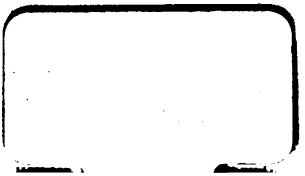
ON DIABETES AND ITS CONNECTION WITH HEART DISEASE.

BY

JACQUES MAYER, M.D.



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BY

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LONDON:

J. & A. CHURCHILL, NEW BURLINGTON STREET.

1888.

LONDON :
WERTHEIMER, LEA AND CO., PRINTERS,
CIRCUS PLACE, LONDON WALL.

PREFACE.

THIS paper is partly reprinted from the *British Medical Journal* for May 5th, 1888. Want of space prevented me from giving a full account of my researches into the subject of heart disease in connection with diabetes, in the columns of that periodical; and I now beg to submit it to the Profession in a separate form, in the hope that it will tend to amplify our knowledge of the various forms which diabetes is apt to assume in practice, and which have engaged my special attention during my twenty years' practice at Carlsbad.

ITALIENISCHES HAUS,
ALTI WIESE, CARLSBAD,
May, 1888.

ON

DIABETES AND ITS CONNECTION WITH HEART DISEASE.

A GLANCE at the literature of diabetes, which more especially since the memorable discoveries of Claude Bernard has attained very large proportions, shows us that singularly little is as yet known on certain affections of the heart and blood-vessels, which are apt to occur in the course of that disease. This may, perhaps, be accounted for by the circumstance that those who have occupied themselves with investigating the pathology of diabetes, seem to have given their chief attention to the examination of those organs which experimental physiology had shown to be more particularly involved in its production.

Thus we find that Seegen* in his book on diabetes, containing a record of 140 cases, says but little on the condition of the heart and blood-vessels in his patients. In one of his cases, that of

* Seegen, "Der Diabetes Mellitus." Leipzig, 1870.

a man aged 58, the right side of the heart was found hypertrophied; in another there was a feeling of congestion in the cardiac region; a third was subject to angina pectoris, although the heart was believed to be normal; in a fourth he found slight insufficiency of the mitral valve, and finally, in a fifth case, a systolic murmur was heard over the left ventricle. In other six cases the heart is simply stated to have been normal. This author does not say a word about any anatomical lesions of the organs of circulation in diabetes, in his chapter on morbid anatomy, where reference is made to thirty cases examined by Rokitansky and a few other anatomists.

In Cantani's clinical lectures on diabetes* there is also a great dearth of information about affections of the heart and blood-vessels. In 220 cases referred to by him, there was only one with valvular disease, which latter, however, had already existed before symptoms of diabetes had set in. In 150 cases no mention whatever is made of the physical condition of the heart. Out of five instances in which an autopsy was obtained, the heart was found small and atrophied in four, while in one its size was normal, but the right ventricle was found somewhat dilated.

* Cantani, "Der Diabetes Mellitus." Translated from the Italian by Dr. S. Hahn. Berlin, 1877.

Again, Senator* states that no prominent or frequent symptoms are to be observed in the sphere of the heart and blood-vessels in diabetes. In very obese subjects affected with diabetes, the heart has been found surrounded by fat, as is also seen in others who are not diabetic,† after protracted ill-health; while, where nutrition in general had suffered, it has been found atrophied. The arteries have sometimes shown atheromatous degeneration, but not very frequently, and Dickinson thinks this process to be rare in diabetics.

Donkin,‡ following some other English authors, has drawn attention to atrophy and fatty degeneration of the cardiac muscle found in diabetes. He observed that, in consequence of insufficient propelling power of the heart, hydrops occasionally supervened, or that there was sudden death by syncope. There was frequently great wasting of muscular tissue, and the pulse was very small and quick.

R. Schmitz§ describes a group of symptoms in advanced cases of severe diabetes, consisting of shortness of breath, sudden anorexia, vertigo, som-

* Senator, "Diabetes Mellitus," in Ziemssen's "Handbook," vol. xiii., p. 450. 1879.

† Ibid., p. 415.

‡ "On the Relation between Diabetes and Food." London, 1875, p. 186.

§ R. Schmitz, "Berl. Klin. Wochenschrift," 1876, 13, 5.

nolence, fulness in the head, and liability to fainting. Such signs he refers to relaxation and fatty degeneration of the heart. The pulse is soft and small; it is sometimes accelerated, but in other cases exceedingly slow; the apex-beat is always feeble, and often scarcely perceptible; the sounds of the heart and of the great vessels are feeble, and very indistinct. Such a condition of the heart Schmitz has ascertained in 80 out of 109 diabetic patients.

Leyden* has made some interesting remarks on asthma in diabetes, which point to a very different condition. The signs which he has observed, are those habitually found in cardiac asthma. There are attacks of dyspnœa, with palpitations and cardiac debility, occurring sometimes at a comparatively early period, where the diabetes does not seem far advanced, either in duration or intensity. According to Leyden, mental emotions are the exciting cause of such attacks. Asthma and cardiac debility may also arise from certain affections of the lungs.

In one of Leyden's cases, the diabetes took a rapidly malignant course, and led to extensive lung-disease, with well-marked attacks of cardiac asthma. The autopsy showed that these attacks

* Leyden, "Asthma and Diabetes Mellitus." Zeitschrift für Klin. Medicin, vol. iii., p. 358. 1881.

had been owing to hypertrophy and dilatation of the left ventricle, with fatty degeneration to an almost minimal extent.

Lecorché* has published some interesting observations on endocarditis, which he has seen, in a comparatively short time, in fourteen cases, as a complication of sub-acute and chronic diabetes. The age of the patients varied from 27 to 78 years; not one of them had suffered from rheumatism, or had been a habitual drunkard. The inflammation generally affected the mitral orifice, and only once the aortic orifice. In two cases the arteries showed the atheromatous change. The symptoms of diabetic endocarditis were the same as those of the common form of that disease, viz., a feeling of oppression, palpitations, intermittent pulse, œdema, and some other well-known sequelæ. There was a systolic murmur audible at the apex, but sometimes this only appeared after irregularity of the pulse and œdema had already been present for a considerable time. According to this author, the cause of the endocarditis is to be found in the continued contact of the saccharine blood with the inner surface of the heart.

Vergely† has made some noteworthy observa-

* Lecorché, "De l'Endocardite Diabétique," Arch. Gén., Avril, 1882, p. 385.

† "Gazette Hebdomadaire," vol. xx., p. 22, 1883.

tions on angina pectoris in four cases of diabetes which were in the first stage of the disease, and where nothing abnormal could be discovered in the heart. He believes the two affections to be etiologically connected.

In Frerichs'* book on diabetes the affections of the heart occurring in the diabetic have not been treated of, either from a clinical or an anatomical point of view. He has, however, observed sclerosis of the vessels in diabetes, and says :† "I have frequently seen sclerosis of the vessels, sometimes only of the coats of the arteries, at others with valvular disease which was combined with it, and I therefore consider it probable that there is a connection between the two conditions. They occurred in protracted forms of diabetes, in which I could follow the gradual and slow evolution of these changes in the heart and vessels, particularly such as were complicated with gout."

With regard to anatomical lesions he states‡ that the heart was frequently found small and atrophied, either pale or brownish-red, and weighed from 130 to 200 grammes. Valvular disease was repeatedly discovered, and it is worthy of note that during the course of diabetes chronic arteritis is apt to become developed.

