Resection of the shoulder joint : remarks upon the cases of six invalids, admitted during the year 1864, at the Royal Victoria Hospital, upon whom resection of the shoulder-joint had been performed in New Zealand for gunshot injuries / by T. Longmore.

Contributors

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RESECTION OF THE SHOULDER JOINT.

RESECTION OF THE SHOULDER JOINT.

Remarks upon the Cases of Six Invalids, admitted during the year 1864, at the Royal Victoria Hospital, upon whom Resection of the Shoulder-joint had been performed in New Zealand for Gunshot Injuries.

By Deputy Inspector-General T. Longmore, Professor of Military Surgery at the Army Medical School.

On the 21st of July, 1864, ninety-two invalids arrived from New Zealand by the ship "Light Brigade," and among the number were twenty-nine men sent home on account of gun-shot wounds. These men formed the first detachment of wounded invalids who have arrived in this country since the present war in New Zealand commenced*. The "Light Brigade" left Auckland on the 4th of April, 1864; and the time occupied on the voyage was, therefore, 110 days.

The general nature of the wounds of the invalids who arrived by this vessel is shown in the classified return which follows.

* The commencement of the present war in New Zealand has one feature of melancholy interest to medical officers, inasmuch as one of their number, Staff Assistant-Surgeon William Astle Hope, M.B., of seven years service, lost his life on the occasion of the treacherous attack by a party of Maories on the 4th May, 1863, which formed the first outbreak of hostilities. Assistant-Surgeon Hope was accompanying an escort from an out-post at Taranaki to Auckland, when the whole party were fired upon by natives concealed in the surrounding bush. Dr. Hope was wounded by a musket-ball which penetrated the chest, and, in addition, received fatal injuries inflicted on the head by a tomahawk.

TABLE showing the Number of Invalids admitted under "Vulnus Sclopetarium" from New Zealand, during the Year 1864, together with the Classes and Orders of their Wounds, and the Actions in which they were received.

Classification and Specification of Wounds and Injuries.		Admitted.	Discharged.		Action in which the Wound was received.						Total.
Class.	Order.		Invalided.	Duty.	While on Escort Duty near Drury, February, 1863.	Shepherd's Bush, 17th July, 1863.	While on Escort Duty, 17th July, 1863.	Near Cameron's Town, 1st September, 1863.	Fort Putoko, 2nd October, 1863.	Rangiriri, 20th November, 1863.	
1. Wounds of the Head.	2. With Contusions or Fracture of the Cranium without depression	2	1	1	..	1	..	..	..	1	2
4. Wounds of the Chest	3. With lesion of contents by Contusion, or with non-penetrating Wound ..	1	1	..	..	..	..	..	..	1	1
	5. Penetrating Contents	1	1	..	..	..	..	..	1	..	1
6. Wounds of Back and Spine	3. With lesion of Spinal Cord ..	1	1	..	..	..	..	..	1	..	1
8. Wounds of the Upper Extremities ..	1. Simple Flesh Wounds.. ..	1	1	..	..	..	..	..	..	1	1
	2. With contusion and partial Fracture of long Bones ..	3	3	..	..	1	2	..	..	..	3
	4. With compound Fracture ..	10	10	..	..	..	..	..	..	10	10
	5. Penetrating or perforating the structures of Carpus or Metacarpus	3	2	1	..	..	..	1	..	2	3
9. Wounds of the Lower Extremities ..	1. Simple Flesh Wounds ..	1	1	..	..	..	..	..	..	1	1
	2. With Contusion and partial Fracture of long Bones ..	2	2	..	1	1	..	..	..	..	2
	4. With compound Fracture ..	3	3	..	..	1	..	..	..	2	3
12. Wounds with direct injury of large Nerves	.. ..	1	..	1	..	..	..	..	1	..	1
	Total	29	26	3	1	4	2	1	3	18	29

Some comments will be hereafter made on each class and order of the injuries tabulated in this return ; but there is one feature of such peculiar interest among them that it seems to deserve special remark on its own account. This is the large proportion of gun-shot wounds in the region of the shoulder which have led to the operation of excision, or resection, of the head and upper part of the humerus. Out of the twenty-nine invalids no less than six, or nearly one-fifth, have offered examples of this operation, and in every instance the result has been exceedingly favourable. All the wounds for which these operations were performed occurred in one and the same action, viz., the action at Rangiriri on the 20th of November, 1863.* The official army returns of the killed and wounded at Rangiriri shewed that 33 non-commissioned officers and men were killed, and that 69 non-commissioned officers and men were wounded. The proportion of resections of the shoulder-joint to the total number of casualties was, therefore, 1 in 17. Resection was also performed in the instance of an officer wounded in the shoulder in this same engagement. I propose in the following paper to make some general comments on the six cases that have arrived at Netley, and afterwards to give their histories, and the results of the operations performed, in detail.

