ON AMPUTATION FOR DIABETIC GANGRENE.

BY

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My reasons for asking the indulgence of the Society to an account of a few rather ordinary cases is, first, that the term *diabetic gangrene* is often, somewhat loosely, made to include a variety of different conditions, our knowledge of which has, however, during the last few years been gradually becoming more definite; and, secondly, that the advance of modern surgery should make us reconsider our position with regard to the treatment of its different varieties.

It is probably true that patients with sugar in the urine are more liable than other people to suffer from gangrene, and that when once started the disease with them is likely to run a more rapid and disastrous course; not that diabetes of itself is supposed to be able to produce gangrene, for the determining causes are usually, if not always, those which might occasion it if no sugar were present in the urine. I believe that this applies not only to simple diabetics but also to gouty subjects, who, at the time, are suffering from glycosuria, and to

diabetics who are the subjects of gout ; and, at all events, I venture with all humility to doubt the possibility of always discriminating between these three states, and therefore, from the surgeon's point of view, the necessity (I do not say the advisability) of attempting to do so.

No doubt the reason why the gangrene is more active in diabetics is that their tissues are weaker, and thus less able to resist the growth of micro-organisms and the influence of their products, partly also perhaps because their tissues supply a better pabulum for these low forms of life.

And the determining causes of gangrene are many. But those to which attention is particularly directed are three :

1. Inflammatory conditions.
2. Atheroma of vessels.
3. Peripheral neuritis.

1. The inflammatory conditions are familiar to every one, and include such cases as sloughing of the labia, depending primarily upon itching and consequent scratching of the part ; rapidly spreading carbuncles, or the rapid sloughing of ulcers such as I saw some years ago in a gouty old gentleman who had both albumen and sugar in the urine ; the front of his leg became quickly involved in a superficial slough starting from a previously existing ulcer, but under the influence of opium and a suitable diet, and the application of antiseptic fomentations, the sloughs separated and he recovered. Under the same head could be included the sloughing in a surgical wound which has not been kept aseptic. This condition is also very well known, but I may illustrate it by a case in which I excised the tongue by Kocher's method in a diabetic patient. He had left the hospital apparently almost well, when extensive sloughing set in in the deeper parts of the wound, and he rapidly died of pyæmia.

2. *Atheroma of vessels.*—It appears to be pretty widely

recognised, though not very distinctly stated in English writings, that patients with diabetes are particularly liable to atheromatous changes in their vessels; and several observers have pointed out—especially in Germany—that in most cases of spontaneous gangrene of the lower extremities in diabetics, extensive arterial degeneration is to be suspected. Frerichs,¹ for example, writing in 1884, says, “Sclerosis of vessels in diabetes, sometimes of the valves, was often observed, especially in cases where gout was present.” And Billroth has hinted that possibly the *endarteritis proliferans*, in which there is a great overgrowth of the internal coat leading to blocking of the vessel, but with little tendency of the new growth to degenerative changes, described by Winiwarter,² may sometimes be the cause of diabetic gangrene. I shall show the vessels from the amputated leg of one of my patients to illustrate the degree to which arterial degeneration may go on.

Some may possibly be inclined to doubt the truth of this assertion, even while admitting the fact that diabetics very often have rigid arteries; but probably none will deny that glycosuria is a very potent *predisposing* cause of atheroma, as it certainly is of beer drinking; and when a beer-drinking diabetic gets atheroma, it is impossible to discriminate between the two causes which are at work. Israel³ found arterial sclerosis in thirteen out of twenty diabetics who consulted him, and as he made no observations on the other seven, he presumes that a still larger proportion manifested it. There is a man at University College Hospital now aged thirty-one, with marked diabetes, who has taken copiously of beer from the age of seventeen till he found, twelve months ago, that it began

¹ ‘Ueber den Diabetes,’ von F. F. Frerichs, Berlin, 1884, s. 77.

² “Ueber eine eigenthümliche Endarteritis und Endophlebitis mit Gangrän des Fusses,” von Felix v. Winiwarter, ‘Archiv für klinische Chirurgie’ (Langenbeck), 1879, s. 202.

³ “Einige Beziehungen des Diabetes Mellitus zum Chirurgie,” Berlin, ‘Klin. Wochenschrift,’ 1882, s. 705.

to disagree with him—five or six pints a day was his allowance;—the arteries of his arms are hard and somewhat tortuous, harder indeed than those of any other patient in the ward, twelve of whom I examined, of ages (given below ¹) varying from 23 to 63.

