have seen cases of cardiac strain from over-exertion in boys, and it is for this reason that I think more care should be taken than has previously been the case in regard to the examination of the boys' hearts before allowing them to undertake long-distance racing. I have a very great belief in the utility of exercise. I have no wish to diminish exercise in the training of

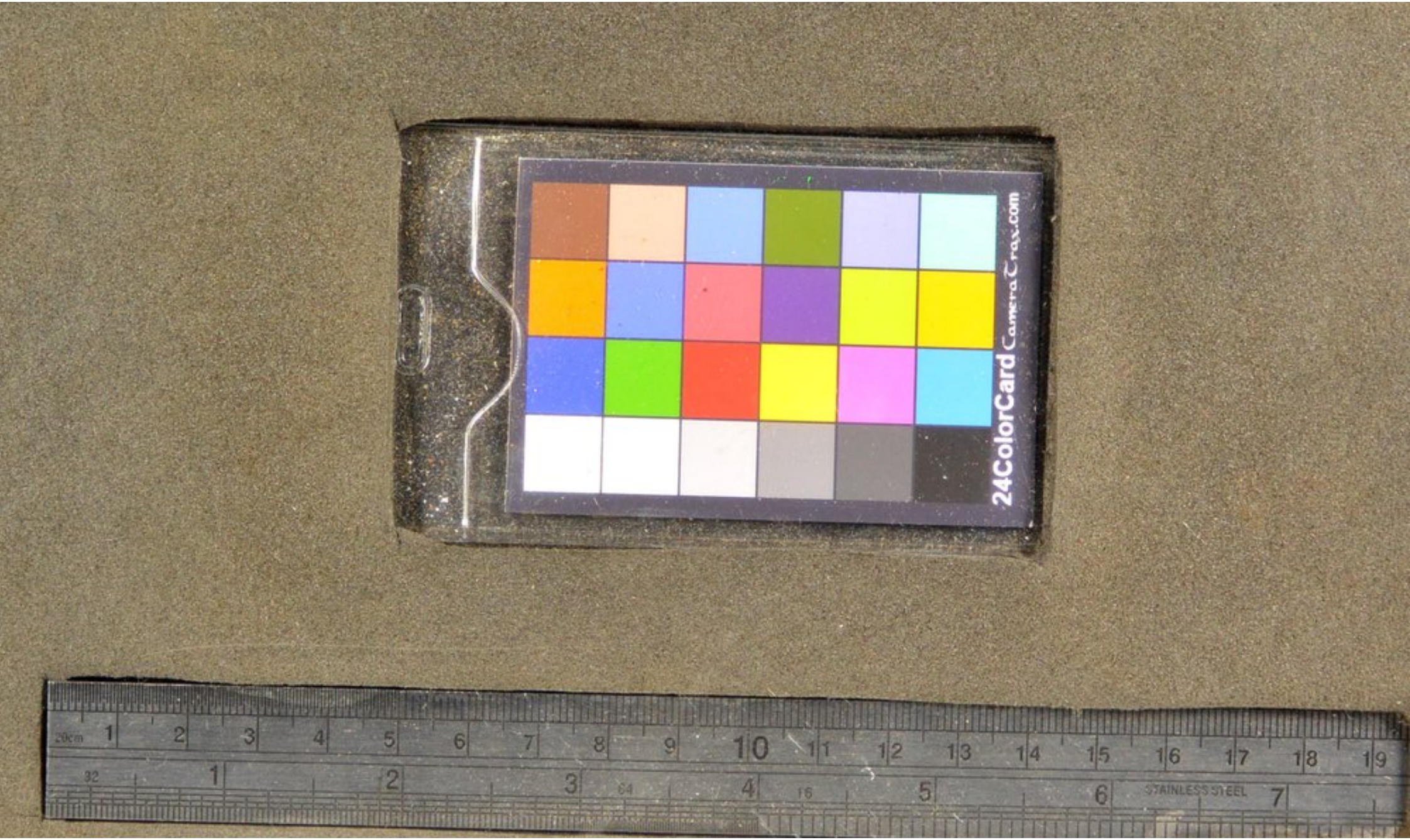
schoolboys. What I should like to do is to guard against over-exercise and strain. In football there is much greater exertion for a short time, and with some boys the strain might be too much for them, but I do not think this is likely to be anything like so great as the long-continued strain of a very long race. In our public schools great attention is paid to games, and the training the boys thus get—bodily, mentally, and morally—is, I think, of the greatest value, but I am inclined to think that it would be a good thing if this were supplemented by exercises which would develop them equally all round. In the University of Pennsylvania the students on entering have to pass a physical examination, and the professor of physical training notes their weak points and arranges exercise for them so as to produce an equal development throughout the body. The strong points he leaves to take care of themselves. I had once a long conversation with Professor Hueppe of Prague, who is not only a scientific man of great eminence, but a great athlete, and his opinion was that in Germany they had too many exercises and too few games ; that in England we had too many games and too few exercises ; that the ideal of development was to be gained by a mixture of the two.