Although the proportion of the wounds for which resection of the shoulder has been resorted to in respect to the whole number of gun-shot wounds inflicted during the war, or to amputations at the shoulder, cannot be known until the general returns are furnished at the close of the campaign in New Zealand, still the number of cases among these invalids furnishes an indication of their having hitherto occurred in an unprecedented large proportion. It is not easy to account for a preponderance in the number of these injuries from any peculiarity in the action at Rangiriri, or of the warfare generally in New Zealand. The fighting has generally taken place when the opponents were close to each other. The British troops have had in a majority of cases to assault fortified positions defended by the natives, or they have been fired upon by the Maories when they were near at hand, lying in ambush. At Rangiriri the fighting took place in an attack on the natives, who occupied a position consisting of a double ditch and high parapet, with an entrenched row of rifle-pits stretching out behind and at right angles to the front line. There was also a square redoubt of considerable strength in rear of the main line of intrenchment. The nature of the conflict does not give any explanation for the fact of so large a proportion of wounds occurring in the particular region of the shoulder; but the nearness of the opponents sufficiently explains the extent of mischief done to the bones when struck, notwithstanding the small size of the projectile, and the smooth-bore of the fire-arm generally employed by the natives of New Zealand.† The occurrence of injuries favourable to the practice of resection must be considered as probably accidental ; but, as regards the operations performed for their relief, these are undoubtedly due to the advanced experience of those medical officers who have had to treat the cases. A few years ago the same injuries would have led to one of two alternatives ; either to primary or to secondary amputation of the limb at the shoulder-joint, or to the probable deaths of the patients from the consecutive effects of their wounds without surgical interference.

It is believed that resection operations for gun-shot injuries of joints, which have now been sufficiently demonstrated to be of great practical value, especially when performed in the upper extremity, are not had recourse to so frequently as is desirable in field practice ; and, therefore, it may be useful briefly to allude to the experience gained respecting resections of the shoulder in some recent campaigns. The history of the first practice of this operation is fully recounted by Mr. Guthrie in his Treatise on Gunshot Wounds and need not be further alluded to here.‡ During the period of the Peninsular campaigns,

* This would be in New Zealand the end of the spring months or beginning of summer. The season, therefore, would be favourable for the treatment of wounds, admitting of very free circulation of air without personal inconvenience, and lessening the risks of hospital gangrene and other complications.

† The weight of the smooth-bore musket ball ordinarily used by the Maories, judging from the specimens sent home as patterns to England, is 5 drs. 20 grs.

‡ Third edition, London, 1827, p. 470 to p. 506.

as shown by the same distinguished surgeon, excision of the head of the humerus, although it had met with considerable support from Barons Percy and Larrey among the French, was not a recognised operation in the British Army. This arose "not from experience of its failure, but possibly from too great an attachment to the operation of amputation in consequence of its success, and from magnifying the dangers attendant on excision." Even at the date at which this work was written, however, Mr. Guthrie was led to give as his opinion that, wherever the concomitant circumstances were favourable to recovery, excision was a preferable operation to amputation; and he defined the circumstances of each of the classes of cases in which either amputation, excision, or what he speaks of as a different operation "removal of the splintered pieces of bone by incision," was, according to his opinion, the most eligible practice to be adopted. The operation was not regarded with favour, however, by other eminent British surgeons who had witnessed the field surgery of that period. Professor J. Thomson regarded it as unsuited to the circumstances of war surgery.* Hennen, wiht all his wide experience, mentions in his observations that he had never seen the operation performed in the field, speaks of its seriousness, the comparative rarity of the cases requiring it, and its doubtful utility;"† and, from the general tenor of his remarks, shows he did not regard it as one to be recommended in field practice.

