joint with fracture of sternum and ribs; fracture of the skull, fracture of ribs, and amputation through both thighs, &c. One case died on the fourth day, never having recovered from the state of collapse; here amputation through the thigh had been performed, and the patient had also sustained a severe bruise of the abdomen. One case of amputation of the thigh, along with a severe injury to the hand, died of tetanus on the 14th day.

Lastly, 3 cases died of intercurrent diseases. These were a case of amputation through the leg, which died of delirium tremens; an amputation through the femur, from pneumonia, on the 21st day, the wound being practically healed; and a case of amputation through the humerus, in which abortion occurred, followed by the patient's death from puerperal fever.

Ninety-one excisions of joints were performed, with 5 deaths: 2 excisions of the hip died from shock; 1 excision of the hip from hæmorrhage 3¼ months after the operation; 1 excision of the hip from thrombosis of the iliac vein two months after the operation: 1 excision of the knee from tubercular meningitis. Among these cases were 44 excisions of the hip, which recovered. Two cases died from intercurrent disease, viz., 1 excision of ankle-joint from delirium tremens, and 1 excision of the shoulder-joint from phthisis and hæmoptysis. Thus there were in all 93 cases of excision of joints with 7 deaths.

There were 10 operations for ununited or badly united fracture without a death. Also 50 cases of osteotomy, of which 1, a patient affected with the hæmorrhagic diathesis, died from hæmorrhage.

There were 45 cases of hydrocele treated by opening the sac, stitching it to the skin and introducing a drainage tube. No bad result.

There were 119 excisions of the mamma in 110 patients. Among these were 75 cases in which the fat and glands in the axilla were also removed. Of the 110 cases 6 died; 1 from shock, 1 from anthrax, which Volkmann thinks must have been introduced with the cat-gut, 2 from exhaustion in old people, 2 from erysipelas—in 1 case arising from a bed-sore, and in the other commencing after the antiseptic dressings had been left off.

Up to this time Volkmann had treated seventy-three compound fractures and twenty-four wounds of joints conservatively without a single death.

Adding together the whole results, we find that 562 serious operations and injuries were treated, with twenty-nine deaths, *not one of these being due to infective disease arising under an antiseptic dressing.* Volkmann further states that not a single case of pyæmia or septicæmia occurred among patients treated aseptically during these three years. Erysipelas attacked three or four of the cases which were treated on aseptic principles.

Here is a piece of evidence which cannot be overlooked. Into an infected hospital the aseptic method was introduced without any other change being made in the arrangements of the hospital. At once the infective diseases, which were attacking almost every patient, disappeared in the cases treated aseptically, only one case of pyæmia and about twelve of erysipelas occurring during more than four years, and almost all of these arising at the very commencement of the trial when as yet the surgeon had not had sufficient experience of the working of the method. When this experience was obtained, these diseases practically entirely disappeared. In estimating these results at their proper value, we must also remember that during the aseptic period, operations were performed and limbs preserved in a way impossible in an infected atmosphere. What would have been the result of the 150 operations on bones, or of the hydrocele cases, or of the wounds of joints, or of the compound fractures in the former infected atmosphere, if they had not been treated aseptically? What would their result have been in a good atmosphere, such as St. Bartholomew's hospital is said to possess? Would there have been *no* infective diseases there?

Similar remarkable facts have been published by Professor Nussbaum of Munich, who commenced aseptic treatment two years later than Professor Volkmann. The 'Allgemeines Krankenhaus' at Munich, though by no means very deficient in sanitary arrangements, became infected with septic diseases, so that almost every case of open wound treated in the wards was attacked by them. Pyæmia was rife, affecting nearly all cases of compound fracture or wounds of bones, amputation wounds, &c.; erysipelas was constantly present. During 1872, hospital gangrene also appeared, and steadily spread in spite of all the precautions which were taken. In 1872, twenty-six per cent. of all the wounds were attacked with hospital gangrene, and during 1873 the proportion increased to fifty and ultimately eighty per

cent. Erysipelas, too, which in 1872 was comparatively mild, became much more virulent and frequent. All this occurred in spite of the use of antiseptics, of the open method, &c.