I examined yesterday a girl of 13, who is attending at University College Hospital for diabetes, from the symptoms of which she has suffered since Christmas, 1891. She passes about 90 oz. of urine, with a sp. gr. 1046 and 1048, and is but little amenable to treatment. In March of this year she suffered from neuritis of the right brachial plexus and the left great sciatic nerve, but the pain and tenderness have quite passed away. She has had no knee-jerks for some time, but has no anæsthesia nor hyperæsthesia. Her radial and brachial arteries are straight but very hard and incompressible, though the pulse is very small and feeble. The posterior tibial vessels are also hard, but the pulse in them is very weak. There is no valvular murmur at the heart.

Anyone looking through published accounts of cases with this idea in his mind cannot fail to be struck with the frequency with which, when the pulse is mentioned, it is added that the vessels are hard and incompressible.

I have placed upon the table specimens and micro-

¹ 1. Male, æt. 62. Interstitial nephritis and chronic bronchitis and emphysema. Arteries a little tortuous, but soft.

2. Male, æt. 29. Aortic regurgitation. Arteries soft and straight.

3. Male, æt. 52. Aphasia, albuminuria. Arteries soft and tortuous.

4. Male, æt. 37. Hæmaturia, enlarged prostate, vomiting. Arteries tortuous and rather hard.

5. Male, æt. 39. Lead colic. Arteries not quite straight, but soft.

6. Male, æt. 47. Cirrhosis of liver. Arteries soft and not tortuous.

7. Male, æt. 30. Gangrene of lung. Arteries straight and soft.

8. Male, æt. 27. Aortic and mitral disease; has had double pneumonia. Arteries straight and soft.

9. Male, æt. 24. Jaundice. Arteries straight and soft.

10. Male, æt. 23. Emphysema and bronchitis. Arteries soft and straight.

11. Male, æt. 37. Phthisis, first stage. Arteries rather hard, but straight.

12. Male, æt. 37. Emphysema and bronchitis, alcoholic. Arteries soft and straight.

scopical preparations of some of the arteries of a man of only 24 years of age—a footman—who died in coma at the Brompton Hospital, which show marked overgrowth and some degeneration of the internal coat. Unfortunately the vessels of the leg were not examined. There is no history of this man's habits with regard to alcohol, but his occupation is a suggestive one.

During the writing of this paper I have only had the opportunity of examining *post mortem* the vessels of two other cases of diabetes. Both were young subjects, and neither showed any naked-eye degenerative changes in the vessels; but most unfortunately both of the preparations have been mislaid before they were examined microscopically.

It is to be hoped that in time more evidence will be forthcoming as to the state of the arteries and veins and peripheral nerves in young people suffering from diabetes, because it is to be noted that spontaneous gangrene does not occur—or very rarely occurs—in them before early middle age, and it is to be presumed that this may depend upon the fact that up to that time the vessels are comparatively speaking healthy. I am conscious that this argument is inconclusive, because it may be urged that neither does carbuncle occur in young people, and, besides, the diabetes of old and middle-aged people seems to stand upon a different footing from the acute disease of children and young people. To this, however, it may fairly be replied that the young person with his acute disease may, if he take sufficient care, live to be a middle-aged person with the chronic disease; and as to carbuncles, we do not know at all how much the arterial circulation or thrombosis may have to do with their causation and progress.

3. The subject of peripheral neuritis is a very large one. Even that portion of it which concerns us is by no means limited. Ziemssen,¹ in 1885, seems to have been the first to start the idea that the neuralgic pains of

¹ 'Münchener med. Wochenschrift,' 1885.

diabetics depend upon peripheral neuritis; and Leyden,¹ in 1888, classified and arranged the various forms in which it may occur. In our own country it has been recognised and described by Buzzard and Althaus, and in France by Charcot and others. A very good *résumé* of the whole subject will be found in a paper by M. B. Auché² published in 1890. The conclusion of those who have studied the matter appears to be that diabetics are frequently the subjects of peripheral neuritis arising from no other cause except the glycosuria; that the symptoms following from such affections may consist of motor, sensory, trophic, or vaso-motor derangements; and that while they are subject to considerable variations, they often approximate very closely to those of alcoholic neuritis. The peripheral neuritis of diabetics is apparently much more frequently met with in the lower than in the upper extremities, and the variety, or the combination which chiefly concerns the subject of this paper, is that which causes perforating ulcers, usually originating in corns, just as they do in patients suffering from tabes. It may be set down as a combination of the sensory and trophic forms of the disease, and has even been called *tabetic*. It is noteworthy that the knee-jerks are frequently either temporarily or permanently absent in diabetes, but Argyll-Robertson pupil does not appear to have been ever observed.

