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From "The Practitioner" for July, 1907.

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"The Practitioner," Limited,
149, Strand, W.C.

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To give an exact description of the heart in diabetes is at present extremely difficult, almost impossible. We may understand the difficulty that surrounds this subject, if we consider what the result would be if any one attempted to describe the condition of the heart in patients suffering from cough. The cause of the cough might be simply a little laryngeal, or bronchial catarrh, and the heart would be found perfectly normal. In other cases, in which the cough depended upon emphysema, or chronic cardiac disease, the heart might be greatly dilated, or hypertrophied, and, in cases of chronic phthisis, it might be somewhat atrophied. The results of post-mortem examinations would thus be so contradictory as to be absolutely valueless. The same difficulties occur in an attempt to give an account of the condition of the heart in diabetes, because the term diabetes is very often used to include all cases in which sugar appears freely in the urine. But the appearance of sugar in the urine, or glycosuria, is not a disease, like cough it is merely a symptom. It may be produced experimentally by alterations in several entirely different organs, viz., the liver, the pancreas, or the kidneys.

Hepatic glycosuria from alteration in the liver, or in the circulation through it, occurs after puncture of the fourth ventricle, as in Claude Bernard's well-known experiment, after many nervous lesions, and from the administration of various poisons. Pancreatic glycosuria may be produced by an obstruction of the pancreatic duct. Renal glycosuria appears after the administration of phloridzine.

It is probable that the causation of glycosuria in patients is quite as complex as, or even more complex than, that which can be produced experimentally, and yet cases of glycosuria, until within quite a recent period, have all been classed as diabetes. It is this that makes it so difficult to write on the condition of the heart in diabetes.

Glycosuria sometimes persists for a very long period indeed without producing any marked effect on the patient. I have had under observation, at intervals, for nearly thirty years, a

patient, whom I first saw for glycosuria in 1879. For two years previously, he had been troubled with intermittent pulse, but this condition subsided, and although he has had glycosuria ever since, from time to time, when I last saw him a few months ago his urine was quite free from sugar, and his heart and circulation quite normal, with the exception perhaps of a little accentuation of the second sound over the aortic valves. His ailment I regard, not as diabetes, but as gouty glycosuria.

Gouty glycosuria is, I think, just as different from true diabetes as bronchial catarrh is from phthisis. True diabetes, as a rule, occurs early in life, and runs a rapid course, whereas gouty glycosuria usually occurs after middle age, and may persist for many years without apparently doing the patient any harm.

In the progress of such cases, however, the glycosuria not infrequently becomes less marked, or disappears altogether, and other gouty conditions become prominent, more especially arterio-sclerosis, gouty kidney, cardiac hypertrophy, and other consequences. It is obvious then that to look for anything like uniformity in the post-mortem conditions occurring in cases, in which sugar has been present in quantity in the urine during life, would be as absurd as to look for uniformity in post-mortem conditions in persons who had suffered from cough. It is probably on account of the absence of uniformity in their results, that Professor Seegen, after examining thirty-two cases of diabetes, on which autopsies has been made in Vienna by Rokitansky, between the years 1838 and 1870, mentions the condition of many other organs, but entirely passes over that of the heart and arteries. Other authors are almost equally unsatisfactory, and the best account, that I can find of the changes in the circulatory apparatus, is given by von Noorden. Here again the difficulty arises that the post-mortem conditions he records were probably due, in many cases, to gout, or to some other complication rather than to the diabetes itself. Thus atrophy, with fatty infiltration and dilatation, is found in some cases, but the atrophy occurs oftenest in those, whose condition is deteriorated, and especially in those, in which diabetes has been complicated with tubercle. The fatty condition of the heart was not infrequently due to sclerosis of the coronary arteries. Cardiac hypertrophy has been found in proportions varying from 10 to 13 per cent., but in these cases there were generally alterations in the kidney as well.

In true diabetes, the cardiac affections most likely to occur are those which depend upon impairment of the nutrition of the muscular fibre, or of the nerves of the heart by the presence of sugar in the blood, or by other metabolic changes coincident with this excess of sugar. One of the commonest symptoms of diabetes is weakness of the muscles in the limbs and disturbance in peripheral nerves, either of their sensory or motor functions, or of both. What occurs in the limbs we would expect also to find in the heart, and this is actually the case.

In young patients, in whom diabetes is not complicated with other diseases, the muscular tissue of the heart is frequently found, on post-mortem examination, to be flabby or atrophied. During life, the circulatory symptoms are such as we would expect. They are shortness of breath on exertion, and frequently irregularity or palpitation on exertion or excitement, or after too free indulgence in the pleasures of the table, in alcohol or tobacco.