* Frerichs, "Ueber den Diabetes." Berlin, 1884.
† Ibid., p. 77. ‡ Ibid., p. 140.

If we add to this that Frerichs attributes some of the symptoms of diabetic coma to cardiac debility, and the sudden death which he sometimes observed, to paralysis of the heart, we have stated everything of what Frerichs regarded as a connection between diabetes and heart disease, independently of such as is caused by certain diseases of other organs, such as the kidneys.

It will be seen from the preceding remarks that the clinical symptoms, as well as the anatomical lesions which have been described, have almost exclusive reference to cases of diabetes which have lasted for some considerable time. There are as yet no observations based on carefully continued physical examination of the heart, from the very commencement to the final termination of the disease. This is probably owing to the circumstance that diabetic patients as a rule enter the hospital only after the disease has greatly undermined the powers of the system generally.

It would appear to be easier to approach this side of the question in private practice; but there likewise the matter has attracted comparatively little interest. Even Pavy,* who has done so much towards the elucidation of the pathology of diabetes in its theoretical as well as practical aspects, has, in his report on 1,360 cases of diabetes which he

* "Deutsche Med. Wochenschrift," 1886, No. 28.

brought, about three years ago, before the British Medical Association, when treating of the physical examination of the organs in diabetes, only spoken of the condition of the liver in that disease.

With regard to my own observations on this point, I may here refer to a paper* which I published nine years ago on certain symptoms which I had observed in cases of diabetes complicated with obesity. These patients were apt to be suddenly taken with dyspnœa, although not to an alarming extent; they complained of pain and a feeling of oppression in the cardiac region, the pulse was abnormally quick, beating at a rate of 120 to 140 in the minute, with marked want of rhythm (delirium cordis). The pain sometimes spread from the heart to the shoulder, or to the left arm. In fact, the symptoms were analogous to those of angina pectoris.

Attacks of this kind have come under my notice in the initial stage, as well as in the further progress of the disease, but more frequently at an advanced period, after the obesity had more or less subsided; and physical examination of the heart showed mostly dilatation of the ventricles.

I did not then think that there existed an

* Jacques Mayer, "Ueber die Wirksamkeit von Karlsbad bei Diabetes Mellitus." "Berl. Klin. Wochenschrift," 1879, Nos. 21, 31, 32.

etiological connection between these symptoms and the diabetic process, or more strictly speaking, the saccharine blood, more especially because the same cardiac symptoms and physical state of the heart, on which Leyden* has thrown a flood of light, have also been frequently observed in cases of obesity without diabetes.

Subsequently, however, I discovered similar symptoms in diabetes uncomplicated with obesity; and I then thought it would be important to ascertain accurately, and as far as possible from the very beginning of the disease, the physical condition of the heart in every single instance which might come under my observation. I expected to arrive at some interesting results in this matter, as the waters of Carlsbad attract year after year a very large number of patients suffering from diabetes, who belong to all classes of society, the cases being of all the various degrees of intensity. I am fully aware that observations of this kind cannot claim the same degree of accuracy as those made in hospital practice; but I have been anxious to atone for this want as far as possible by written notes taken at the time. The number of cases being comparatively large, some degree of value may perhaps be attached to these observations.

* Leyden, "Ueber einen Fall von Fettherz." "Berl. Klin. Woch.," 1878, No. 16.

OBSERVATIONS MADE FROM 1879 TO 1888.

In these I have endeavoured to ascertain whether an etiological connection could be traced between heart disease in its clinical and anatomical aspects, and the principal symptoms of diabetes, viz., glycosuria and azoturia. From this point of view I have examined altogether 380 cases, which are tabulated with regard to sex and age as follows:—

Age.	Absolute Number.			Percentages.		
	Male.	Female.	Total.	Male.	Female.	Total.
Up to 10 years...	0	1	1	0	0·26	0·26
From 10 to 20 ...	1	3	4	0·26	0·79	1·05
„ 20 to 30 ...	3	5	8	0·79	1·31	2·10
„ 30 to 40 ...	29	16	45	7·64	4·20	11·84
„ 40 to 50 ...	99	22	121	26·04	5·80	31·84
„ 50 to 60 ...	76	51	127	20·00	13·42	33·42
„ 60 to 70 ...	51	12	63	13·41	3·17	16·58
„ 70 to 80 ...	7	4	11	1·84	1·05	2·89
Total	266	114	380			

It appears from this table that the large majority of cases occurs between the ages of forty and sixty; indeed, out of 380 patients, 248 belonged to those periods of life.

It is a matter of everyday experience that the course of diabetes is more rapid and unfavourable in youth than in advanced age. This accounts for the circumstance that by far the largest number of my cases, viz., 337, were at the time of observation, in the first stage of the disease, and merely a fraction, viz., 43, in the second stage.

First Stage.	Second Stage.
Males 241.	Males 25.
Females 96.	Females 18.

The female sex shows a far higher percentage in the second stage than the male.

In this, as in previous papers on this subject, I prefer speaking of "stages" rather than of a "mild and severe form," as further experience has shown me that the former classification meets the facts of the case far better than the latter. Out of forty-three cases of the second degree, twenty-six merged, as it were, under my own eyes from the first into the second stage.

If we leave out of sight for the present the degree of intensity of the malady and direct our attention to the general appearance of the patients, we notice certain distinctive features in them which, although they are not absolutely constant

are yet sufficiently characteristic to enable us to distinguish three well-marked types of diabetics.

We have to do, then, 1st, with patients of a feeble and delicate constitution, a more or less pale complexion, and a timid, anxious expression;

2nd. With patients who, on the contrary, have a vigorous and healthy appearance, a florid complexion, and a lively and animated expression;

3rd. With obese patients, some of whom are pale and sallow, while others have either a ruddy or a livid complexion.

In the beginning of the complaint or soon after it has commenced, the physical examination of the heart and vessels hardly ever shows, in any case belonging to the three types just mentioned, that the sugar which is circulating with the blood, or any increased production of urea which may have occurred, have had an unfavourable influence upon the cardiac muscle. Auscultation and percussion reveal the same signs as in patients of a similar condition who are not subject to diabetes.

After the malady has, however, lasted for some time, the physical signs undergo certain changes, which come on sooner or later, according to individual circumstances. To these I now proceed to direct attention.

In cases belonging to the first type, that is, in those of a more or less anæmic and feeble consti-

tution, I have occasionally seen endocarditis supervene, after some little time, as described by Lecorché, but much less frequently than this author, and not so much in patients of an advanced age.

In other cases of the same type the well-known symptoms of cardiac debility came on suddenly, while the physical signs found on examination of the heart did not show that any morbid changes had occurred in the endocardium, or that the volume of the muscular substance of the organ had been altered.

We may, however, conclude from the quality of the pulse, which is very easily compressible and of varying frequency, as well as from the weakness of the heart's sounds and the occasional presence of the so-called, "galloping murmur" (which latter Fraentzel* looks upon as indicating cardiac debility), that in such cases the functional power of the heart is lessened, and that this is owing either to atrophy or to retrogressive changes in the muscular fibres, that is fatty degeneration.