I do not wish to suggest that when the gangrene starts from a perforating ulcer, only changes in the nerves are to be looked for. Probably, in most cases, there is arterial degeneration as well; and it is not improbable that, when the arterial degeneration is the most important factor, the nerves may also suffer at the same time. Winiwarter, in his paper on "Endarteritis Proliferans," describes not only arteritis and phlebitis of the posterior tibial vessels, but fibrous thickening of the sheath of the

¹ Leyden, 'Die Entzündung der peripheren Nerven,' 1888.

² 'Archives de Médecine expérimentale et d'Anatomie pathologique,' 1890, tome ii, p. 635.

posterior tibial nerve. I would only suggest that, in some cases, those in which the gangrene is painful and spreads rapidly, the cause is most likely to be chiefly arterial degeneration; while in those which are almost painless and very chronic, it probably depends upon changes in the nerves. And the deduction with regard to treatment, which I think may be made, is that, if the former class of cases are to be interfered with at all (and if the gangrene be spreading rapidly, I think it is not only justifiable but indicated), amputation at a considerable distance from the seat of the trouble should be practised. The latter class may more safely be left for the chance of separation by natural means, but if the patient's condition be otherwise good, there is very little risk in removing the necrosed part within a short distance of the completely or imperfectly formed line of demarcation.

This opinion is, of course, quite opposed to that of antiquity. It is opposed, I believe, to that of some surgeons at the present day,—for example, to that expressed in one of the latest English works on operative surgery.¹ But I think that when Mr. Treves says, “Diabetes offers an almost positive bar to any kind of operation;” and again, “Diabetic gangrene of a limb is scarcely within the scope of surgical measures; an amputation in such a condition is almost invariably fatal,” he is expressing rather the views of a past generation than those of the present time. König² (though he does not advocate early and indiscriminate amputations) strikes, I think, a truer note when he says that the fact that the tissues of a diabetic patient are very prone to serve as a nidus for the growth of micro-organisms should only make us doubly careful, when we operate, to keep our wounds aseptic. In truth, the introduction of the antiseptic principle has rendered operations upon diabetics very much less formidable than they used to be when most of the present text-books on surgery were written. The

¹ ‘A Manual of Operative Surgery,’ by Frederick Treves, 1891, vol. i, p. 18.

² ‘Centralblatt für Chirurgie,’ No. 13, 1887.

weakened tissues may be, and often are, able to withstand the mere mechanical injury of an operation, although they cannot endure this as well as the irritation produced by putrefaction. At the same time it must not be forgotten that no amount of antiseptics can do away with the danger of coma, or heart failure, following an operation, though their wise employment may immensely diminish the chance of sloughing of the flaps.

I have myself seen a patient die from coma after amputation at the knee for gangrene of the foot, in the hands of a distinguished surgeon whose antiseptics are quite above suspicion.

To illustrate the foregoing observations I will read the notes of two or three cases.

CASE 1. *Diabetes ; gangrene of foot ; amputation above knee ; recovery.*—T. T—, the patient, is a large, fat, muscular man, unmarried, 48 years of age, a coffee-house keeper by occupation for the last thirty-one years, who has been much exposed to the heat of the kitchen, and for many years has partaken freely of alcohol in one form or another. Up to thirty years of age he used to take as much as five or six pints or more of beer daily ; then he stopped this and took to gin and water, and afterwards whiskey and water and claret. He never was intoxicated, but took it constantly and freely for a prolonged period.

The family history yields only two facts of importance, namely, that an uncle died of gangrene of the toes, and that there appears to be phthisis on the mother's side. He himself gives no history of gout, unless some pain, fourteen years ago, in the right foot may have been due to this cause. He does not appear to have ever suffered from a serious illness, except a bad carbuncle five years previously, and some abscesses of the neck at the age of twenty-eight, until he applied at University College Hospital, in September, 1891, for gangrene of the middle toe of the right foot, which had followed a small festering

sore round the quick of the nail of the little toe, contracted twelve weeks before. There appears to have been considerable inflammation of the foot, which at one time extended halfway up the calf, but had subsided again, and the sore on the little toe had partially if not completely healed. The actual gangrene started only a week before his admission (on the 19th of September, 1890), and was caused by an abrasion on the upper surface of the middle toe, five days before. On admission it was black as far as the base, and the foot was red and hyperæmic almost as far as the malleoli; there was a feeble pulse in both anterior and posterior tibial arteries. The temperature was usually a little below 100° , never above.