In an address delivered in 1875, at the end of the academical year,[1] Professor Nussbaum mentions these facts and describes also the results which followed the introduction of strict aseptic treatment. With regard to his former results, to which I have just alluded, he says that he had employed in the treatment of wounds the open method, various forms of occlusion, continuous water-baths, chlorine water, carbolic acid, salicylic acid in powder and solution, Mr. Lister's carbolic paste, and even the carbolised gauze dressings. 'Alles, alles,' says he, 'war nicht im Stande, den Hospitalbrand, die Pyæmie zu bekämpfen.' Without any other change, strict aseptic treatment was used in all possible cases, and then, he says, at once they experienced one surprise after another: everything went well; there was no more hospital gangrene, though a week or two previously eighty per cent. of the wounds were suffering from it; pyæmia and erysipelas were only observed in one or two cases, and these disappeared as skill in the use of the method was acquired. Nussbaum adds: 'One might reply' (to these facts), 'pyæmia and hospital gangrene are diseases which often suddenly attack a hospital without any apparent cause and often also suddenly disappear. But think, my friends, that during the sixteen years in which I have had charge of this hospital pyæmia has not been absent a single month, and yet it suddenly *disappeared* on the introduction of the Listerian method.'

A year later, Dr. Lindpaintner, Professor Nussbaum's assistant, published a detailed account of Nussbaum's practice from April 1st, 1875, to the end of March 1876.[2] I shall not enter at length into these results, but there are some points to which I must call attention.

During this period there were 459 operation or accidental wounds under treatment, and of these twenty-six died. The cases were not all treated aseptically as will be evident when I consider the causes of death, to which I must now allude.

[1] *Die Chirurgische Klinik zu München im Jahre* 1875; Stuttgart: Fred. Enke, 1875.

[2] *Deutsche Zeitschrift für Chirurgie.*

Three cases in which primary amputation was performed died in a few hours. Other extensive injuries were present in all these instances.

One patient, æt. 79, died suddenly of cerebral hæmorrhage 31 days after resection of the elbow joint.

In one case a malignant tumour of the scalp was removed, and the disease was found to have perforated the skull. Recurrence rapidly took place, and the patient died with symptoms of compression.

One case of gunshot wound of the skull and brain went on well for 11 days, and then died suddenly. Cause unknown.

A large abscess of the mamma connected with caries of the ribs was opened aseptically, and was progressing typically, when death occurred suddenly on the 3rd day. Cause unknown.

One case of large ulcer of the leg, which had healed, died of phthisis nearly 4 months after admission.

One case of extensive abscess of the knee-joint, which was incised aseptically, died of phthisis 5 months after the operation, the knee-disease having recovered, and the wound having completely healed.

One case of extensive suppuration in the parotid region died. There was constant vomiting, and on post-mortem examination catarrhal pneumonia was found.

A very weak, unhealthy subject, suffering from compound fracture, for which secondary amputation was performed, died 5 days after the operation from thrombosis of the pulmonary artery.

One case of excision of the mamma (æt. 72) died, and on post-mortem examination there was found cancer of the lungs, capillary hæmorrhages in the stomach, and extensive aphthous patches in the œsophagus. Death was sudden after the existence of difficulty of breathing for a few hours.

In one case of excision of the mamma peritonitis set in on the 4th day, though up to that time the patient had been doing well. The peritonitis was found to proceed from a cancerous tumour in the liver, which was breaking down.

One case of excision of the mamma died on the 15th day from unilateral pleuro-pneumonia on the same side.

One case of large abscess in the neck died of 'fibrinous pericarditis' 38 days after the abscess was opened, and after it had healed.

One case of ovariotomy, in which there had formerly been peritonitis, and where extensive adhesions were present at the time of the operation, died of peritonitis.

One case of compound fracture of the leg, which was doing well, died of myocarditis on the 25th day.

One case of resection of the elbow-joint died of œdema of the lungs and fatty embolism on the 11th day.

One case of compound fracture of the femur in which the bone was very extensively comminuted and the knee-joint opened, died of septicæmia.

The remainder of the fatal cases occurred in patients not treated aseptically, and were due to septicæmia, erysipelas, pneumonia, pyæmia, phthisis, peritonitis, and shock.

I have thought it well to mention all the causes of death, and now I shall summarise what Dr. Lindpaintner says as to septic diseases.

Erysipelas occurred six times during that year, but not in any case which was being treated aseptically. It occurred in four cases of septic wounds, in one case after the Listerian dressings had been left off, and in one case of excision of the mamma treated aseptically but spreading from an inflammation in the neck and never extending under the dressing.

There was no case of hospital gangrene.

There were three cases of septicæmia—one after a septic operation (excision of the hip), one case admitted with septicæmia, and one case of compound fracture in which an unsuccessful attempt was made to eradicate the causes of putrefaction (alluded to above).

There were three cases of pyæmia—one occurring after a putrid wound in the thigh, one in a case with putrid sinuses near the elbow-joint, in which no operation was performed, and one after dilatation of a stricture of the urethra which had followed a previous amputation of the penis.

