II. Compound Fractures made by the Surgeon (*continued*).

No.	Name and Age	Date of Operation and Discharge; with Result	Injury	Treatment	Remarks
98	Peter B., 11.	*Op.*, Dec. 2, 1872. *Dis.*, Feb. 11, 1873. *Result* cured.	Similar injury to that in No. 97.	Excision of elbow-joint by a longitudinal incision.	Aseptic course, except that the drainage was not good for the first day or two. The wound had completely healed on January 27. Movements good when discharged.
99	Donald McL. 45.	*Op.*, Nov. 14, 1874. *Dis.*, Feb. 28, 1875. *Result*, cured.	Ununited fracture of humerus a little above its middle. Of fifteen months' standing.	Ends of fragments refreshed and tied together with silver wire. Wound left open.	Aseptic course. Wound quite healed on December 27. Union was complete and wire removed on February 27.
100	James J., 24	*Op.*, Dec. 15, 1875. *Dis.*, June 8, 1876. In process of cure.	Fracture of lower end of humerus, with inability to use the arm. Done six weeks previously.	Excision of elbow-joint by longitudinal incision.	The wound went on well till the Christmas holidays, when it putrefied. After that an abscess formed in the upper arm. In March only two sinuses remained to heal. It is not stated whether these had completely healed when patient was discharged. Movements fair.
101	John N., 15 . .	*Op.*, Nov. 27, 1875. *Dis.*, Jan. 31, 1876. *Result*, cured.	Badly united fracture of the humerus, about its middle, the arm being bent inwards.	Bone divided by hammer and chisel and brought into proper position. Drainage-tube inserted and plaster of Paris applied at once.	Aseptic course. The wound had completely healed on January 16. The bones were firm when patient was discharged.
102	Jessie S., 14 .	*Op.*, Aug. 21, 1875. Date of discharge is not given. *Result*, cured.	Osseous anchylosis of the elbow-joint in the straight position, the result of old fracture.	Excision of elbow by H-incision.	Aseptic course. The incisions were quite healed on September 25. Movements good. (See T. Chart L.)
103	Edward W., 12	*Op.*, Jan. 15, 1879. In process of cure.	Badly united fracture of humerus. See Operations on Joints, No. 18, p. 432.		Aseptic course.

Thus we have 9 compound fractures of the humerus without any bad results.

Compound Fractures of the Forearm (Surgeon).

104	John McI. 34 .	*Result*, cured.	Ununited fracture of olecranon. See Operations on Joints, No. 3, p. 426.		Aseptic course.
105	Thomas W., 14.	*Op.*, May 3, 1873. *Dis.*, Nov. 20, ,, *Result*, cured.	Ununited fracture of radius. See No. 38, p. 476.	A piece of bone was cut out of the ulna to allow the ends of the radius to come into contact. The ends of the radius were refreshed Fragments tied together by silver wire. Left open.	Aseptic course. Plaster of Paris applied on July 28, when both wounds were healed. Removed on November 17, when union was complete. Wires also removed on that day. Seen again in March, 1874, when the arm was strong, and in every way perfectly useful.
106	Alexander—, 26	*Op.*, Nov. 10, 1875. *Result*, cured.	Dislocation of the head of the radius backwards. See Operations on Joints, No. 10, p. 428.		Aseptic course.
107	J. McJ., 30 . .	*Op.*, Jan. 15, 1876. *Dis.*, April 13, ,, *Result*, cured.	Ununited fracture of the radius: of sixteen months' standing. Had been previously operated on by another surgeon. The ends of the bones were not in contact.	Ulna divided and a portion removed. The ends of the radius refreshed. Fragments tied together with silver wire. Wounds left open.	Aseptic course. The wounds had healed and union was complete when the patient was discharged.
108	James S., 53 .	*Op.*, Jan. 26, 1877. *Dis.*, June 19, ,, *Result*, cured.	Ununited fracture of the radius: of twenty-two weeks' standing.	Ends of radius refreshed. A piece cut out of the ulna. Fragments tied together with silver wire. Wounds left open.	Aseptic course. Both wounds had healed in six weeks without any pus formation whatever. Plaster of Paris was applied on March 3. Apparatus removed on June 2, when union was complete. Wires removed on that day. (See T. Chart LI.)