He was passing, at this time, ninety ounces of urine a day, with a sp. gr. of 1040, containing a trace of albumen, and 22.1 to 30.8 grains of sugar to the ounce, but there was no undue thirst nor appetite; and although he had for some time been perceptibly losing flesh, none of the ordinary symptoms of diabetes were present. On the 23rd he was put upon a strict antidiabetic diet, and on the 25th he was ordered 1 gr. of opium every sixth hour. Notwithstanding which, though the sugar was reduced to from 16.79 to 23.3 grains per ounce, and the total amount of urine to from thirty-eight to fifty-four ounces in the twenty-four hours, the gangrene continued to extend at the rate of about a quarter of an inch a day, so that by the 25th the purplish blush had involved about three quarters of the foot, and three toes were completely mortified. The heart sounds were normal.

No careful observation upon the state of the peripheral nerves was made at the time, nor was any search made for symptoms of tabes. But since the operation, to be described, it was noted that his knee-jerk was sometimes present, sometimes absent. The ulnar nerves were very easily felt, and were, perhaps, harder than natural; they were not tender, and there was no other tenderness on the course of the large nerves. He did not suffer from neuralgia. The vessels of the upper limbs were hard; the

pulse was weak and unequal in the two radials. The pulse in the left posterior tibial was very weak, that in the dorsal artery of the foot could not be felt; but in any case the amount of subcutaneous fat, and the slight cedema now present, would have made that difficult. It seemed to me that the prospect of a line of demarcation forming was not good, and that the best chance would be given him if the limb were to be amputated above the knee. This was accordingly done on September 28th, in the following way. A circular sweep was made round the limb below the patella, and all the soft parts were raised until the femur was reached just above the condyles. The periosteum was then divided and raised for about an inch, when the bone was sawn through; but, as this did not give quite enough covering, the limb was raised in the air, and the periosteum was separated for nearly another inch, the bone being subsequently removed. When the bleeding had been stopped, this tube of periosteum was in the first place closed, so that before the sutures were applied the face of the stump presented a peculiar appearance, as no bone was apparent at all. A small short drainage-tube was inserted in the middle of the incision, which was removed on the third day. Nothing need be said about the progress of the case. Very great care was taken to conduct the operation antiseptically, and the stump behaved as an aseptic stump should do. The temperature only ran to 99.4° on the day after the operation, and after that did not touch 99° . From the 4th to the 15th, indeed, it was constantly subnormal. The pulse was seldom below 90 or above 100. By October 14th the wound had healed, except a superficial granulating surface half an inch long, which had absolutely closed by the end of the month. It is interesting to note that the patient developed a dusky spot on the heel of the opposite foot, while he was lying in bed, but the epidermis over this never separated, and the spot regained its natural colour.

I append a table showing the analysis of the urine, from which it will be seen that this patient's glycosuria

Date.	Quantity in ounces.	Sp. gr.	Urea.	Albumen.	Sugar.	
					Quantity per ounce.	Total in 24 hours.
Sept. 21	33 + ?	1040	...	Trace	Grains. 30·8	Ounces. 2·12 +
22	66 + ?	1040	...	"	22·1	3·03 +
23	90	1038	1·6%	"	25·8	4·89
24	58	1041	2·5%	$\frac{1}{5}$	27·23	3·27
25	48	1039	2·4%	$\frac{1}{5}$	22·35	2·23
26	38	1038	2·8%	$\frac{1}{5}$	16·79	1·31
27	80	1035	2·3%	$\frac{1}{5}$	25·8	4·30
28	54	1034	2·2%	$\frac{1}{5}$	21·79	2·43
29	32 + ?	1020	...	$\frac{1}{5}$	6·55	
30	45	1036	...	$\frac{1}{5}$	8	
Oct. 1	58	1032	...	$\frac{1}{5}$	4	
2	48	1030	...	$\frac{1}{5}$	3	
3	36					
4	48	1025	...	Trace	1·33	
5	50	1020	...	"	None.	
6	42	1026	...	"	Trace.	
8	68	1028	...	"	"	
9	30	1033	3·25%	"	4·63	
10	24					
11	37	1035	...	Trace	6	
12	64	1024	...	"	2	
13	68	1027	...	"	3·75	
14	60	1022	...	"	2	
15	18 ?	1027	...	None	3	
16	48	1026	...	"	3	
17	58	1021	...	"	2	
18	49	...	...	"		
19	28	1030	...	"	None.	
20	64	1025	...	"	"	
21	58	1017	...	"	"	
26	48	...	...	None	"	
27	—	1027				