There was thus only *one case* of infective disease among the cases treated aseptically—the case of bad compound fracture of the femur. Here, of course, the surgeon had not to deal with a wound made by himself, but with one made without aseptic precautions, and it is of course always a matter of uncertainty in such instances whether the wound can be afterwards rendered aseptic or not. The case of peritonitis after ovariotomy and the cases of pericarditis and myocarditis might

no doubt be attributed to failure in the method. Whether or not they were due to such a cause, I do not know.

This success in the exclusion of traumatic infective disease has continued up to the present time in the cases treated aseptically, and in a publication of Professor Nussbaum's in 1878, entitled 'Sonst und Jetzt,' he states that there had been no further instance of these diseases. It may be interesting to see what he says:—

	Formerly.	Now.
'Injuries of the head, compound fractures, amputations and excisions, in fact, almost all patients in whom bones were injured were attacked by pyæmia. For example, of 17 cases of amputation 11 died from this cause. Even patients with severe whitlow died of it.		No pyæmia.
'Hospital gangrene had got the upper hand to such an extent, that in spite of the open method, in spite of continuous water-baths, in spite of the use of chlorine water or the actual cautery, finally 80 per cent. of all wounds and ulcers were attacked, large arteries being opened into. . . .		No hospital gangrene.
'Almost every wound was attacked with erysipelas.		No erysipelas.'

Still later, in the last edition of his work on antiseptic surgery, published in 1880, the same statement is reiterated and Nussbaum now says, that since the introduction of the aseptic method there has been *no* instance of pyæmia, hospital gangrene or erysipelas among the patients treated in that way. And yet, he adds, no other change has been made; 'the wards, the furniture, the nursing of the patients and their number remain the same.'

Indeed, in summing up his five years' experience he goes so far as to say that 'any recent wound, treated by this method, is guaranteed against pyæmia, hospital gangrene, erysipelas, progressive suppuration, and in general against all accidental com-

plications.' And further: 'The fate of a patient seriously wounded is almost entirely in the hands of the surgeon who applies the first dressing.' Such is Nussbaum's experience after using this method for five years in a hospital in which infective diseases were very prevalent.

These facts cannot be overlooked, and are of the very greatest value—of much more value than any number of results in healthy hospitals. For here we have an immediate abolition of traumatic infective diseases, only one case occurring in five years, and that after a wound not made by the surgeon; there was thus not merely a great diminution in the frequency of these diseases but absolute cessation. These facts, when surgeons in this country have deigned to notice them, have been attributed to increased cleanliness alone, the result of the introduction of strict aseptic precautions. It is asserted, and the assertion no doubt holds good in many places, that dirty sponges, dirty instruments, &c., were used in dressing the various cases, and that no care was taken to cleanse the instruments after their use, nor to keep apart those employed in bad cases. I venture, however, to affirm that these objections do not apply to the practice of such men as Bardeleben, Esmarch, Hueter, Nussbaum, Volkmann, and many others whom I might mention—men who are at the head of the surgical profession, and who owe their high reputation to their thorough knowledge of physiology and pathology. In Professor Nussbaum's case this objection cannot be upheld for one moment, for he had charge of two hospitals, one in the country placed under good hygienic conditions, and the other in town not so well situated in these respects. The same surgeons and the same methods of dressing and nursing were employed in the one institution as in the other, and yet the country hospital remained healthy, while the one in town became infected. Surely the same uncleanliness would have told, at least to some extent, in the country as in the town. But further it must be remembered that the result of the use of the aseptic system was *not merely the diminution*, but the *abolition*, of these infective diseases. Now cleanliness, as advocated by Mr. Savory—and I shall refer to this matter again—does not result in the *abolition*, but merely in the *diminution* of these affections, and I do not allow that

the results which Mr. Savory gives were solely due to cleanliness as distinguished from asepticism.

Then, again, these diseases *disappeared at once*, for Nussbaum tells us that *from the day* when he began this treatment thoroughly, these diseases never attacked any of the cases so treated. What an extraordinary amount of cleanliness would be required to effect this! But indeed we are told that cleanliness alone had not been able to abolish these diseases, even after *several years' practice of it*, for Nussbaum says in 1878,[1] that even then a tracheotomy or other wound which could not be treated aseptically was liable to be attacked by erysipelas of as severe a type as formerly. And, further, Nussbaum had been practising cleanliness before the introduction of the aseptic method; for many of the wounds were irrigated with antiseptics, such as carbolic acid, &c., without any apparent benefit. Cleanliness is, no doubt, a most excellent thing in its own place, but its power as a preventive of infective disease in an infected atmosphere is very limited indeed.