II. Compound Fractures

No.	Name and Age	Date of Operation and Discharge; with Result	Injury
109	William B., 45	*Op.*, March 20, 1879. *Result*, cured.	Ununited fracture of the olecranon. See Operations on Joints, No. 17, p. 432.
110	John H. 28 . .	*Op.*, Jan. 14, 1881. *Dis.*, March 5, „ *Result*, cured.	Ununited fracture of both bones of the fore-arm, the result of a machine accident eleven months' previously.

In all there were 7 cases of compound fracture of the fore-arm without any bad result. (There were 11 distinct compound fractures.)

Compound Fracture of

111	Maggie C., 17 .	*Op.*, April 1, 1875. *Dis.*, May 12, „ *Result*, improved. One case of compound fracture of the lower jaw, which did well.	Anchylosis of one side of the jaw. Jaws firmly closed. The result of old necrosis.

Following the example of most writers who discuss the results of compound fracture, I shall now leave out of consideration the cases in which primary amputation was performed, and also those which died within forty-eight hours. The following result will then be obtained. Since the end of 1871 up to the present time Mr. Lister has had under his care 95 [1] patients affected with compound fractures; of these 95 patients only 2 died. (The number is apparently 97, but 2 patients are each counted twice.) I may tabulate the result as follows:

Part injured	No. of cases	No. of deaths	Total No. of fractures	Secondary amputations
Femur . . .	26	1	30	1
Bones of leg . .	34	1	50	2
Clavicle . .	3	—	3	—
Humerus .	12	—	12	—
Fore-arm . . .	12	—	16	—
Skull . . .	9	—	9	—
Lower jaw . .	1	—	1	—
Total .	97	2	121	3

A patient on whom an operation has been performed, whose wound has healed, and on whom a second operation has then been done, is, of course, reckoned as two separate cases

made by the Surgeon (*continued*).

Treatment	Remarks
	Aseptic course. (See T. Chart XI., p. 439.)
Incisions over each bone. Fragments refreshed and tied together with silver wire. Wounds left open.	Wounds superficial and spray discontinued on January 31. Silicate apparatus applied on February 7. Wires removed March 16. Union satisfactory. (See T. Chart LII.)

the Lower Jaw (*Surgeon*).

An incision was made behind the ramus of the jaw on the anchylosed side, and the condyle of the jaw was cut through.	The wound was almost absolutely healed on April 21, when boracic dressings were applied. A wedge was kept between the teeth, and when the patient was discharged she could open her mouth without aid for half an inch. When seen in July her condition had much improved.

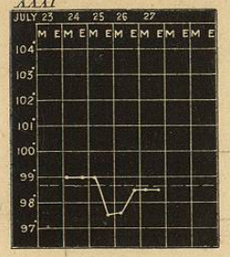
It may, perhaps, be more convenient if I separate the cases of accidental compound fracture from those made by the surgeon. The following is the list of the accidental ones:—

Bone	No. of cases	No. of deaths	Secondary amputations
Femur . . .	3	1	—
Leg . . .	19	1	2
Humerus . . .	3	—	—
Fore-arm . . .	5	—	—
Skull . . .	9	—	—
Total .	39	2	2

The following is the list of those made by the surgeon:—

Bone	No. of cases	No. of fractures	No. of deaths	Secondary amputations
Femur . .	23	27	—	1
Leg . . .	15	31	—	—
Clavicle . .	3	3	—	—
Humerus . .	9	9	—	—
Fore-arm . .	7	11	—	—
Lower jaw .	1	1	—	—
Total .	58	82	0	1

XXXI



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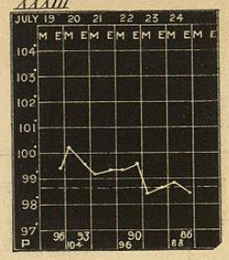

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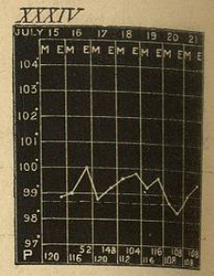

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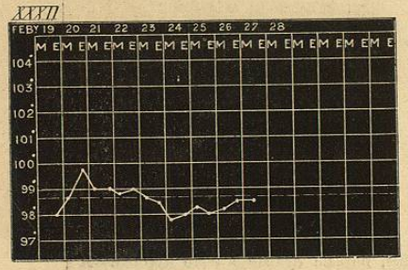