was very amenable to treatment. The improvement, when he was taking an antidiabetic diet and four grains of opium in the twenty-four hours, was very great ; for a time, indeed, the sugar absolutely disappeared. A certain amount of albumen (usually only a trace, but sometimes as much as one fifth) was present, but the amount did not bear any constant relation to that of the sugar. It is, however, perhaps possible that the case is one not so much of true diabetes as of glycosuria alternating with albuminuria in a gouty subject. He keeps now in pretty

good health (October, 1892), is much stouter; he is rather careful with his diet, but passes urine of high specific gravity, which contains a large quantity of sugar and some albumen. There is slight œdema of the leg.

In the parts removed at the operation the following points are to be noted:

1. Marked changes due to chronic rheumatic arthritis in the knee-joint, namely, a soft velvety condition of the cartilage, lipping and flange-like projections of the bone, and a rather large loose cartilage.

2. Advanced atheromatous changes in the popliteal artery and the arteries of the leg with much calcareous deposit, some of these vessels being rigid tubes, while the anterior tibial was almost completely obstructed.

3. Microscopically the changes in the internal and middle coats were characteristic of ordinary atheroma, not endarteritis proliferans.

4. No obvious pathological changes in the veins or nerves.

The knee-joint showed marked signs of rheumatoid arthritis, viz. nodular overgrowth sufficient to cause lipping or flange-like projections from the edge of the femoral condyles; a finely granular almost velvety appearance of the cartilage; a loose body in the joint one inch by three quarters of an inch in diameter, and from one eighth of an inch to quarter of an inch thick, one surface being rough and bony in appearance, the other being smooth and apparently cartilaginous, the edges, however, being rolled over so as to form a rim all round it; it weighed thirty-seven grains.

The arteries for the length of eighteen inches were dissected out and are now exhibited. The *popliteal artery* forms a rigid tube from the deposit of calcareous material in the middle coat. To the naked eye, a transverse section shows thickened internal and middle coats; the two can be readily separated. The internal coat, whether viewed from the surface or in section, does not show any patches of atheroma, but appears to be uniformly thickened

and thereby rendered opaque. In the middle coat the calcareous deposit does not occur in the form of rings, but irregularly. Here and there it shows through the inner coat. The external coat shows no obvious changes. The naked-eye changes above described apply also to the arteries of the leg and foot. These are most marked in the anterior tibial, which is nearly twice as large as the posterior tibial. The latter and the peroneal are of about equal size.

The *anterior tibial artery* for a distance of nearly half an inch beyond the bifurcation of the popliteal is so much narrowed by thickening and calcareous deposit in its middle coat that the lumen will barely take an ordinary sized probe. Just below this constriction the artery is a little dilated for an inch and a half, and its coats are thinned. This part of the vessel contains some recent blood-clot. The lower half of the anterior tibial artery is also filled with blood-clot, partly decolourised and firmly adherent to the arterial wall. At the lower end the lumen is completely occluded by very firm clot.

Of the terminal branches of the anterior tibial, the *dorsal artery of the foot* forms a hard rigid tube, and its lumen is filled with partly decolourised clot. The other small arteries are much more healthy.

The *posterior tibial artery* between its origin and the place where the peroneal is given off is completely occluded by thickening and contraction of its middle coat. It may be that there is decolourised clot in the centre of the solid cord which the artery here forms, but this is not visible to the naked eye. Just below the occluded portion this artery is dilated, and contains some recent blood-clot, and below this again and to its lower end it contains decolourised clot which fills up the lumen of the vessel almost throughout its whole length.

The *peroneal artery* from its origin onwards is filled with decolourised clot, and is impervious.

The *veins* were not obviously diseased. The inner coat looked opaque.