In a further number of cases the physical examination of the heart, which had in the beginning shown nothing abnormal, revealed, as time went on, dilatation of the organ, which for a period did

* Fraentzel, "Zeitschrift für Klin. Medicin," vol. iii., p. 491.

not seem to lead to any very striking symptoms, but which was, as soon as an exciting cause of some sort had acted, followed by severe dyspnœa and delirium cordis.

Cases of this kind are analogous to those of overstrain of the heart having a protracted course, in which Leyden* has, with Da Costa, distinguished a first stage of functional disturbance of the heart's action, and a second period of organic lesion, with dilatation of the ventricles. In the cases to which I am now referring, however, the functional symptoms of the first stage are not so clearly marked as in the other class, although Leyden† says pertinently, when speaking of the commencement of that cardiac affection: — "In private practice we shall only in very exceptional instances succeed in observing the first onset of this condition. The symptoms are then so insignificant, and become so gradually developed that the patient does not at once seek medical advice, but only subsequently reports the initial symptoms from recollection."

With regard to diabetic patients of the second type, I have found, in the majority of cases, after the malady has lasted for a variable time, a well-marked group of symptoms pointing to the deve-

* Leyden, "Die Herzkrankheiten," Berlin, 1886, p. 34.

† Ibid., p. 35.

lopment of cardiac hypertrophy. The complexion then becomes reddish, the mucous membrane of the mouth and the conjunctivæ is congested, the eyes are lustrous, and the carotids pulsate strongly as soon as there is the slightest emotional excitement. Vertigo, headache, and singing in the ears, are frequently complained of. The first signs of shortness of breath appear habitually after a somewhat abundant repast; walking exercise after meals causes discomfort; there is pain in the stomach and belching, and the action of the bowels becomes irregular. Sleep is broken, and often disturbed by a dry cough.

The pulse is full and strong, but does not show unduly high tension. It is regular and not accelerated, but on the contrary, sometimes rather retarded.

The physical examination of the heart shows a strong impulse, which extends over several intercostal spaces. The apex-beat is either within or without the mamillary line towards the left side, mostly in the fifth or sixth intercostal space. Percussion shows an enlarged sphere of dulness upwards and downwards, and less so in the transverse direction. The heart's sounds are loud and normal. In short, we have to do with idiopathic hypertrophy of the left ventricle, which has become gradually developed.

Further observations have shown me that this condition of the heart may persist for a number of years without producing much systemic disturbance, provided the patient avoids over-exertion and emotional excitement, is temperate in his habits, more especially with regard to alcoholic stimulants, and is careful to take regular exercise. On the other hand, where there is impaired nutrition; where, as is sooner or later always the case in diabetes, the food taken does not suffice to supply the wants of the system; where, therefore, the structure of the organs themselves is called upon for the maintenance of work, or where sedentary habits of life promote arterio-sclerosis, there the functional activity of the heart necessarily becomes lessened. The cardiac muscle is then relaxed and dilated, and sooner or later severe symptoms of disturbed balance of power make their appearance. Signs of cardiac debility, in fact, are then of cardinal importance in the further progress of the disease.

I have come to the conclusion that insufficient cardiac force, with dilatation of the ventricles, is, in a large number of cases of diabetes, traceable to more or less fully developed hypertrophy of the muscular substance. If it were objected to this, that alarming cardiac symptoms in diabetic patients

of the second type occur sometimes with extreme suddenness, without any hypertrophy having been ascertained previously, I would reply: 1st, that it is sometimes difficult or impossible to recognise this during life, inasmuch as enlargement of the lungs may be an impediment; 2nd, that in cases which progress rapidly, the increased volume may not be sufficient to cause marked signs, while the symptoms which have been described above may occasionally be overlooked.

It is, however, by no means necessary that hypertrophy should be invariably followed by dilatation. Even a vigorous muscle may waste away if insufficiently nourished. Moreover, I have seen a few cases where, after hypertrophy of the left ventricle had indubitably manifested itself, in the progress of diabetes, symptoms of cardiac debility appeared, and yet the physical signs of dilatation were absent. This can only be accounted for by assuming that the muscular substance which was at first hypertrophied, has become atrophied, and that in consequence of a diminished blood-supply the capacity of the heart could be lessened without dilatation being produced.

In patients of the third type, where diabetes is complicated with obesity, I have only ascertained a single new point tending to explain the morbid phenomena on the part of the heart. It seems to

me that, independently of the influence of accumulation of fat on and in the interstitial tissue of the muscle, as well as of arterio-sclerosis, which is so frequently present, the diabetes as such intensifies the degree of the heart-affection, and accelerates the eventual termination of the illness.

It is therefore seen from the preceding remarks that enlargement of the heart, owing either to hypertrophy or dilatation, occurs much more frequently in diabetes than might be assumed from the scanty information which has hitherto been available in the literature of the subject.

In 82 out of 380 cases of diabetes which have been under my care, the condition which I have just described has been present, without any other pathological change which could have led to it.

I now subjoin a few cases with the view of illustrating my statements.

Case 1.—G. R., a merchant, aged forty-seven, comes from a healthy family. He was found to be diabetic nine months ago, the quantity of sugar amounting then to 4·7 per cent.

I first saw the patient on June 19, 1879. He is of medium height, bones large, muscles well developed, and fat moderately so. The face was congested; nothing abnormal could be discovered in the lungs and nervous system. The pulse was full and

strong, of medium tension, regular, 64 per minute. The heart's dulness extends from the upper margin of the third down to the sixth rib, slightly beyond the mamillary line; towards the right it does not project beyond the edge of the sternum. The apex-beat was strong, and found in the fifth intercostal space, a little outside of the mamillary line. The liver and spleen appeared normal. The patient complained of constipation, headache, and rather frequent attacks of vertigo, with fulness and discomfort in the stomach after meals.

June 21st.—The quantity of urine in the twenty-four hours amounted to 2,200 cubic centimetres; spec. grav., 1,034; 4·3 per cent. of sugar = 94·6 grammes. No albumen.

I came to the conclusion that the diabetes had existed for some considerable time before it had been discovered, for although the patient had followed for many months a strict diet, the sugar only disappeared from the urine after twelve days of an exclusively nitrogenous diet. Within the next five years the patient was on three separate occasions under my care for four weeks consecutively, viz., in 1881, 1882, and 1884.

In 1881 I observed the case from July 15th to August 12th. The patient stated that during the past two years he had been fairly well, except that he had, after rather plentiful repasts, been

troubled with headache, vertigo, and some little shortness of breath. Nevertheless, the physical examination showed that the hypertrophy of the left ventricle had increased. The sphere of dulness was greater longitudinally, as well as transversely. The apex-beat was about two centimetres outside the mamillary line in the sixth intercostal space. The appearance of the patient was not changed; there was no albumen in the urine; he was still in the first stage of the complaint. The spleen and liver appeared enlarged, the spleen was also hardened.

July 7th to August 3rd, 1882.—There is now, in addition to the earlier symptoms, broken sleep, frequent sensations of heat in the cardiac region, and dry cough at night. The condition of the heart is the same as before.

July 9th.—Quantity of urine in the twenty-four hours, 1,970 cubic centimetres; spec. grav., 1,032; 2·5 per cent. of sugar = 48·95 grammes. No albumen.

August 1st.—Quantity of urine, 1,850 c.c.; spec. grav., 1,028; 0·8 per cent. of sugar=14·80 grammes. No albumen.