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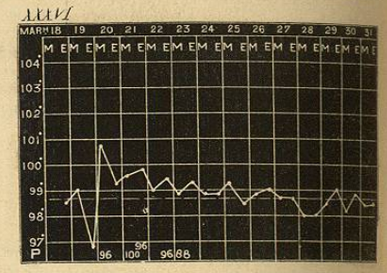

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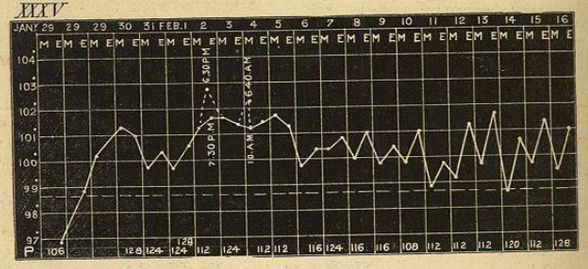

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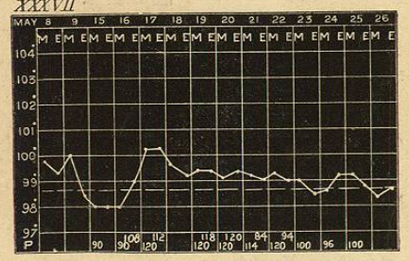

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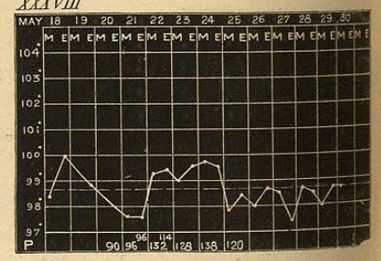

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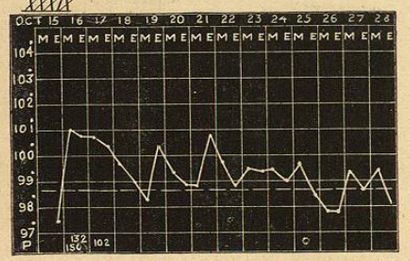

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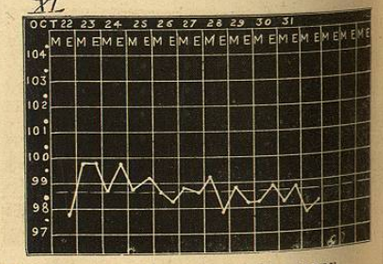
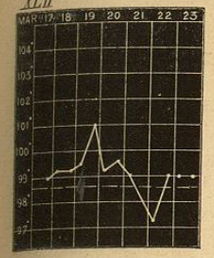


TEMPERATURE CHARTS OF MR. LISTER'S CASES OF COMPOUND FRACTURE.

XLII



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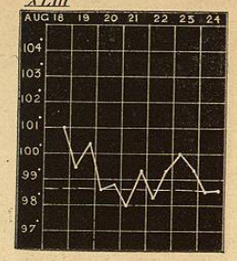

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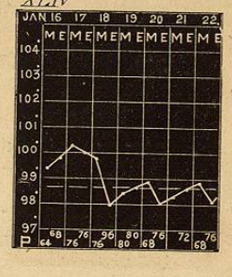

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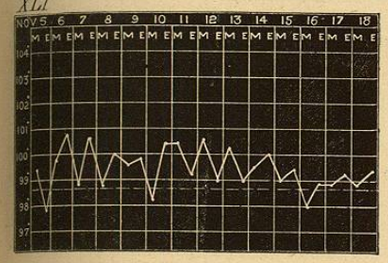

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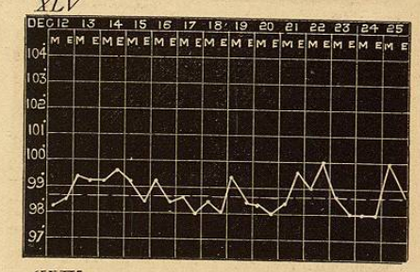