Baron Larrey is usually quoted as having performed the operation of resection of the shoulder-joint ten times with recovery in the campaign of Egypt in the early part of the present century. His operation was not, however, strictly speaking, resection of the joint; indeed he says so himself:— "Mais je n'ai point à m'occuper de la résection de la tête de l'humerus que je n'ai pas eu occasion de pratiquer;"‡ but it consisted of the removal by incision of only those portions of the head of the bone which had been fractured by a projectile, or of the whole head when it had happened to be separated by the same means from the shaft. The saw was not employed in the operation, and only those fragments which were absolutely detached were removed. Larrey, however, mentions that this surgical operation had only been adopted in two cases prior to the ten cases here referred to. All cases of similar injury had previously led either to primary amputation of the limb at the shoulder, or to subsequent amputation when the consecutive effects of the wound had become manifest.

The successful results of these cases by Baron Larrey, and of nineteen others of a similar nature mentioned by Baron Percy about the same period, gave great encouragement to the practice of the operation among continental surgeons.

* Primary amputation, or, otherwise, what has been elsewhere called the "expectant curative" treatment, were the rules of practice for wounds in the shoulder by musket-bullets in which the articulating surface of the humerus was fractured, after the battle of Waterloo. A large proportion of those in whom primary amputation was performed recovered; but of those in whom no operation had been performed, Dr. Thomson writes, "some died during the first attack of inflammation and fever; we saw some sinking more slowly under hectic fever and diarrhœa; and of the remainder, a great proportion had passed, or were passing, into a state in which secondary amputation afforded the only chance of recovery." No instance of excision is alluded to by Professor Thomson, and he himself was led to recommend primary amputation at the shoulder-joint in all such cases. "Whether the necessity for amputation at the shoulder-joint may be superseded by division of the deltoid muscle, and the excision of the head of the humerus in the manner which has been practised by M. Larrey, is a point which must be left to future experience to determine. The number in which this operation would succeed has not been determined; but the length of time and care necessary to complete the cure, and the various accidents to which during the period the injured part must be liable, incline me to doubt whether it will be found of much utility in military practice." Report of Observations in the British Military Hospitals in Belgium after the Battle of Waterloo. By John Thomson, M.D., &c. Edin. 1816, p. 246, &c.

† Observations on some important Points in the Practice of Military Surgery. By John Hennen, Deputy Inspector of Military Hospitals. Edin. 1818, p. 40.

‡ Campagnes d'Egypte, Mémoires, tome ii, p. 172.

Especial attention was paid to resections of joints for gunshot wounds in the Schleswig-Holstein army, of which Dr. Louis Stromeyer was Surgeon-in-chief, in the campaign of 1849 against the Danes; and a monograph treatise, recording very fully the experience resulting from that war on the subject, was published in May, 1851, by Dr. Frederick Esmarch, one of the surgeons engaged in it.* Dr. Esmarch shows that of eight cases of injuries to the shoulder-joint, complicated with injury to the bone by gunshot, in which resection was not performed, five proved fatal, and in the three survivors operative interference appeared to be called for after six months treatment; while of nineteen cases of similar injuries in which resection was performed, only seven proved fatal, the cause of death in all being pyœmia, which might have been averted under better nosocomial arrangements. More or less useful arms were saved for the twelve survivors; a certain amount of mobility remained in all, and in many the active mobility returned to so great a degree that the patients could even perform heavy work.

During the Eastern campaign of 1854-55, out of 14,849 wounded officers and men, and out of 998 recorded amputations and resections in the English army, the total number of resections of the head of the humerus was 16. Among these, three deaths took place, or 18·9 per cent.; but, in one of these, in which death took place by gangrene, there was such a complication of other injuries in the neighbourhood of the comminuted humerus that, as stated in the record, it could be scarcely with fairness included in the list of deaths following resections. Ten of the resections above referred to were performed as primary, six as secondary operations.

In the French army the proportion was even less. Professor Legouest has stated that the total number of scapulo-humeral resections in the French army in the Eastern campaign was 38, of which 21, or 55·3 per cent. proved fatal.† The total number of wounded officers and men in the French army was 44,044.‡ The proportionate number of resections, therefore, of the head of the humerus in the French army was 1 in 1,185 wounds of all kinds; in the English army it was 1 in 928 wounds.§

In February 1855, the distinguished military surgeon, M. Baudens, recorded, in a memoir upon scapulo-humeral resection, read at the Academy of Sciences in Paris, 14 cases of the operation performed in his Algerian campaigns, out of which number 13 recovered, and only 1 died.‖

The Sepoy mutiny in India of 1857-58 caused 935 soldiers of Queen's troops to be invalided to England for the effects of gunshot wounds or surgical operations consequent upon them. Among these there was only one case of excision of the shoulder-joint. There were nine instances of complete ablation of the limb at this articulation.