May 17th to June 20th, 1884.—Patient rather emaciated, complains of frequent dyspnœa and palpitations. During the last six months there have been repeated attacks of angina pectoris.

The pulse is permanently accelerated, 80 to 90 per minute, feeble, irregular, of low tension, the radial arteries are narrow. Apex-beat in the seventh intercostal space, soft and easily compressible. The area of dulness at the left side is increased in all directions; on the right side, at the base of the sternum, it is perceptibly enlarged. The heart's sounds are pure, but feeble. The liver and spleen have become more enlarged.

May 19th.—Quantity of urine in the twenty-four hours, 1,300 c.c.; spec. grav., 1,036; 4·8 per cent. of sugar=62·4 grammes. Traces of albumen, no casts.

During the time the patient was now under my care, he had a severe attack of cardiac insufficiency, after taking a walk subsequently to a meal. The attack was one of cardiac asthma, and lasted about thirty-five minutes.

June 18th.—Quantity of urine, 1,680 c.c.; spec. grav., 1,031; 1·6 per cent. of sugar=26·90. No albumen.

Case 2.—M. S., aged fifty-six, a merchant, from New York, comes from a healthy family without hereditary tendencies. Diabetes for the last three years. He had a slight attack of pneumonia twenty years ago; since then he has from time to time suffered from dyspepsia, which he ascribes to drinking too freely of iced water. During the last

two years he has often had headache, and after drinking tea or coffee a feeling of discomfort in the cardiac region. His occupation has been laborious and exciting; he has slept badly. Polyuria and polydipsia have lately somewhat diminished. There have been symptoms of dyspepsia, and sluggish action of the bowels.

July 1st, 1882.—Patient is of medium height, muscles well developed, bones normal, complexion florid, fat not too abundant, most teeth are gone, those still present are decayed. No fœtor ex ore. Lungs normal. The liver projects about two centimetres beyond the ribs, and is of medium consistency. The spleen is a little swollen, hard, and tough.

Pulse 60, strong, full, regular, tension somewhat increased, but no rigidity. Dulness at left side very marked and increased, reaching from third to sixth rib; apex beat in sixth intercostal space, about one centimetre beyond the mamillary line. Impulse strongly resisting, dulness at right side not increased. Heart's sounds loud, normal.

July 3rd.—Quantity of urine, 1,800 c.c., spec. grav., 1,038; 2·25 per cent. of sugar = 40·50 grammes. No albumen.

July 27th.—Quantity, 1,760; spec. grav., 1,028. No sugar or albumen.

Case 3.—L., aged forty-five, a merchant, from

Hungary, has indulged in sweet dishes; had catarrh of the bladder three years ago, but not now. Diabetic symptoms for several years. Diabetes diagnosed six months ago, with 5 per cent. of sugar.

Until a year ago he felt well, and could follow his occupation, which was very laborious; had only from time to time headache and vertigo. After a full meal, more especially if washed down with wine and coffee, there is a feeling of fulness and pressure about the heart, but no palpitations. Cause unknown. For the last twelve months his strength has gradually diminished, and he has rapidly wasted away; after muscular efforts there is dyspnœa and palpitations.

August 24th, 1882.—He complains of fatigue, which is easily induced, weariness, and somewhat increased thirst, as well as dryness in the mouth, broken sleep, frequent attacks of dyspnœa, with severe palpitations, dyspepsia, and cough.

Short stature, bones rather strong, muscles flabby and thin; florid complexion, skin dry, breath smells of acetone, teeth decayed, sight feeble. Slight bronchitis, nothing wrong with lungs. Pulse 80, regular, easily compressible; radial arteries narrow, dulness increased on right as well as on left side, on the left reaching about 2 cents. beyond the mamillary line, on the right extending about 1 cent. beyond parasternal line. Apex-beat in

sixth intercostal space, rather broad, soft, and easily compressible. Impulse on left side slightly, on right side more strongly resisting. Liver enlarged, and tender on pressure.

August 26th.—Quantity of urine, 1,800 c.c.; spec. grav., 1,037; 6·5 per cent. of sugar = 117 grammes. No albumen.

August 29th.—Diet having been rigidly enforced for three days, the quantity has come down to 1,650 c.c., spec. grav., to 1,034; 3·3 per cent. of sugar = 54·45 grammes. No albumen.

September 18th.—Quantity, 1,600; spec. grav., 1,033; 2·6 per cent. of sugar=41·6 grammes. No albumen.

The result of the last analysis, after a six days' strict nitrogenous diet had been enforced, showed that the patient was, as far as the elimination of sugar was concerned, in the second stage, or at least in an advanced period of the first stage of diabetes.

In 1883 he was again under my care from June 21st to July 15th.

Emaciation had then made further progress. The symptoms of diabetes and those of cardiac insufficiency were about proportionate in degree. There are more frequently severe attacks of asthma; pulse 90 to 95, feeble. The physical examination of the heart shows that the dilatation of both ventricles has still further increased.

June 23rd.—Quantity of urine, 1,700 c.c.; spec. grav., 1,040; 7·2 per cent. of sugar=122·4 grammes. No albumen.

July 15th. — Quantity, 1,850 c.c.; spec. grav., 1,038; 4·6 per cent. of sugar=85·1 grammes.

Case 4.—Mrs. J., aged 53, from S., England, a clergyman's wife. She had in former years frequently suffered from boils, and ascribes her illness, which was diagnosed twelve months ago, to severe grief. She has five children, all of them healthy. No hereditary tendency ascertainable. Diabetic symptoms, more especially polyuria and polydipsia, only slightly marked. She is easily fatigued after exercise, and disinclined for mental work.

August 4th, 1883. — Patient looks strong and vigorous, muscles and fat well developed. Complexion healthy; the conjunctivæ rather congested. She complains of frequent headache and occasional attacks of vertigo. When sitting for any length of time, respiration becomes uneasy; no cough. She finds it necessary to change her position frequently at night.

Pulse 62, full, strong, rather above medium tension, regular, dulness of left side increased upwards, downwards and outwards, extending beyond mamillary line about 1 to 1½ centimetres. Apex-beat in sixth intercostal space, outside the mamillary

line, very broad and powerful. Impulse likewise strong. Heart's sounds pure and loud. Liver somewhat enlarged, feels on inspiration rather harder than usual, spleen somewhat enlarged. Pressure and fulness in stomach rather frequent after full meals.

August 6th.—Quantity of urine, 1,860 c.c.; spec. grav., 1,030; 1·8 per cent. of sugar = 33·48 grammes. No albumen.

August 9th.—After three days' strict diet, 1,800 c.c.; spec. grav., 1,026; no sugar, no albumen. The patient was in the first stage of diabetes.

At the end of four weeks' treatment she was able to assimilate well from 60 to 80 grammes of amylaceous food.

Case 5.—A., restaurateur, aged 37, of Berlin, says that he has always been quite well. There have been diabetic symptoms for two years, and the disease was diagnosed about eighteen months ago. Since then he has taken chiefly nitrogenous food. There is no diabetes in his family, nor insanity. He has not been subject to neurotic influences. He ascribes his illness to excesses in sexual indulgence, in drinking, and in smoking.