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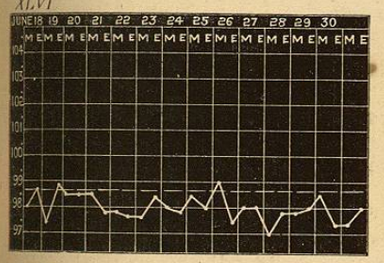

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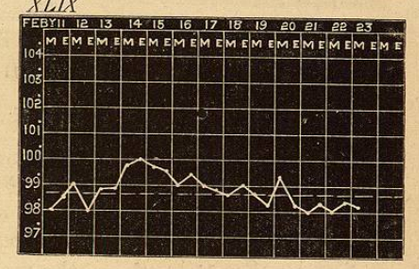

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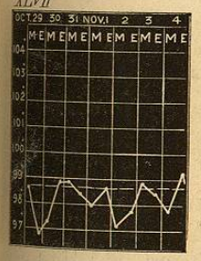

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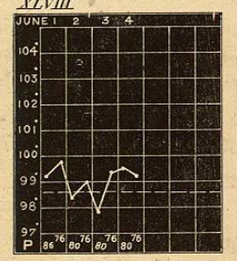

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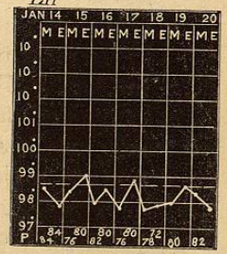

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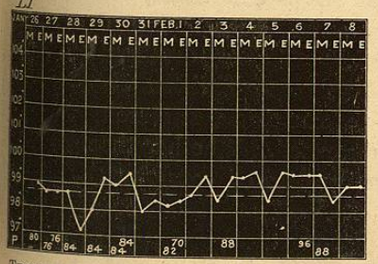

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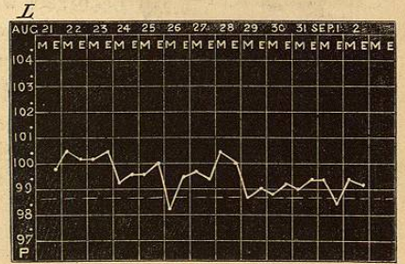

TEMPERATURE CHARTS OF MR. LISTER'S CASES OF COMPOUND FRACTURE (*continued*).

Some writers have a fancy now-a-days to group the cases according to age. The following are the facts in these 95 cases :—

0–9 years	10–19	20–29	30–39	40–49	50–59	60–69	70–79
12 cases	25	19	20	8	7	2	1

(In one case the age is not known.)

If we again subdivide these into accidental and intentional, we find the following :—

Accidental.

0–9 years	10–19	20–29	30–39	40–49	50–59	60–69	70–79
4	10 (1 death)	7 (1 death)	9	2	3	2	0

(In one case the age is not known.)

Intentional.

0–9 years	10–19	20–29	30–39	40–49	50–59	60–69	70–79
8	15	12	11	6	4	0	1

It is thus evident that the results are not due to absence of old patients.

The result exactly confirms the anticipations expressed on p. 461, that where the element of shock is excluded, and where the surgeon has merely to *keep out* the causes of fermentation, not to *eradicate* them, the mortality would fall and an element of certainty be introduced into the results.

In order to get comparative statistics similar to those given in Chapter XVII., I have looked through Mr. Spence's account of his work from 1872 to 1878, given in the papers to which reference has already been made (p. 378), and the following seem to be the facts :—

I find mention of 16 primary amputations during this period, and of these 7 died. In only 1 of these cases is it stated that death occurred within forty-eight hours, and thus we have to consider 15 primary amputations with 6 deaths. Then I find 5 secondary amputations with two deaths, neither within forty-eight hours. Also 1 secondary excision which recovered. And then only 2 cases of compound fracture treated conservatively, both of which recovered. Whether these are all the cases of compound fracture treated conservatively, I

cannot say, but as these 2 are mentioned, I presume that had there been any more, they would also have been stated. Hence, in Mr. Spence's list of cases treated during the greater part of the period referred to, and in the same hospital as Mr. Lister's cases, we find traces (for they are not grouped) of 23 compound fractures which lived for more than forty-eight hours, and of these 8 died, some of the deaths being due to infective disease. These facts are also interesting as showing what a large proportion of compound fractures are amputated primarily in the practice of a surgeon not treating his cases aseptically, and also the large proportion of secondary operations. For of 23 compound fractures 15 were amputated primarily (6 deaths), 5 were amputated and 1 excised secondarily, and only 2 were treated conservatively. And even if Mr. Spence has not published all his cases of compound fractures the facts remain equally striking, for, with a much smaller number of patients than Mr. Lister and with less hospital accommodation, Mr. Spence has performed a larger number of primary and secondary operations.