Microscopic appearances.—Transverse sections of the
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popliteal artery show the following appearances. The inner and middle coats are both much thickened. In some places the inner coat is as thick or even thicker than the middle coat. The external coat is also thicker than normal. Along the concave margin of the section here and there may be seen broadly fusiform epithelial cells with large oval nuclei, and occasionally a layer of smaller spherical cells with round nuclei beneath them. These together constitute the *epithelial layer*. The *sub-epithelial layer* is enormously thickened. It is composed of fibrous tissue made up of very fine fibrils. The inner part of the layer has the fibrous tissue arranged for the most part in bundles which run in a direction transverse to that of the vessel. Between the bundles are some long spindle-shaped nuclei (but these are relatively few in number), and also some round, more darkly-stained nuclei. The nuclei of this layer are in some instances shrivelled so as to leave a clear space around them. The deeper layers show much less regular arrangement of the tissue. The deepest part of all, next to the elastic lamina, is finely granular or almost homogeneous-looking in many places, not unlike the appearance seen in the later stages of atheroma. In this layer, too, there are a few darkly-stained nuclei. There are no longitudinal fibres to be seen.

The *elastic lamina* in many parts of the section shows no obvious changes. Nowhere is it so wavy as in a normal artery. At those points where the subepithelial layer is thickest the elastic lamina becomes lost, gradually thinning down on each side to a fine edge. In other places it appears as if the lamina were split, since a piece of it can be traced into the subepithelial layer, eventually becoming lost in that layer, while another portion continues on in the normal relation to the middle coat. Between the two portions is tissue like the deeper parts of the subepithelial layer in other places.

The *middle coat* is probably a little thicker than normal throughout, though not markedly so except where deposit of calcareous matter (staining very deeply with

logwood) has taken place. Here, too, is a fusiform thickening of the middle coat. The constituents of this coat have the normal appearance and arrangement except as above indicated.

The *outer coat*, thicker than natural, shows a large number of elastic fibres cut transversely and situated in bundles between the circular fibres of the coat, just outside the middle coat. There are no noteworthy changes in the appearance of this coat.

In none of the coats are the appearances indicative of recent inflammation as evidenced by leucocytic infiltration.

The section of the dorsal artery of the foot shows much the same changes; the calcareous deposit in the middle coat is more extensive.

Sections of the tibial and popliteal nerves, stained first with osmic acid and then with logwood, showed no pathological appearances.

For the foregoing notes of the state of the vessels I am indebted to Mr. G. B. White, Surgical Registrar at University College Hospital.

This case, I think, may be fairly adduced in support of amputation, and *high* amputation, for diabetic gangrene of the foot. The reasons for selecting the knee for the seat of amputation are two: first, because the atheromatous changes here described appear frequently to involve the arteries of the leg, but seldom those of the thigh; secondly, because at the knee it is easy to make a good circular amputation with the minimum of interference within the soft parts.

The next case belongs to a somewhat different category.

CASE 2. *Diabetes; gangrene of the little toe; amputation of the toe; recovery.*—R. S—, æt. 61, was admitted under my care into University College Hospital on August 22nd, 1885, on account of gangrene of the right little toe. He had had lumbago and was rheumatic, but had not suffered from rheumatic fever, gout, or syphilis; his mother died of phthisis, but there are no other facts

of importance in his family history. He had been a heavy drinker for twenty years, and a very thirsty man for long—going to bed with a jug of barley water beside him,—and his thirst had increased during the last few years before his admission.

He had had a corn on the under and outer surface of the affected toe for a year, which had suppurated and continued to suppurate till about a fortnight before his admission, when it became gangrenous and very painful—the pain shooting up the limb. A line of demarcation had formed, but there was a good deal of brawny redness on the dorsum of the foot. The superficial arteries appeared to be healthy. The urine had a specific gravity of 1041 and 1045, and contained a considerable quantity of sugar.

I removed the toe on August 27th by an oval incision carried through the dusky tissues. Very careful anti-septic precautions were taken. The wound was left completely open; it healed slowly, but healing was almost complete by the time he left the hospital on October 13th. The temperature did not rise above 99.6° after the operation, but was often over 99° in the evening up to September 17th. On August 27th he was put upon anti-diabetic diet, and, though there is no note of it, I have no doubt opium was given, with the result that the sugar very much diminished and ultimately completely disappeared, while the amount of urine passed also diminished, but at the time of his discharge varied still from 70 to 80 ounces in the twenty-four hours.