July 2nd, 1884.—He complains of dryness in the mouth, of a disagreeable taste, which occurs apparently without any particular cause, of con-

gestion of head and face, which is sometimes so bad that while walking in the street he has to take hold of something to prevent himself from falling. Complexion ruddy. Breath smells of acetone. Most teeth decayed. There is a slight tremor in the upper extremities, probably owing to excessive smoking. The patient is a powerful man, with strong bones and well-developed muscles and adipose tissue. Liver enlarged, about two centimetres beyond the ribs. Lungs normal.

Pulse 70, vigorous, full, somewhat increased tension. Apex-beat wide, not easily compressed, in sixth intercostal space, about one centimetre outside the mamillary line. Dulness in left side everywhere increased. Impulse diffuse and intense; heart's sounds loud and pure.

July 4th, 1884.—Quantity of urine, 1,950 c.c.; spec. grav., 1,027; 2 per cent. of sugar, 39·0 grammes. No albumen.

July 7th.—Quantity, 1,780 c.c.; spec. grav., 1,025. No sugar or albumen.

He was in the first stage of diabetes. His tolerance for hydrocarbons was, at the end of four weeks' treatment, fair. He was able to completely assimilate 80 grammes of amylaceous food per diem.

Case 6.—Mrs. C. A., aged 39, from London. Has

suffered for many years from frequent attacks of muscular rheumatism and headache. Although living in very comfortable circumstances has had much worry and annoyance. To this she attributes the diabetes; no other cause can be ascertained. Her temper is at present very uncertain. Diabetes was diagnosed fifteen months ago.

July 30th, 1884. — The patient complains of increased thirst and frequent calls to pass her water. Fatigue is easily induced, and occipital headache frequent. Independently of the latter, she has also occasionally attacks of megrim. No dyspepsia or constipation; sleep deficient. Painful sense of dragging in legs, which is increased by walking.

She is tall and well-made, muscles well, and adipose tissue rather abundantly developed. Complexion fair, but is much reddened by the least excitement.

Pulse full and strong, of medium tension, 68 per minute. The volume of the left ventricle does not appear to be altered. Apex-beat in fifth intercostal space, scarcely extending beyond the mamillary line; nevertheless the elevation appears to be unduly strong to the hand. The dulness is not increased; the sounds are pure and loud. Liver, spleen, and lungs normal.

August 2nd.—Quantity of urine, 2,150 c.c.; spec.

grav., 1,030 ; 2·9 per cent. of sugar=62·35 grammes. No albumen, no acetone.

August 5th.—After three days' animal diet the quantity has gone down to 1,870 c.c. ; spec. grav. to 1,029 ; 0·3 per cent. of sugar=5·61 grammes.

In the further course of the treatment, which was carried out for five weeks, the sugar soon disappeared from the urine. The first stage of the disease was evidently not far advanced. The concomitant symptoms, more especially the muscular pains, and sleep, were better.

Three years afterwards I saw the patient again at Carlsbad, on August 3rd, 1887. She had changed very little in her appearance. Her general health had been good, with the exception of tendency to congestion of the head. She has more mental force, but some subjective symptoms have supervened which are referable to the heart.

After mental emotions and the use of alcoholic stimulants she complains of severe throbbing in the region of the heart and in the neck. She is unable to take as good a late dinner as formerly, for if she does so, pain in the stomach and shortness of breath come on, and she has a bad night.

The muscles are well nourished. Pulse strong, full, of somewhat increased tension and normal rhythm, 70 per minute.

Apex beat and impulse much increased. The

former is about a centimetre outside of the left mamillary line, in the sixth intercostal space; it is broad. Dulness at left side transversely as well as longitudinally increased, dulness on right side normal, heart's sounds loud and pure.

The liver projects about two centimetres below the right hypochondrium, its consistence is normal. Lungs healthy.

August 6th, 1887.—Quantity of urine, 2,200 c.c.; spec. grav., 1,036; 3·5 per cent. of sugar. No albumen.

The sugar disappears after five days' anti-diabetic regimen. The first stage of the disease seems therefore rather further advanced than before.

Case 7.—A. F., aged forty-two, country gentleman, from Pomerania. During the last twelve months marked polydipsia and polyuria; sleep broken. Diabetes was diagnosed eight months ago. Father died of pleurisy, mother still alive at sixty-five. Brothers and sisters are healthy. In June, 1878, had a fall from a horse, and had to remain in bed for some days afterwards. Has committed no excesses, and not suffered from worry or excitement. Has lost 1·8 kilogrammes of his body-weight of 71 kilo. during the last two months.

May 27th, 1886.—Complains of dryness in mouth and increased thirst, undue excitability, and painful dragging in the legs. Sometimes headache

and anxious feelings. Virile power normal, digestion good, vision impaired, teeth decayed, breath smells of acetone.

Pulse 65, full, strong, regular, of normal tension. Dulness on left side increased, extending from third to sixth rib, and going beyond the mamillary line. Apex beat in sixth intercostal space, about two centimetres outside of the mamillary line; intense and broad. Impulse vigorous, sounds pure, lungs normal. Liver and spleen healthy.

May 30th.—Quantity of urine, 2,280 c.c.; spec. grav., 1,039; 4·8 per cent. of sugar=109·44 grammes. No albumen.

June 2nd.—After three days' rigid diet, quantity reduced to 2,050 c.c.; spec. grav., 1,037; 3·5 per cent. of sugar=71·75 grammes. No albumen.

Further observation showed that the elimination of sugar could be reduced with nitrogenous diet, but much more slowly than is generally the case in the first stage. In many cases it does not seem expedient to insist on a long continuance of strictly nitrogenous diet, and I did not recommend it in this instance. I could therefore not ascertain whether the sugar might have been made to eventually disappear altogether with such a regimen. The patient was allowed to take 100 grammes of bread and a half litre of milk per diem, with sufficient meat and fat; very little alcohol. The

mineral water was drunk at a temperature of 71° F.

Towards the end of the treatment the daily quantity of urine varied from 1,800 to 2,000 c.c., and that of sugar from 2 to 2·8 per cent.

Case 8.—Mrs. K., aged forty-four, from St. Petersburg. Has had four confinements; one child died when quite young, of cholera, three others are healthy. Has always had much mental work to do, with sedentary habits. Both parents alive, father seventy-three, mother sixty-six. Has never been seriously ill. Two years ago increased thirst and frequent calls to pass water; emaciation during the last twelve months. Loss in ten months, 5 kilos. of a body-weight of 59. Diabetes was diagnosed in September, 1885.

June 7th, 1886.—She complains of occasional faint feelings, tinnitus aurium, strong throbbing of the carotids, and congestion about heart when excited. Short stature, muscles feeble. Adipose tissue slight. Complexion very red, in strong contrast to generally feeble appearance. Eyes rather staring, smell of acetone in breath.

Pulse 64, full, strong, of regular rhythm. Tension somewhat increased.

The physical examination of the heart shows a powerful, heaving impulse, extending over several

intercostal spaces. The apex beat, which is intense, is in the sixth intercostal space, and extends beyond the mamillary line to the left, by about a centimetre. The left dulness is enlarged in all directions; to the right, dulness not increased. Sounds loud, the first long and muffled.

Urine during night from June 7th to 8th, 900 c.c.; spec. grav., 1,035; 2·5 per cent. of sugar=22·5 grammes.

June 15th.—Quantity for 24 hours 1,720 c.c.; spec. grav., 1,030; 1·75 per cent. of sugar=31·10 grammes.