But from these papers I glean the following facts which are free from any objection. During this time (1872–78), 6 compound fractures seem to have been made on healthy bones by Mr. Spence, and of these 2 died. One case, however, died in 36 hours, and therefore, following our rule, we have 5 intentional compound fractures of healthy bones with 1 death. These were, 1 excision of the head of the humerus in a case of unreduced dislocation—death in thirty hours; 1 excision of the knee for bad anchylosis; 1 operation for badly united fracture of the femur; and 3 excisions of the elbow for anchylosis—1 of these cases subsequently underwent amputation and died, apparently of septicæmia.

Before leaving Mr. Lister's results, I may refer to some operations on bones which have the same dangers as compound fractures, though the bone is not fractured across.

Thus the removal of exostoses is a serious matter. Mr. Lister has operated for exostoses thirteen times (from the end of 1871 till October 1880), four times on the femur, and twice on the tibia, without any bad result.

In chronic osteitis not yielding to treatment, Mr. Lister

cuts down, exposes the bone for a considerable extent, and then digs a long deep trough in it with the gouge and hammer. This treatment at once relieves the pain, and generally cures the disease. Mr. Lister has performed 10 such operations (from the end of 1871 to October 1880), without the slightest bad result in any instance.

And then there are a number of operations in which, as in the removal of tumours, portions of bone have been cut away without any bad result.

By including all these operations together the number of cases could be very much increased without the addition of any bad result. I have preferred, however, to adhere rigidly to the cases of compound fracture, meaning by that not subcutaneous division of the bone, but a large wound open and communicating freely with the bone, generally by means of a drainage-tube.

I shall now consider the results obtained by other surgeons, and I shall take first, as being the most remarkable results as yet published, the statements made by Dr. MacEwen in the 'Lancet' for September 18, 1880. He there gives the result of all the cases in which he has made compound fractures aseptically. He points out that these cases were really compound fractures, and not in any sense could they be called subcutaneous operations. The wounds varied in length from $\frac{3}{4}$ inch to $1\frac{1}{2}$ inch, and the edges of the wound were held aside so that the bone was freely exposed, and purified air had free access to the divided fragments. In this way he has operated on 330 patients affected with various deformities. Of these 220 had knock knee (367 limbs), 64 had bow legs (104 legs), 40 had tibial curves &c. (80 legs), and 6 had osseous anchylosis of the hip or knee The bones were either simply divided by the chisel and hammer, or wedge-shaped portions were cut out. Although he only operated on 330 patients, he produced compound fractures on 557 limbs. And as he often produced 2 or more separate compound fractures on the same limb, it came about that he had in all made and treated aseptically no less than 835 compound fractures.

What were the local results? Here we have to consider 835 compound fractures, and here Dr. MacEwen tells us that only in 8 out of these 835 wounds did suppuration occur, even

though union by first intention was impossible. In one case there was no apparent cause for the suppuration; in the other 7 cases some cause was present. In 3 instances irritation and inflammation were set up by the pressure of the splint, &c.; in 3 cases there was bruising and laceration of the soft parts; and in 1 a piece of muscle was severely injured in adjusting the bones. In each of these 8 cases the occurrence of suppuration was preceded by elevation of temperature.

What was the result as regards the necessity for further operation? Here we have to speak of 557 limbs; 557 cases in which secondary amputation might have been necessary. Secondary amputation was, however, only necessary in one instance, although some of the limbs had as many as four or five compound fractures. The operation in this case was necessary because, owing to an accident, the bandages had become displaced, and gangrene of the foot occurred. This patient recovered perfectly.

What were the results as regards life? Here we have to consider 330 lives which might have been lost, and in connection with this it is to be remembered that many of these patients had multiple compound fractures, in some instances as many as 10. And yet of these 330 cases only 3 died, and not one of these deaths was in any way due to the operation. MacEwen describes these 3 cases in detail, and I may state that the causes of death were diphtheria, tubercular meningitis, and pneumonia contracted before the operation.