Rejection of Recruits : Need of Physical Training.

But there is another section of the community in which physical training is badly wanted. Around a football match we may see several thousands of men who have collected to watch the play, but who are themselves sadly deficient in physical development. At the time of the Boer War two out of every five who presented themselves as recruits were either rejected at once or within less than two years for physical deficiency, and it was stated in the *Evening Standard* of Jan. 24th this year that something like one-third of the men in London who present themselves for enlistment in the Territorial Force have to be rejected owing to some physical defect. The most important defect apparently is that in vision, and this I think is due in great measure to early over-straining of the eyes. The proportion of Germans who suffer from shortsightedness is very great, and this I know has been attributed to the strain on the eyes caused by the German characters, both printed and written, and in scientific works the Roman characters are now generally employed. One of the most striking examples of strain on the ciliary muscle that I have ever seen was a patient who came from South Africa to consult me because he supposed he had a tumour in his brain. He was a man in active business, and was able, he said, to read his account books for four or five minutes, and then everything seemed to spin round and he could not see the figures any more. I examined him very carefully and found

that he had nothing the matter with him except a little presbyopia. His condition simply was, that by a great strain of the ciliary muscle he could adjust his focus so as to see the figures in his ledger for four or five minutes, then the muscle became tired, accommodation relaxed, and he could see nothing more. I sent him to an oculist who provided him with proper spectacles, and he went back to South Africa cured. To avoid such deficiencies in vision it is, therefore, advisable that the eyes should not be strained in school by making the child read small type or with a bad light.

Deficiency in sight is not the only cause of rejection. Imperfect development of the muscles, of the lungs, and of the heart are also responsible. The Board of Education has recognised the necessity for physical training in the schools, and has issued an admirable syllabus of the subject; but now arises a great difficulty. The subject is new, the teachers of the three R's have not been trained in it, and who is to teach the teachers? We want, for the sake of the country, a central institute for physical training, which might be on the same lines as the London University, with colleges all over the country, where the teachers could be themselves taught, while the central institute might examine as to their fitness and grant a certificate, but it is exceedingly difficult to get people to see the necessity of this. They all complain of the expense and wish to lessen the education rate below what it is at present. I for one should be quite pleased to do this, but it ought to be by cutting off a lot of extraneous subjects, teaching the three R's thoroughly, and building up the physique of the children. But any scheme of physical training would have been liable, as I have said defore, to do harm instead of good, unless it were preceded by compulsory medical examination of school children. This, fortunately, we have now got, so that, as medical men, with the good of the country before us, we must now do the best we can to ensure proper physical training. By obtaining this we shall diminish the number of cripples and of unemployed; by strengthening the physique we shall, I think, strengthen the *morale;* and, as I said in an address I gave some two or three years ago, it is cheaper to spend pence upon children than pounds upon paupers.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