June 20th.—Quantity for 24 hours, 1,850 c.c.; spec. grav., 1,025; 0·3 per cent. of sugar=5·55 grammes. No albumen.

Further observation showed that patient was in an advanced period of the first stage of diabetes.

Case 9.—S. N., aged forty-eight, a merchant, from Hanover; diabetes diagnosed three years ago. It appears that the disease has become very gradually developed; and as the patient has lived carefully, it has retained the same slight degree of intensity until now. No cause to be ascertained. He complains of nothing but shortness of breath and slight palpitations, after fatiguing exercise.

June 1st, 1887.—A tall, vigorous man, muscles and adipose tissue well-developed. Florid complexion; teeth good. No smell of acetone in breath.

Pulse 66, full, strong, regular, tension normal. Apex beat heaving, most intense in fifth intercostal space, still plainly perceptible in the sixth, extends beyond the mamillary line to the left by 1½ centimetres. Left dulness marked, and enlarged upwards and downwards. Right dulness does not go beyond the right parasternal line. Liver and spleen moderately enlarged; the latter has a tough feel.

June 3rd.—Quantity of urine in 24 hours, 1,650 c.c.; spec. grav., 1,028; 1·7 per cent. of sugar=28 grammes. No albumen.

June 5th.—After two days' rigid diet, 1,700 c.c.; spec. grav., 1,023. No sugar or albumen.

A case of slowly progressing diabetes of the first degree.

Case 10.—V. W., aged forty; landed proprietor, from St. Petersburg. Has come to Carlsbad on account of liver and stomach trouble. Diabetes has not been diagnosed, although he states that he has for a long time past drunk a good deal of fluid during the night.

August 19th, 1886.—Quantity of urine in 24 hours, 2,100 c.c.; spec. grav., 1,039; 3·5 per cent. of sugar. No albumen or acetone.

Patient has been a free liver, smokes excessively, and has a very exciting and fatiguing occupation. An elder brother suffers from diabetes, which has

also occurred in other members of his family. His father may possibly have died of it.

A tall, powerful man, muscles good, adipose tissue moderate, complexion normal, ruddy. Expression intelligent, but anxious; conjunctivæ somewhat congested. He is occasionally despondent; has frequent headache, shortness of breath after meals, palpitations on going upstairs, and after much exercise on level ground. No marked cases of cardiac asthma have occurred, but it is evident that there is sometimes failure of the heart's power. He is then suddenly taken with dyspnœa, is obliged to stand still, and afterwards has to go on at a moderate pace. Periodically a dry cough; skin vulnerable.

Pulse 75; radial artery somewhat narrow, low tension; there is an intermittence after every 8 to 10 beats.

On palpation only a slight vibration is perceived in the heart's region. Apex beat easily compressible, but plainly perceptible; is in fifth intercostal space, a centimetre outside of the left mamillary line.

Dulness extends on the left margin of the sternum from third to sixth rib, and is of medium intensity. Heart's sounds plainly perceptible, although somewhat feeble, and not quite regular.

In the lungs a few moist sounds; liver mode-

rately enlarged. Knee-jerk sluggish; vision impaired.

August 22nd. — After three days' rigid nitrogenous diet, the sugar disappeared from the urine, but returned on allowing him 120 grammes of hydrocarbons per diem during the next five days, 32 grammes being the average. When only 60 grammes of hydrocarbons were allowed, there was more tolerance; for at the end of four weeks the percentage of sugar was 0·4, and the quantity 8·00 grammes per diem.

On summing up the results obtained, it is seen that in Case 1, hypertrophy of the left ventricle became developed under the influence of the diabetic metabolism, that compensation had been insufficient, and dilatation had ensued. In Case 3, it would appear that either previous to the occurrence of the dilatation, there had been hypertrophy of the left ventricle (and this is rendered probable by the statements of the patient), or, that it has been produced directly, analogous to that form of dilatation which occurs from over-exertion of the heart (Joh. Seitz, Leyden, Da Costa, O. Fräntzel) by compensatory hyperactivity, and proportionately insufficient nutrition.

Case 10 may be similarly interpreted. In this

patient, diabetes had unquestionably existed for years before I had the opportunity of diagnosing it. This is rendered evident by the symptoms observed by the patient himself, as well as by the hereditary predisposition which exists, and the numerous unfavourable influences which have permanently acted upon him.

While the signs of disturbed compensation are in him most prominent, their presence may be understood by assuming that preceding symptoms of cardiac hypertrophy have remained as unnoticed as the diabetes itself. This supposition is all the more probable because the muscular fibres of the heart are as yet in a comparatively good condition; and in consonance with this, the subjective troubles do not show an advanced degree of cardiac insufficiency.

In the other seven cases, the symptoms are so clear that a further argument concerning them does not seem to me necessary.

From the preceding remarks it appears that in a considerable number of cases of diabetes, hypertrophy and dilatation of the heart become developed, without there being any morbid changes in other organs, such as the kidneys, arteries, etc.,

which so frequently lead to these affections. If we now come to consider to which noxious influences these morbid changes in the structure of the heart are due, it seems most plausible to assume that they are owing to chemical irritation of the heart, by certain matters circulating in the blood; and these matters can only be sugar and urea.

With regard to urea, it has been shown by the experiments of Haughton, Reich, Rosenstein, Huppert, and Gaetgens, that diabetic patients eliminate more urea, other things being equal, than healthy persons. Cases are on record where from three to five times the average normal quantity of urea has been excreted. Thus Dickinson found it in one case to amount to 142 grammes, Leube to 150, Fürbringer to 163, and Senator to 70 in a child. I have not unfrequently found it to amount to from 50 to 80 grammes.

It is well known that the quantity of sugar contained in the blood in diabetes far exceeds that which is found in the normal blood, the latter varying from 0·05 to 0·20 per cent.; and although the numbers found by Hoppe-Seyler* and Cantari† in some cases, viz., 0·9 and 0·8 per cent., cannot be looked upon as averages; yet the blood of the diabetic is always so overcharged with sugar

* "Physiologische Chemie," p. 430.

† Moleschott, "Untersuchungen," vol. xi., p. 443. 1875.

that this latter may act as an irritant upon the heart's substance.

I look upon the anatomical lesions of the heart in diabetes, which I have described, as consequences of glycæmia and azotæmia.

Such abnormal states of the blood lead to polyuria, glycosuria, and azoturia, which are known to have a prejudicial influence upon the kidneys. If we therefore ascribe the hypertrophy and hyperplasia, which is so frequently discovered in the kidneys of the diabetic, to the presence of the anomalous secretions just alluded to, we may then likewise assume that urea and sugar have the same noxious effect on the heart, in producing an increase of volume in that organ.

In connection with this I may here refer to the experiments of Grawitz and Israel,* who produced hypertrophy of the heart in rabbits, first by causing chronic nephritis, and second by removing one kidney. These observers explain the increased cardiac function which took place in their experiments, by the partial loss of renal function; and conclude that those matters which are excreted from the blood by the kidneys, constitute an irritant for the heart, leading to increased function and eventually to increased volume.

* Virchow's "Archiv.," vol. lxxvii., p. 315.

Riegel,* proceeding more from a purely clinical point of view, has furnished another link in this chain of reasoning by showing that in a large number of cases of scarlatinal nephritis increased tension of the arterial system and cardiac hypertrophy ensued, and he has referred this to the retention of urea and other matters in the blood.