To sum up Dr. MacEwen's results, we find that of 330 patients only 3 died, in each case the fatal result being independent of the disease: of 557 limbs affected with compound fracture only 1 required secondary amputation or other operation, and this from a cause independent of the wound; and lastly, of 835 compound fractures, suppuration only occurred in 8 wounds, though primary union was impossible in all.

These results are the more striking when it is remembered that many of the patients operated on were not in good health, 'On several occasions,' says Dr. MacEwen, 'the patients were so weak that there was considerable hesitation about administering an anæsthetic. Many have been carried to the wards by their friends, as they were unable to walk except by

the aid of crutches, and that for a very short distance.' It is indeed strange that such facts are allowed to pass entirely unnoticed, and that in spite of them surgeons continue to assert that equally good results may be obtained by cleanliness, good ventilation, &c. These injuries will be generally acknowledged to be grave ones, and there is no record whatever of anything like similar results from other than aseptic methods of treatment. In reference to the statistical value of such cases, Mr. Holmes justly remarks: 'Of all wounds, perhaps those of compound fractures of the leg are the best adapted for studying the effect of different ways of dressing. Amputations and other major operations depend so much more for their success on the health of the patient and the previous course of the disease, that it is hardly possible to draw from their results any absolute conclusions as to the effect of the system of dressing. This objection applies, of course, to compound fractures to some extent (as indeed it does to every surgical affection); but much less than to amputations, especially when the severer accidents which call for immediate amputation, or which prove fatal from other injuries, are left out of account.'

Professor Volkmann has published a detailed account of all the compound fractures treated by him conservatively since he introduced the aseptic method. These are 73 in number (75 fractures), and of these 73 patients not one died.[1] In one or two cases of injury to joints, primary resection was practised. These, of course, still remained compound fractures, and are very properly included here. The following is Volkmann's list:

Part injured	No. of cases	No. treated conservatively	Secondary resection	Secondary amputation	Death
Femur . .	1	1	—	—	—
Patella . .	3	3	—	—	—
Leg . . .	43	36	2	5	—
Humerus . .	8	8	—	—	—
Fore-arm . .	20	14	3	3	—
	75	62	5	8	0

[1] In his address at the recent meeting of the International Medical Congress in London, Volkmann said: 'When I adopted the antiseptic treatment of wounds my last 12 patients, with compound fracture of the leg, had all died of pyæmia or septicæmia. From that time up to the present day I have treated, one after another, 135 compound fractures, and not a single patient has succumbed to either of those accidental wound diseases; 133 were cured, two died, one of fat embolism of the lungs during the first few hours, and one, a drunkard, of delirium tremens.'—*Lancet*, August 13, 1881.

Now, in considering these facts we have first to notice, that no less than 48 patients were injured by direct violence, and that in 20 cases the bones were extensively shattered. A number of the cases were machine accidents, and Volkmann says with regard to these, that it was at first a very difficult matter to decide whether any attempt ought to be made to save these limbs. In 19 of the cases joints were involved in the injuries: of these 5 were resected and 3 amputated secondarily, while 11 were treated conservatively to the end. In 2 cases primary resection of the joint was performed, once at the shoulder-joint and once at the elbow-joint.

The following are the ages at which these accidents occurred:

1–10	11–20	21–30	31–40	41–50	51–60	61–70
5	13	14	17	10	9	5

With regard to the cases of secondary amputation and resection, Volkmann expressly states that they chiefly occurred soon after the treatment was first introduced, and that with increasing experience of the aseptic method these cases have become more and more infrequent; and he states that 3 cases of secondary amputation would have been unnecessary if the injuries had been, in the first instance, properly diagnosed and treated. In speaking of the results of his cases he rightly divides them into two sets, the first being those which occurred during the first year, while they were learning the method; and the second, those treated during the remainder of the period (three years or more) after they had learned the method. In the first set they had always suppuration and sometimes gangrene of portions of the skin; here they injected a strong solution of chloride of zinc at first, and afterwards they washed out the wound daily with carbolic lotion. When they found that chloride of zinc ought not to be used, and that it was unnecessary and hurtful to wash out the wound, they got very different results. Then they found, and this was the case in