In the Italian campaign of 1859, 26 cases of resection of the shoulder-joint, with 17 recoveries and 9 deaths, have been recorded by Dr. Demme. He also shows that, in 43 cases in which no operative interference was resorted to where the treatment was "curative-expectant," 29 died and only 14 recovered. He records also that, "unfortunately, amputation at the shoulder-joint was practised in very many cases in which resection might have been performed.¶

* This Essay was translated by Mr. S. F. Statham, and published by J. W. Tatton, 29, Queen Anne-street, London. 1856.

† Traité de chirurgie d'armée. Par L. Legouest, Médecin Principal, Professeur de clinique chirurgicale (Val-de-Grâce), Paris, 1863, page 747.

‡ Relation Médico-Chirurgicale de la Campagne d'Orient. Par le Dr. G. Scrive, Médecin-Inspecteur, &c., &c., Paris, 1857, p. 349.

§ Since the above was written, the large work of Dr. Chenu, Médecin Principal, on the medico-chirurgical results of the Crimean campaign has appeared. He states that the total number of resections for fractures of the humerus (query, does this include resections of portions of the shaft?) was 45, and that 25 of those who were subjected to the operation died, while 20 survived to be pensioned. "Rapport au Conseil de Santé des armées sur les résultats du service médico-chirurgical aux ambulances de Crimée, par J. C. Chenu, &c." Paris, 1865, page 504.

‖ Mémoire sur la résection de la tête de l'humérus, lu à l'Académie des Sciences, séance du 26 Février, 1855.

¶ Militär-Chirurgische Studien in den Italienischen Lazarethen von 1859. Von Dr. Hermann Demme, Würtzburg, 1861, p. 225.

The war in America will doubtless hereafter add greatly to our knowledge of the statistical results of this operation. At present the information published on this head from that country is only very partial.

In a classified tabular return of 20,930 gun-shot wounds treated in the United States Army General Hospitals during the four months ending the 31st December, 1862, and published from the Surgeon-General's Office at Washington in July 1863, it was shown that 269 wounds of the shoulder-joint had occurred. Excision was performed in 51 cases, and the results were shown to be 10 deaths, 15 discharged from hospital, while 26 remained under treatment at the close of the period named. No descriptive remarks accompanied the return.

A consolidated Table of resections, collated from records in the Surgeon-General's Office of the Confederate States, from June 1, 1862, to February 1, 1864, has been published by Dr. Chisholm, Professor of Surgery in the Medical College of South Carolina. This Table shows 68 cases of resection of the shoulder-joint in that period, of which 48 were successful and 20 unsuccessful. Forty-one of these were primary resections with 28 successful results, and 27 secondary with 20 successful results. Professor Chisholm remarks that, in the 48 successful cases, the patients regained very useful arms, the forearm and hand possessing all their former movements. He adds that the "operation was not performed as frequently as necessity required."*

The above statistics tend to show that, while resection of the shoulder-joint has gradually become established as a regular operation in military practice for gunshot wounds involving the articulation, there is still reason to believe from the testimony of competent surgeons, that it has not been hitherto resorted to so frequently as it might have been with advantage. The proportionate number of resections of the shoulder among the invalids who have already arrived from New Zealand leaves no doubt that the value of the operation has been fully acknowledged in practice in the war which is now proceeding in that colony. No case in which amputation at the shoulder has been performed has arrived from it at Netley.

The six resection operations in New Zealand were performed by three Medical Officers, viz., one by Inspector-General Mouat, V.C., C.B.; four by Surgeon W. A. Mackinnon, C.B., 57th Regiment;† and one by Staff-Assistant-Surgeon C. C. Dempster. The portions of bone in the five latter instances have been transmitted to the museum of the Army Medical Department at Netley.

Dr. Mackinnon also practised resection in the case of the officer who, it was before mentioned, received a wound of the shoulder-joint in the same action in which the foregoing six patients received their wounds.