I therefore consider that the forms of heart disease which occur in diabetes are owing to the circumstance that the kidneys are unable, after a time, to continue the excessive efforts which they have been called upon to make; that their compensating functional activity gradually decreases, and that this leads to increased cardiac action, hypertrophy and dilatation.

Israel† has in another series of experiments varied the conditions under which he had worked with Grawitz, and has arrived at results which afford a considerable amount of support for the views I have been led to form with regard to heart affections being the sequelæ of diabetes. Israel's experiments on rabbits, into the details of which I cannot in this place enter, tend to show that the heart's action may adapt itself from time to time to the way in which urinary matters are formed in the system, and thus conduce to their

* "Zeitschrift für Klin. Med.," vol. vii., p. 260.

† Virchow's "Archiv.," vol. lxxxvi., p. 299.

elimination. He has, indeed, experimentally proved that we may cause hypertrophy of the heart in animals by the introduction of matters which can no longer be utilised for metabolism, and which must therefore be eliminated.

The disturbance caused by increased elimination of urea was investigated by feeding rabbits with large doses of that substance. They at first received two grammes of it per diem, and the dose was gradually increased to 8 and 12 grammes per day, without causing any serious deviation from health in the animals. In all the rabbits which had been thus treated, there ensued hypertrophy of the heart within a few weeks. Israel also found that hypertrophy of the kidney preceded that of the heart in all cases, being slight in old animals, and more fully developed in the young; thus showing that the system gradually gets accustomed to increased claims upon the functional activity of the organs. A similar result occurred after the introduction of nitrate of sodium, while grape sugar did not appear suitable for prolonged administration. When, however, injections of a concentrated solution of one or two grammes of this substance were made, either into the veins or the peritoneum, he was able to show by means of the kymographion that an increase in the pressure of blood was the result.

From these experiments Israel has drawn the conclusion that healthy kidneys will to a very great extent answer the increased calls made on their power, but that in extreme cases, such as diabetes and feeding with urea, they eventually become insufficient, and this sooner or later, according to individual circumstances. This insufficiency is then met by increased functional activity of the heart, which, if persisting for a sufficient time, leads to hypertrophy of that organ.

It is in this sense that I wish to be understood to account for the hypertrophy and dilatation of the heart, which is so frequently found in diabetes.

It is well known that the kidneys are often found after death in a state of hypertrophy and hyperplasia; and although the results of autopsies of such cases hitherto recorded do not seem to confirm my theory, that the heart's volume is eventually increased under these circumstances, I would point to the fact that these post-mortem examinations have been made exclusively on hospital patients, who are generally admitted for more or less acute diabetes, where rapid wasting of the substance of the organs is so apt to occur.

The cardiac muscle behaves in such cases much the same as other muscles, which although they have more work to do, yet do not become hypertrophied if they are insufficiently nourished.

A very telling analogous instance is furnished by pernicious anæmia, where the small quantity of oxidisable constituents of the blood, and the necessity of supplying the system with oxygen, may be supposed to act as irritants on the heart, and would lead to hypertrophy provided that organ were well nourished; but as such is not the case, and the heart is yet called upon for undue efforts, fatty degeneration will, on the contrary, be the result.

We may take it for granted that the anatomical lesions to be found in diabetic patients of a better class would differ, as far as the heart is concerned, from those to be met with in average hospital patients.

While regretting the fact that no post-mortem records of the better class of diabetic patients are as yet available, I considered it all the more important to go carefully through the records of the Pathological Institute of Berlin, especially as Israel had already found in 10 per cent. of diabetic cases which had proved fatal in the Charité, hypertrophy of the heart without valvular disease, and without affections of the arteries and kidneys.

Professor Virchow was kind enough to allow me to peruse these records from 1856 to 1887, and in going through them I gave special attention to the facts recorded on the condition of the heart, blood-vessels, and kidneys.

There were altogether 69 cases with the diagnosis of "Diabetes Mellitus." Many of these have already been mentioned in Frerich's book on Diabetes.

Name.	Organs of Respiration.	Organs of Circulation, Heart, Blood-vessels.	Digestive Organs.
Auguste Mittelhaus, workwoman. aged 17. Cause of death: Diabetic coma.	——	Dilatatio cordis. Heart above average size, cavities enlarged; endocardium and valves intact. Aorta of medium width (6 c.m.) intact.	——
Henrietta Werner, aged 53.	Phthisis ulcerosa cavernosa pulmonum.	Heart somewhat dilated; muscular fibres brownish, rather flabby.	Gastric catarrh.
Johanna Born, aged 57.	Phthisis cas. ulcerosa pulm. Bronchitis et peri-bronchitis caseosa.	Heart hypertrophied. Papillary muscle thick. Ostium of aorta wide (7·1 cent.) Both cavities dilated. Weight of heart 295 grammes.	Stomach dilated. Gastric catarrh.
U., aged 21, female.	——	Heart strongly developed, both cavities somewhat dilated. Muscle of left ventricle light brown, otherwise intact.	——

In nine out of these 69 cases the heart was found to have been hypertrophied. The records are as follows :—

Liver and Spleen.	Pancreas.	Kidneys.	Nervous System.
Spleen flabby, anæmic, 100 grammes, Liver 1410 grs.	50 grs.	Hypertrophia renum. Kidneys of more than average size, more especially the right; cortical substance everywhere broad; the tracings of the blood-vessels on the surface show unusual size of the several compartments of the cortex. Cortex proportionately large to medullary cones. Glomeruli prominent.	Hyperæmia cerebri. Dura intact. Convolutions very numerous. Pia has distended veins, which are everywhere transparent. Grey matter throughout slightly reddened. Cerebral substance moist, has a peculiarly sweet odour. No local lesions.
Hyperplasia lienis.	——	Hyperplasia renum.	Hyperostosis universalis cranii. In brain and cord nothing abnormal.
Liver weighs 1,350 grs., the centres of acini hyperæmic.	Small, but normal.	Right kidney, 158 grs., of good consistency, 12·0, 5·5, 3 ; left kidney, 168 grs., 12·5, 6·3, 3.	Fibroma duræ matris.
Liver of normal size, surface smooth. Parenchyma greyish red, except a few yellow spots. Acini rather small, indistinct.	Very small, capsule somewhat adherent with neighbourhood.	Both kidneys enlarged, cortex very broad, design everywhere distinct.	Hyperæmia cerebri.