The notes of this case are very imperfect, the state of the vessels being very slightly recorded. The process was very slow, and, although there was a good deal of pain, I think his trouble was allied to that of a perforating ulcer,—a better example of which, however, is given in the following case.

CASE 3. *Perforating ulcer of foot; separation of necrosed part.*—On October 28th, 1891, I saw, with Dr.

Brookhouse, of Brockley, a lady, aged 73, who had completely lost the second toe of the right foot, owing to gangrene which had started in June, from a corn which had been suppurating since January, 1891. When the gangrene once started, its progress was very rapid but almost painless, the patient bearing the various incisions, which Dr. Brookhouse had made, almost without complaint. When I saw her there remained a scar on the dorsum and another on the sole of the foot, and in the latter situation were two openings at the end of a fistulous track two inches long. These I laid into one, at which the patient scarcely shrank; by November 17th the wound had almost healed.

The patient is thin, but has, throughout her life, enjoyed excellent health. She has had rheumatic fever, but not gout, and there is no history of gout in the family. She had facial neuralgia and sciatica about ten years ago, but, with this exception, has been remarkably free from any painful diseases, and certainly no others which could be attributed to peripheral neuritis. The knee-jerks in the early part of this year were almost absent, but there did not appear to be any tactile imperfection, or inability to appreciate heat, either in the upper or lower extremities. There does not seem to be any neurotic tendency in the family.

The urine had been examined previously, but no sugar was found till April, 1891. The actual amount has not been estimated, but it does not seem to have varied, nor does the specific gravity of the urine (which for some months past has varied from 1030 to 1038—on two occasions only having fallen to 1024), notwithstanding a strictly antidiabetic diet, and the administration of Liq. Arsenic. Bromati and Codeia in $\frac{1}{2}$ gr. doses, with Ext. Nucis Vom. gr. $\frac{1}{4}$ t. d.

I obtained a few more facts about this case at a recent examination (October, 1892). Her diabetic symptoms only dated from eighteen months before the onset of the gangrene, and at the present time the urine has a sp. gr. of 1024,

and contains only a trace of albumen and sugar. The wounds are now soundly healed. For a considerable time she has complained of a numb feeling in both legs and feet, and there appear to be irregularly defined patches of partial anæsthesia and hyperæsthesia in both feet and in the lower thirds of the legs. The pulse in the posterior tibial arteries is not to be felt, but both dorsal arteries of the feet are large and remarkably soft. Her radial arteries are also both remarkably soft and straight for a person of her age. All her life she has been in the habit of taking a small amount of beer with her meals, and very occasionally spirit. Her husband died last year of diabetes; I only mention this because I have seen it stated that diabetes has occurred so frequently in husband and wife as to suggest that it is hardly a fortuitous occurrence.

It would be quite improper to generalise from three cases, and the opportunities are not sufficient for one surgeon, unless his clinique be exceptionally large, or the chapter of accidents throws an unusual number of cases in his way, to gain experience enough to form a valuable opinion from what he has seen. The experience of others, moreover, does not really form a very sound basis for coming to a conclusion, chiefly because the phrase "*strictest antiseptic precautions*" has such a very different meaning in different places. But the records of men like Kuster are well worthy of consideration. Kuster is so convinced of the similarity between senile and diabetic gangrene that he describes them all together. He began by amputating below the knee, but became convinced that the higher operation was much more likely to be successful. It is very important to note that out of eleven diabetics five died, four of coma, and one of heart failure; and when it is remembered that coma may follow a slight accident or such a trivial operation as the removal of a cataract, it behoves us to think twice before recommending any operation in a diabetic that is not essential for the saving of life.

In conclusion, I will state again the two points which it is

the object of this paper, if not to prove, at all events to suggest, that a large proportion of the cases of gangrene of the lower extremities of diabetics will be found to depend either on arterial degeneration or on peripheral neuritis ; and that in the former class it is probable that the changes in the arteries will extend at least as high as the knee. Whilst, therefore, it is right to amputate in those of the former class if the disease be progressing rapidly, not lower than the knee, those of the latter may either be left alone, or if amputation be undertaken, it need not be at a great distance from the seat of the disease.

(For report of the discussion on this paper, see 'Proceedings of the Royal Medical and Chirurgical Society,' Third Series, vol. v, p. 4.)