The operation adopted in all the cases has been that by a straight incision on the anterior aspect of the shoulder, in a direction agreeing with the position of the long tendon of the biceps. This is the form of operation which was chiefly adopted by the Prussian surgeons in the Schleswig-Holstein campaign of 1848, where it was known as Langenbeck's method of resection. It is the form of operation generally practised on the dead subject at the Army Medical School, as I believe it to be the simplest, and generally most effective mode, of performing resection of the shoulder in military practice. Least injury is done by it to any of the important structures connected with the articulation. No arterial branches of large size are divided, so that there is no risk of serious bleeding, primary or secondary. It presents no difficulties in its performance that ordinary skill and care will not overcome; and it offers, perhaps, greater facilities for the use of the saw in resecting the upper end of the humerus than any other method. If the long tendon of the biceps has not been destroyed by the action of the projectile, it can readily be preserved. The importance of preserving this tendon for assisting in moulding, and in afterwards acting upon the new articulation, is now generally acknowledged, although its division was formerly directed, as one step in

* "Manual of Military Surgery, for the use of Surgeons in the Confederate States Army." By J. J. Chisholm, M.D. Third edition, Columbia, 1864, p. 380.

† Another very favourable case of scapulo-humeral resection, performed by Surgeon Mackinnon subsequently to the cases mentioned in this report, arrived at Netley from New Zealand on the 21st of January, 1865.

the operation, by Larrey, Guthrie, and many others. The position of the tendon can always be readily determined, even if it be so much covered as to be imperceptible to the touch, by following the outer margin of the muscle to which it belongs, and no difficulty is experienced in setting it free from its sheath up to its origin from the edge of the glenoid fossa. A difficulty in the operation occasionally arises from not carrying the incision far enough upwards, so as to free the tendon from its connections completely up to its origin. If this be not done, an opening is not obtained sufficiently spacious for the easy extraction of the fragments into which the head of the bone may be shattered; and the tendon itself is not so easily turned to either side while the tendinous insertions into the tubercles are being divided. When the tendon is completely loosened, a semi-circular incision, first on one side and then on the other, the arm being rotated by an assistant, if it has not been broken completely across, readily enables the operator to divide the tendinous insertions into the tubercles and the front part of the capsule, and renders easy the division of the posterior part of the capsule, as well as of part of the attachments of the pectoralis major, teres major, and latissimus dorsi muscles, if this be necessary. The head of the humerus, supposing it remains attached, or the upper end of the humerus if the fracture has caused a complete division of the bone, can now be readily brought out of the opening for the application of the saw. If the head of the humerus has been completely separated by the shot, or has been partly split off, these fragments will have to be dissected out; and here "Ferguson's clawed forceps for grasping bone," which forms one of the instruments in the Army Capital case of instruments, renders great assistance to the operator. Without such a firm hold as this instrument affords, the removal of the fragments is difficult.

The chief practical objection to the mode of operation by the single incision over the course of the biceps tendon is that the after-discharges cannot so readily escape in consequence of the opening being in front. Dr. Stromeyer, on this account, introduced another mode of operation by which the joint was opened from above and behind. The incision was commenced at the posterior edge of the acromion and carried semi-circularly backwards and downwards about three inches, and Dr. Stromeyer says, from the facility with which the secretions escaped as the patients were lying in bed, and the consequent prevention of burrowing of pus, the patients operated on in this way overtook in their recovery patients who had been operated upon by the single incision in front months before. The frequency, however, with which an opening occurs behind from the projectile having passed through the shoulder, and the ease with which a counter-opening is made by the surgeon, if the projectile has lodged, or the pus does not readily escape from the front and is inclined to gravitate posteriorly, seem to render this objection of no great weight; while, on the other hand, the ease with which the long tendon of the biceps is preserved, if the projectile has left it intact, and the facility which the whole resection is performed by the single incision, are strong recommendations of the latter method. Moreover, the experience gained by the results of the cases under consideration tend to confirm its advantages.

The various flap operations—horse-shoe shaped flap resections,* as they are sometimes called—formerly recommended, in which the muscles are divided transversely to the line of direction of their fibres, appear to lead to comparatively very unfavourable results, and, though necessary, perhaps, in some diseased conditions of the joints, are no longer justifiable from a musket shot injury of the bone in such young and vigorous subjects as soldiers usually are.

A short time ago there happened to be together in the invalid hospital at Fort Pitt two patients, in each of whom the shoulder-joint had been resected; but in one, by the longitudinal, and in the other, by the flap, operation. The contrast in the results of the two operations was so remarkable, and was calculated to be so instructive, that photographs were taken of the two patients.† The histories of their cases are briefly the following:—

Case 1. *Operation by Longitudinal Incision.*—Sergeant J. McDonald, 79th

* See case recently reported in the "Lancet" of March 11, 1865.

† The lithographic drawings which accompany this paper have been copied from the photographs referred to in the text.