From the weakness of the cardiac muscle, any over exertion is apt to produce dilatation more easily in such patients than in healthy people, and they recover from its effects much more slowly. The pulse rate is very readily quickened to an extraordinary extent by any excitement of body or mind. Not infrequently the patients complain of attacks of faintness, or of oppression, or pain amounting to angina pectoris.

These symptoms may be in part due to the presence of sugar, and to the general alteration in metabolism, which leads to glycosuria, but they may also be the consequences of an original nervous condition, which gave rise both to these symptoms and to the glycosuria. In 1875, I recorded a case of glycosuria in the *St. Bartholomew's Hospital Reports*, in which exophthalmic goitre existed at the same time. In this case there was tachycardia, with cardiac dilatation, and a certain amount of mitral regurgitation. The case was remarkable for the sudden death of the patient without any apparent cause, and no valvular disease of the heart was found after death. In this case there had been no increased exertion preceding death, and only a little emotional disturbance. Sudden death has, however, not infrequently been noted in cases of diabetes, not only after emotional disturbance, but after unusual exertion, such as mountain climbing or a long journey.

In the case which I described there was, as I have already said, no valvular lesion whatever, although there was a marked regurgitant mitral murmur during life, which was probably due to cardiac dilatation.

Endocarditis may occur in patients suffering from diabetes, as well as in others, and may lead to valvular changes, but it does not seem much, if at all, more frequent in diabetics than others. Of course the coincidence of glycosuria with valvular disease is unfavourable. In mitral disease, occurring in diabetics, dropsy is less common than in others, probably because the sugar acts as a constant diuretic. In cases of glycosuria, occurring in persons after middle age, although the symptoms already mentioned may occur, yet attention should be carefully directed more especially to the occurrence of arterio-sclerosis, increased arterial tension, and all the consequences to which it is likely to give rise. On post-mortem examination, the heart may be found much hypertrophied, and the vessels atheromatous, and the kidneys sometimes showing marked granular atrophy. In cases of glycosuria, in persons above middle age, the urine should always be examined carefully for minute traces of albumen. These are sometimes so slight that it is almost impossible to detect them, except by acidulating freely with acetic acid, and boiling in a test tube the upper part of the urine only, so that the lower part remains as a control. By then examining the tube against a dark background, a faint haze may be seen, and this may generally be rendered more visible by the subsequent addition of picric acid. In many such cases, the sugar readily disappears from the urine, under proper diet and treatment, and the case becomes one of ordinary gouty kidney.