And lastly, it cannot be said that Nussbaum does not now diagnose as infective disease cases which he would formerly have classified under that heading, for post-mortem examinations are made on all the fatal cases by Professor von Buhl, quite independently of Professor Nussbaum, and thus any such error would be corrected. Nussbaum remarks in a note to Mr. MacCormac ('Antiseptic Surgery'), 'the mortality is reduced to one half, and the only cases brought to the postmortem room are those of death by suicide, from severe mechanical injury, in old people, or from cancer and tubercle.'

Socin of Basle uses language very similar to that of Nussbaum with regard to the occurrence of infective diseases. He has also observed their complete disappearance under aseptic treatment, and as the result of his experience, he says that, 'Every case of amputation which dies of pyæmia or of erysipelas is a victim of ignorance, of want of skill or of negligence on the part of the surgeon.'

Saxtorph of Copenhagen has had an experience similar to that of Volkmann and Nussbaum. His results are quoted at considerable length in Lucas Championnière's 'Chirurgie Anti-

[1] *Sonst und Jetzt.*

septique,' to which I must refer the reader. I may, however, just mention the following facts.

Before 1873 Saxtorph had performed 15 excisions of joints, of which 9, or 60 per cent., died. These wounds were treated in the ordinary manner. He then introduced aseptic precautions, but they were very imperfectly carried out. During this period (between 1873 and 1877), he performed 76 excisions of joints with 32 deaths, or a mortality of 42 per cent. The method was then carried out more efficiently, and since 1877, 34 excisions of joints (including 15 of the hip and 12 of the knee), have been performed with 5 deaths, or a mortality of 17 per cent. Indeed, Professor Saxtorph says that since he has carried out the method with absolute strictness, according to Mr. Lister's directions, he has performed 24 major excisions with 1 death (from tetanus), or a mortality of 4·3 per cent. This result has also been obtained in a bad hospital where infective diseases were common. The increased success, according as more efficient precautions were taken to exclude the causes of putrefaction, is very interesting and important.

Another strong advocate of the aseptic method is Professor Esmarch of Kiel. In 1875, he introduced the method into his wards, which had previously been especially liable to attacks of erysipelas. The report of the first year in which Esmarch employed this method is published by Waitz in 'Langenbeck's Archiv' for 1877, and he states that 536 operation cases were under treatment during that year, and of those treated aseptically only four were attacked by erysipelas (one of these cases died). Two patients who were treated aseptically died without any definite symptom except the presence of a continuous high temperature—septicæmia (?). Two cases died of pyæmia, but neither of these tell against the method; one was a case of acute necrosis where an abscess was opened, but where, nevertheless, pyæmia carried off the patient; the other was a case of herniotomy, in which the gut was found to be gangrenous.

These results were very good for the first year of aseptic work, but as Esmarch and his assistants gained experience, the cases of infective disease became fewer and fewer. His report for 1878 is alluded to by Mr. MacCormac,[1] who states that

[1] *Antiseptic Surgery.*

Esmarch had during that year treated 524 cases with 25 deaths. These cases include forty amputations, 27 major resections, 80 cases of removal of tumours, &c. Mr. MacCormac gives a list of the causes of death, and among them were two from septicæmia after excision of the mamma, presumably performed aseptically, though that is not expressly stated; no facts are given with regard to them. One case of ovariotomy died from peritonitis. In this, as in many other reports, no separation is made between cases dressed aseptically and those treated by other methods.

Mr. MacCormac states that Professor Esmarch informs him that his next triennial report will show better results. A part of this report is already furnished by Dr. Neuber, in his last communication on absorbable drainage tubes and permanent dressings.[1]

Between the end of April and the beginning of October, 1879, all the cases treated aseptically were dressed in this way. These were 131 in number, comprising 5 amputations of the thigh, 7 amputations of the leg, 1 at the knee-joint, 1 through the humerus, and 1 through the fore-arm; 2 excisions of the knee-joint; 4 excisions of the mamma and axillary glands; 5 excisions of the mamma alone; 16 excisions of large lymphatic glandular tumours from the neck varying from 1 to 2 fists in size; 16 excisions of other tumours, &c. During this period 3 patients treated aseptically died, viz., one case of excision of the hip from shock; one case of removal of carcinoma from the ear of a patient (æt. 70), in which there were secondary affections of the glands in the neck, &c., from hypostatic pneumonia; and one patient, who was suffering from septicæmia before his thigh was amputated, and who afterwards died of that disease (not a case in point).