Name.	Organs of Respiration.	Organs of Circulation, Heart, Blood-vessels.	Digestive Organs.
H. Gaudy, aged 39.	Pleurisy, slight broncho-pneumonic foci in left lower lobe.	Heart large, flabby, with abundant deposit of fat.	Stomach dilated.
Ramfeld, working man, aged 40.	——	Heart large and flabby, muscles brownish, valves normal.	——
Fromholtz, aged 50.	Lungs somewhat œdematous, partially adherent, pneumonia caseosa cavernosa.	Heart enlarged, ventricles somewhat dilated, muscles well nourished.	——

Liver and Spleen.	Pancreas.	Kidneys.	Nervous System.
Liver small, anæmic, spleen rather enlarged.	Hard and atrophied.	Hyperplasia renum.	Arachnitis chronica fibrosa, œdema piæ matris, hyperæmia subst. medullaris.
Liver large, dark, brownish red, and tough; acini indistinctly defined; cells turbid, fatty, and deprived of pigment; in left lobe a focus of pus, size of cherry stone; in right two smaller ones. Spleen large and soft.	Atrophied.	Kidneys moderately enlarged, left, $4\frac{1}{4}''$, $2\frac{1}{2}''$, $1\frac{1}{4}''$, surface smooth, capsule easily removable. Both kidneys contain small abscesses.	Purulent meningitis at base; posterior cornua of lateral ventricles, as well as the fourth, contain a turbid yellow liquid. Ependyma much thickened. Pia mater spinalis purulently infiltrated in posterior and inferior parts.
Liver large and heavy, of reddish brown colour, acini small, spleen somewhat atrophied.	Atrophied.	Kidneys enlarged, surface smooth, glomeruli strongly filled.	Dura mater thick, veins strongly distended. Sinuses all wide, filled with blood and tough fibrinous clots. Pia at cortex turbid, oedematous. Posterior cornua adherent. White matter of brain moderately hyperaemic. Cortex small, pale. Plex. chor. post. very strongly developed. Floor of 4th ventricle very tough, smooth. Striae acust. at right side powerfully, at left hardly developed.

Name.	Organs of Respiration.	Organs of Circulation. Heart, Blood-vessels.	Digestive Organs.
Carl Schmidt, aged 57.	Phthisis pulm. ulcer. cavern.	Heart rather large, muscles pale, rather tough.	Mucous membrane of stomach reddened. Gastric catarrh.
Otto Gaehne, workman, aged 26.	Phthisis ulcerosa cavern. præcipue pulm. dextr. Embolia et thrombosis arteriae pulmonalis partial. lateral. utriusque. Infarctus haemorrh. lob. inferior. utriusque. Pneumonia catarrh. caseosa multiplex. Bronchitis et peri-bronchitis caseosa. Pleuritis fibrinosa et tuberculosa.	Dilatatio ventriculi cordis sin. Thrombosis partial. ventric. sin. Aorta angusta. Heart shows globular rounding off at apex. Substance of ventricles of good consistency. Valves intact.	Gastro-enteritis catarrhalis.

The percentage in these records of hypertrophy or dilatation of the heart is 13·0, while in the cases observed by myself it amounted to 21·6 (82 out of 380).

Liver and Spleen.	Pancreas.	Kidneys.	Nervous System.
Liver large (nutmeg), 1,550 grs. Spleen enlarged, 433 grs.	——	Left kidney much enlarged, 216·6 grs., 5″, 2½″, 1⅜″. Capsule thin, easily removable, surface smooth, glomeruli large; right kidney, 4¾″, 2¼″, 1¼″.	Splanchnic nerves on both sides rather strongly marked. The sympathetic in the abdominal cavity on both sides very feeble. Skull extremely thick, hardly any diploë. Dura thick. Root of pneumogastric rather small, sinus transversus wide. Brain 1,549 grs. Grey matter rather pale. Fourth ventricle rather small, ependyma in its lateral parts granular.
Atrophia rubra hepatis, hyperplasia indurativa lienis.	——	Left kidney, 12·2, 4·0, 2·2 cm., is intact, nothing abnormal. Right kidney pretty much the same.	——

If we now consider that most of the post-mortem records just given show simultaneous severe affections of the lungs, and nearly all of them morbid changes in the brain, while in my own 82 cases no

organic disease could be discovered either by clinical symptoms or physical examination, the percentage of 13·0 must be looked upon as considerable. I will not omit to mention that in a number of the other post-mortem records hypertrophy of the heart with chronic endo-aortitis as well as endo-arteritis and hypertrophy were the primary affections.

While, therefore, heart disease in diabetes has only quite recently been mentioned by a very few authors, the occurrence of arterio-sclerosis in that disease has been much more fully dwelt upon, more especially by Frerichs. Those who leave out of account the increased functional activity of the heart have to look to the chemical alteration of the blood as the cause of the vascular disease.

We have seen above that the accumulation of sugar and urea in the blood is not proportionate to the quantity of these substances which is eliminated, but that, on the contrary, in consequence of increased cardiac activity, a compensatory elimination takes place in the urine, which is partly owing to enlarged kidneys and partly to changes in the heart's structure. The dilatation of the blood-vessels, which occurs subsequently, is simply owing to the increased work of the heart, which throws more blood into the vascular system in a unit of

time. Vascular disease is the consequence of permanent mechanical irritation.

Sir William Gull's and Dr. Sutton's 'Arterio-capillary fibrosis,' as occurring in nephritis, and Ewald's 'Muscular hypertrophy of the arterioles,'* must be looked upon as a secondary consequence of the cardiac disease. In the same way the occurrence of arterio-sclerosis in diabetes has to be traced to the mechanical influence of cardiac changes.

To a certain extent, Leyden has taken the same view of these matters in his paper "On heart disease in consequence of over-work," p. 7, where he says, "Although the connection of arterio-sclerosis with physical efforts cannot be made out with absolute certainty, yet it is rendered highly probable by the fact that the working classes suffer from it more frequently, and at an earlier age, than the middle and upper classes; and males more frequently than females."

I hope to have rendered it evident that the cases of cardiac disease which I have observed in patients suffering from diabetes, have to be traced to morbid changes of metabolism. My argument is moreover well supported by the observations of several authors, such as R. Schmitz, who have apparently found fatty degeneration of the heart in a large percentage of cases of diabetes.

* Ewald, "Virchow's Archiv.," vol. lxxi.

If we read such statements by the side of the anatomical records which I have given, it will be seen that they will have to be taken for what they are worth; for neither fatty metamorphosis nor infiltration of fat have been at all commonly met with post-mortem. On the other hand, such observations have a clinical value; since, as far as symptoms are concerned, fatty degeneration, infiltration of fat, brown atrophy, dilatation, and other anatomical lesions of the heart, may show at times the same clinical aspect, viz. of cardiac asthénia; which latter appears to me due to the claims made upon the heart by the diabetic change of metabolism. Compensation under these circumstances must always be temporary, more especially where the nutrition of the system in general suffers at an early period, and where the formation of urea and sugar exceeds that limit within which well-nourished kidneys and a well-nourished heart are able to eliminate these substances.

As far as treatment is concerned, it appears from the foregoing that everything should be avoided which may impair the action of the heart and kidneys; for we know that organs which are in a state of hyper-activity, easily become diseased. I may here refer to the frequent occurrence of valvular disease in nephritis, and of nephritis in

diabetes. The latter I have found recorded in 30 out of 66 cases contained in the records of the Pathological Institute of Berlin. Stokvis* has forcibly drawn attention to the same point in his able paper on diabetes read before the late Medical Congress at Wiesbaden; while I have seen nephritis in 64 out of 380 cases, although not frequently in the form of contracted granular kidney.

The principle of sparing the suffering organs as much as possible, has, in my opinion, to be carried out, particularly as regards diet. In many cases a rigid nitrogenous diet cannot be enforced. I have on this account, during the last few years, frequently added milk to the diabetic diet; and am able fully to corroborate the favourable testimony which Hoffmann has given on this point, before the late Medical Congress.

* Stokvis, "Zur Pathologie und Therapie des Diabetes Mellitus," in Transactions of the Medical Congress, Wiesbaden, 1886.