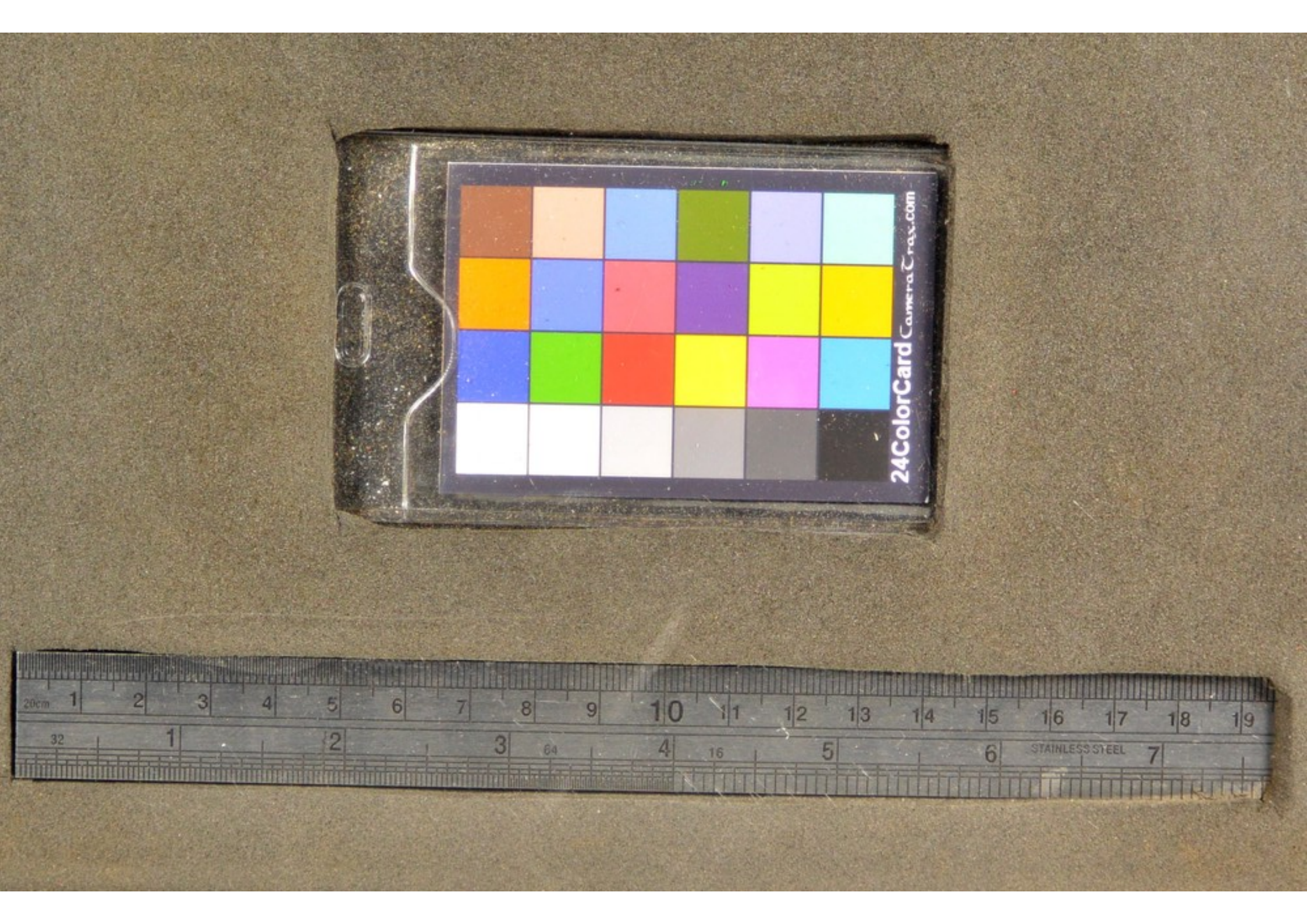
To sum up, shortly, our knowledge of the condition of the heart in diabetes, we may say that in young diabetics there is a tendency to malnutrition of the cardiac muscle and the cardiac nerves, leading to functional disturbance and possibly to sudden death. There seems also to be a tendency for the appearance of atheromatous change in the vessels generally, and in the coronary arteries especially, at a somewhat early age leading to fatty degeneration, feebleness of the heart, and angina pectoris. In gouty glycosurics, while the excessive sugar in the blood is injurious to the nutrition of the heart, the risk, which is chiefly to be feared, is from alterations in the peripheral vessels leading

to high tension, and cardiac hypertrophy with subsequent failure, or to rupture of a vessel and apoplexy.

In regard to the treatment of cardiac disease in young diabetics, the most important point is to lessen the sugar in the blood by appropriate diet; at the same time, it must be remembered that the large amount of water, excreted by the kidneys under the stimulus of the sugar, is apt to carry with it a large amount of inorganic salts, and thus impoverish the organism of its inorganic materials. Especially is this to be remembered in regard to salts of calcium, which have a most important action as cardiac nutrients, and the administration of calcium phosphate, or lacto-phosphate should not be omitted in any case of tachycardia, palpitation, or cardiac weakness and dilatation occurring in patients with diabetes uncomplicated by gout. In such cases, a proteid diet with a minimum of carbohydrates is indicated; cardiac tonics, such as digitalis or strophanthus and codeine, or morphine, which tend to lessen the production of sugar, may all be useful. In cases of gouty glycosuria, the dietary is more difficult, because, on the one hand, carbohydrates are to be avoided as they increase the sugar, and, on the other, albuminous matters should be restricted on account of albuminuria and renal inadequacy, while even fats have been objected to as producing an increased tendency to so-called acetonuria. In such a condition, one is obliged to make milk the staple article of food, and to add to it albuminous foods as free from purin bodies as possible. In many cases, however, one must allow fats as well as small quantities of farinaceous foods, so as to maintain the patient's strength.

The use of digitalis has been objected to by Schott in cases of cardiac disease occurring in diabetics, while von Noorden finds it very serviceable. The reason for this discrepancy of opinion, I believe to be that, while digitalis is useful in a case of diabetes without gouty complications, it requires to be used with great care in cases of gouty glycosuria, in which the heart is hypertrophied, and the arterial tension already too high. In such cases, the tendency of digitalis and strophanthus to still further increase the tension, should be counteracted by the administration, at the same time, of nitrite of soda, tri-nitrine or nitro-erythrite. A combination of salicylate of soda, or some of the other salicyl derivatives with codeine, is, I think, sometimes serviceable.

LONDON:
PRINTED BY EYRE AND SPOTTISWOODE,
HIS MAJESTY'S PRINTERS,
EAST HARDING STREET, E.C.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