During the next 2 months 60 additional cases were treated in this way without a death. These comprised amputations, resections, compound fractures, removal of tumours, &c. Thus during these 8 months 191 cases were treated aseptically with 3 deaths, but in no instance did infective disease arise after the operation.[2]

[1] *Ueber die Veränderungen decalcinirter Knochenröhren in Weichtheilswunden, &c.*; Langenbeck's *Archiv*, Bd. xxv.

[2] At the International Medical Congress of this year, Prof. Esmarch brought forward still more recent statistics. The cases were treated by Neuber's method of permanent dressings, the antiseptic chiefly employed in

Perhaps the earliest in Germany to take up asepticism was Professor Hueter of Greifswald, and he still looks on it as the best method and the 'greatest advance of modern surgery.' He uses salicylic jute instead of carbolised gauze, not because he believes it to be better, but because it is cheaper.

Professor Czerny of Freiburg also added his evidence in 1876.[1] The number of cases to which he alluded was not great, but in his address at the end of the summer session, 1876, he stated that he had been unable to show his class a single case of pyæmia, hospital gangrene, or septicæmia during the whole year. He had two cases of erysipelas, one of these occurring after sequestrotomy and attempted purification of the sinuses with chloride of zinc. (This was not a case operated on from the first aseptically.)

Czerny says that in former years, with the exception of 1875, during which aseptic treatment had also been employed, he had always had a considerable number of cases of infective disease in the wards. The abolition of these diseases could not, he says, be due to anything in the arrangement or service of the wards, for these remained unaltered. They were as full as formerly, as imperfectly ventilated, and the watercloset arrangements were unaltered. A greater number of patients were treated. The results had steadily improved with increased care in carrying out all the details; and his belief is that 'the favourable results which have followed the introduction of this method are to be ascribed to the accuracy with which Mr. Lister's directions have been followed.'

In France this method was first taken up by Dr. Lucas Championnière, whose text-book and other writings[2] on the

the dressings having been Iodoform. They had recently treated 398 cases of major operations and injury with 6 deaths. There was no instance of infective diseases. The cases were 146 excisions of large tumours, including 40 excisions of the mamma and axillary glands and 14 castrations with three deaths—1 from pericarditis and old syphilis, 1 from apoplexy, and 1 from fatty heart; 61 resections; 51 major amputations (18 of thigh, 27 of leg, 5 of arm, 1 of forearm), with 2 deaths—1 from shock and hæmorrhage, and 1 from delirium tremens; 11 exarticulations 26 necrotomies; 13 nerve stretchings, including one for tetanus, which was fatal; 8 herniotomies; 21 chronic abscesses; 12 large wounds; 49 compound fractures.

[1] *Berlin. Klin. Wochenschrift*, 1876, No. 43.

[2] *Chirurgie Antiseptique.*

subject, are now so well known. He also finds that pyæmia, septicæmia, and hospital gangrene disappear when aseptic treatment is employed. He has at times observed erysipelas under this dressing, but the disease was very rarely present and of a very mild type.

As the result of the writings of Lucas Championnière, several French surgeons have introduced this method, but it has not as yet taken the same hold in France that it has in Germany. Those, however, who have used it properly make the same statements as to complete disappearance of infective disease. Among those who have employed this treatment and who have got these results may be mentioned M. Gross of Nancy, who has written a text-book on the subject.

M. Létiévant, of Lyons, is also an enthusiastic supporter of this system.[1] He introduced it into his wards during the summer of 1875, and from that time pyæmia disappeared and the mortality after operations and wounds greatly diminished. His statements with regard to infective disease are: 'Purulent infection has disappeared. Hospital gangrene has disappeared. Erysipelas is much rarer and less severe.'

Professor Panas[2] also found that during a virulent epidemic, those of his patients at the Lariboisière who were treated aseptically escaped erysipelas and other septic diseases.

Returning to Germany, there still remain two pieces of statistics to which I must refer.

The first is Schede's comparative statement of the results of amputations treated aseptically and of those treated in other ways.[3] The aseptic cases were under the care of Busch, Schede, Socin and Volkmann. The cases not treated aseptically were furnished by Bruns, Bardeleben and Billroth.

The most important tables give the result of uncomplicated amputations performed aseptically, contrasted with those treated by other methods.

Uncomplicated amputations treated aseptically:—

[1] *Note sur le pansement antiseptique listérien à l'Hôtel-Dieu de Lyon*, 1880.

[2] *Gazette hebdomadaire*, 1878.

[3] *Amputationen und Resectionen. Handbuch der allgemeine und specielle Chirurgie*, Pitha und Billroth.