Regiment, aged 25 years, was wounded at Lucknow, on the 11th of March, 1858, by a musket-ball which struck him in the left shoulder on its anterior aspect.

The projectile penetrated, splintered the head and shaft of the humerus to a considerable extent, passed backwards and downwards, injured the lower angle of the scapula, and lodged between that bone and the chest wall, from which position it was extracted by incision on the day the wound was received.

The same day excision of the head and upper part of the humerus was practised by Surgeon Scot, 79th Regiment, by one long incision, through the anterior aspect of the deltoid muscle. The incision included the opening of entrance of the projectile. The long tendon of the biceps muscle was preserved.

The condition of the left arm of this patient was observed at Fort Pitt in April, 1862, and is well shown in the photographs which were then taken of it in different positions.

The following are copies of notes made at the time named. "The arm is one inch and a half shorter than the sound arm. The union between the upper part of the shaft and glenoid fossa appears to be ligamentous; there is no bone between the projecting point (shown in Lithograph No. 2) and the acromion process, a space of about two inches. The loss of the solid point d'appui deprives him of the fulcrum necessary for the power of raising the arm from the side. He can raise without difficulty three-quarters of a hundredweight with the arm in an extended position by his side, and he can hold 14 lbs. in his hand when the arm is flexed." (As shown in Lithograph No. 3.)

Case 2. *Operation by Flap.*—Private W. C., 78th Regiment, aged 21 years, was shot at Aldershot Camp, on the 23rd of November, 1861, by a comrade in his barrack-room. The bullet passed through the right shoulder, from behind forwards and inwards through the head of the humerus, shattering it and some of the shaft. The openings of entrance and exit were each about an inch below the level of the acromion process.

Excision of the head and of about three inches of the shaft, was performed next day under chloroform. A flap incision was adopted. The two openings made by the musket-ball were connected by a semilunar incision, the convexity descending towards the insertion of the deltoid muscle. The flap was then raised, and the shattered bone removed.

The two photographs were taken at Fort Pitt in April 1862.

The right arm was then two and a-quarter inches shorter than the left arm. All the movements of the joint were very seriously impaired. The man could not in any degree whatever move the arm from his side himself, nor could he flex the forearm upon the upper arm without support from the other hand. The arm could only be abducted as far as is shown in Lithograph No. 6, under passive motion by an assistant. A splinter of bone, partly detached by the projectile in its passage, had become fixed in a direction towards the axillary aspect of the chest, and evidently interfered with the movements in this direction. It fortunately did not press upon the axillary nerves.

The long head of the biceps muscle had been divided, and the transverse division of the fibres of the deltoid muscle had led to almost complete destruction of its power. When the man attempted to move his shoulder in any direction, he only moved the scapula; but when the scapula was fixed, the humerus could be *passively* moved laterally, backwards and forwards, to a considerable extent by the surgeon.

Unfortunately, out of the six cases from New Zealand, the long tendon of the biceps appears to have escaped injury from the shot in only one instance —in that of Private D., of the 20th Regiment. In the histories of the cases sent home with the patients, the tendon is stated to have been destroyed in one instance, to have been divided in another, and to have been lacerated in two others. In the history of Private Hannighan's case, the condition of the tendon when the resection was performed is not mentioned; but, as there was sufficient evidence that the tendon was not in existence at the time the patient reached Netley, it is to be presumed it was either destroyed by the bullet, or that it had sloughed away after removal from its sheath, and had disappeared with

the discharges during the granulating process of the resection wound. So also as regards the two instances in which the tendon was not originally completely divided, but was found to have been lacerated, there was reason to believe that these injured tendons, from the well-known inferior capacity for repair inherent in tendinous structures, were entirely lost by subsequent sloughing, for there was the same evidence of their non-existence while the patients were at the Royal Victoria Hospital, as there was in Private H.'s case.

The six cases of resection were all secondary operations. The earliest period of performing the resection after the receipt of the original wound was thirteen days, and the latest was twenty-two days, the average date being nearly eighteen days. This delay does not appear to have been the result altogether of necessity nor of choice, so much as a consequence of the fact of the injury not being at first detected. It is by no means singular that this delay in exact diagnosis should have occurred. Nearly every military surgeon who has studied the subject of gun-shot fractures of the humerus near the shoulder-joint has remarked on the difficulty which exists in many instances of determining, in the early period of the case, whether the joint is implicated in the injury or not. The natural mobility of the shoulder-joint in every direction in a state of health; the absence of any particular amount of pain on motion after the injury beyond what might be expected to be present if the soft parts only had been traversed; the rareness with which any escape of pure synovia can be detected; and the preservation of the roundness and general form of the shoulder, from the manner in which the head of the humerus is held by the capsule and surrounding muscles, will often mislead the surgeon in his examination, although considerable damage may have been done by a musket-bullet to the articulation. This will be especially the case if the capsule has been opened, and the surface of the bone little more than grazed, by a shot traversing across the articulation beneath the deltoid muscle. If, on the other hand, there be much shattering of the head or neighbouring parts of the bone, and the patient place himself in the exact position in which he stood at the time of receiving the injury, the insertion of the little finger of the surgeon at once, before inflammation has arisen, will generally sufficiently indicate the nature of the mischief done.

Baron Larrey has mentioned a way of discovering the injury when there is not much shattering, but the humerus has been simply broken across, just below the head of the bone. Supposing the ball has passed through the shoulder, and the arm is allowed to hang in a dependent position by the side of the chest, on placing the fingers between the two wounds, a deep hollow may be felt; and this sufficiently indicates that a want of continuity exists in the bone, produced by the head being held in the articular cavity, while the body of the bone has sunk down a little from its weight. The immediate digital examination of the wounds does not appear to have been made in the New Zealand cases; and, as the wounded had to be removed from Rangiriri to the general field hospital at the Queen's Redoubt, a distance of twenty-two miles, by ambulance-carriage and by water, they could not be examined at this hospital until over two days after the receipt of their wounds. Hence the difficulty of diagnosis after the men reached the hospital.

Staff-Surgeon Dr. Mackinnon, who saw the cases after their arrival at the Queen's Redoubt, and who was kind enough to send me some remarks on them, says,—"You will find it stated in some of the abstract reports of the cases accompanying the invalids, that crepitus was the first indication by which we diagnosed the injured joints. This is a mistake; it was by the use of the probe I made out the true natures of the cases, long after the receipts of the wounds, and when suppuration was fully established. The fact is, the wounded, when first seen on the field, were hastily examined, and the all-important examination by the finger was omitted. Consequently, after enormous swelling and effusion had taken place, it was utterly impossible precisely to diagnose the nature and extent of the injuries to the joints. I endeavoured, three days after the men were hit (on which occasion I first saw them) to make out, by digital examination, if the joints were implicated; but so extensive were the infiltration, effusion, and swelling, that no decisive information could be obtained. Indeed, in some of them, I was led to believe that no wound of the joint existed, and only altered my opinion after the inflammatory swelling had

subsided and suppuration had become established. Then the injuries were clearly ascertained by the probe, as well as by the drooping appearance of the shoulder, and by the escape of the dirty-reddish oily discharge, consisting of mixed sanious pus and synovia, accompanied with a very offensive odour. The latter sign I consider an unmistakeable sign of a wounded shoulder-joint." There can be no doubt that, in the state the shoulder-joints must have been in, and as they were described by Dr. Mackinnon to have been in, on the third day after the wounds had been received, and after the shaking and movements incidental to the transport from Rangiriri, even if the diagnosis had been at once accurately established, it would have been unwise to have performed resection, and that the probable success of the operation in each case was greatly enhanced by delaying the surgical interference until suppuration had become fully established. The majority of the cases of wounds of the shoulder-joint for which resection has been performed in the various campaigns noticed in the beginning of these remarks have been secondary operations. The reasons for this are obvious ; they are the frequent difficulty of diagnosing the cases in the first instance, and, even if the diagnosis be established, the want of means of performing the operation on the field, or even in hospital, before inflammation has arisen. If the diagnosis be established, and circumstances be favourable for performing the resection on the same day that the injury has been received, or before inflammation arises, military experience tends to show that that is the proper time for doing it ; but, when inflammation has arisen, then the operation should be delayed until suppuration has been fully established.

There was one noticeable feature in all the cases, viz., the particular wasting of the portion of the deltoid muscle internal to the line of incision, or that portion arising from the outer third of the clavicle, as compared with the portions of the deltoid external and posterior to the line of incision. This wasting was evidently due to the unavoidable division of the terminal branches of the circumflex nerve and vessels in the operation. In whatever way the resection may be performed the elevating function of the deltoid must be seriously compromised ; for, even if the power of the muscle were wholly retained, it would fail to exert it as an elevator, because the essential fulcrum on which that power was designed to act, namely, the head of the humerus against the glenoid fossa, has been taken away by the operation. And although the tendon of the coraco-brachialis, and the coraco-bicipital tendon, may acquire great power in fixing the humerus so as to allow the deltoid to some extent to exert its elevating influence, this extent must always be extremely limited, for they cannot act as efficient substitutes for the lost fulcrum. The loss of the elevating action of the deltoid must therefore be accepted, like the loss of the rotating power from the division of the muscular insertions into the two tubercles, as a necessary consequence of resection of the head of the humerus. But the holding, or supporting power of this muscle exerted upon the whole upper extremity owing to its position, its extensive origin, and the manner in which it embraces and protects the mutilated parts as well as its faculty of assisting in carrying the arm backwards and forwards, are all functions which may still remain, and serve to point to the great importance of preserving the integrity of its structures as fully as possible. The wasting of the internal fibres above noticed, however, seems a necessary result of resection by the single incision ; but it has this compensating feature, that it is a less serious loss to the patient than an atrophied condition of the outer and posterior fibres would be, because the upper clavicular fibres of the great pectoral muscle can take the place of the inner deltoid fibres to a considerable extent in supporting the shoulder and drawing it forwards toward the chest.

The greatest length of bone removed occurred in Case No. 5, that of Private A. Law, 65th Regiment. In his instance the head, neck, and fragments of the shaft of the humerus nearly three inches in length, were taken away. The length of bone removed must therefore have been about four inches in all. It is stated that the progress of this case after the operation towards recovery was unchecked, and the results appeared as satisfactory as in any of the others. In the case of Serjeant McDonald, whose arm, after resection of the head and part of the shaft of the humerus is represented in the lithographs, a space remained destitute of bone above the upper end of the humerus for about

two inches, the bone being replaced by ligamentous connexions. These cases strongly show that Mr. Guthrie's limitations of the practice of excision in gun-shot wounds to injuries of the head and neck of the bone is unnecessary, "If the splinters extend to the body of the bone," he writes "amputation should be performed; if it be confined to the head and neck of the humerus, incision ought to be practised."* Sergeant McD's. case particularly shows what immense strength and varied movements may be retained notwithstanding the absence of a considerable amount of bone in the place of the original shoulder-joint. The exact length of bone that can be resected with a reasonable hope of a satisfactory result hardly seems to be settled; but the rule laid down on the point by M. Baudens in his memoir, elsewhere quoted, seems to be a very safe guide to follow. It is to the effect, that when the lesion extends beyond the neck, the bone should not be divided beyond the insertions of the deltoid, pectoralis, and teres major, and the latissunus dorsi muscles, for on this condition alone can any movements of the arm be preserved. As the insertions of these muscles extend to a considerable distance, they may sometimes be partially removed and successful results be still obtained. I am by no means sure, however, that observance of the rule given by the same distinguished surgeon that resection should be absolutely confined to the lesion is attended with the most favourable results.

Professor Van Buren, of New York, has been kind enough to send me a photograph, nearly of full size, of the head, and *six inches* of the shaft, of a right humerus, which were excised during the present war in the United States, on account of a comminuted gunshot fracture, with a successful result. The wound was inflicted in action at Culpepper, on October the 11th, 1863, by a fragment of shell, weighing nine ounces, which lodged under the deltoid muscle. The patient is reported to have recovered "without a bad symptom, and with a very useful arm." It is to be presumed, from the length of shaft removed in this case, that all humeral movements must have been lost, and that the usefulness described refers to the preservation of the movements of the hand, wrist, and some of those of the forearm, when the limb is artificially supported. The portions of the bone removed are in the Army Medical Museum at Washington, to which they were presented by the operator, Surgeon D. W. Bliss, U. S. Volunteers. The head, neck, tubercles, and adjoining part of the shaft were entire; the comminution was chiefly effected in the lower half of the part of the humerus excised, but two fissures extended for some distance into the upper half. The questions might arise in this case whether, as the head, neck, and some distance of the shaft, as well as the principal vessels and nerves, were intact, a hope might not have been entertained of recovery without resection; or, resection being determined upon, whether it might not have been limited to the injured part of the shaft; but, under any circumstances, the case is of interest in showing the length of bone which may be resected with success. M. Baudens has mentioned an instance in which the head, neck, and upper part of a humerus having been fractured by gunshot, he had performed resection below the insertion of the deltoid muscle, and the patient recovered.† In this case, the arm remained suspended in the midst of the flesh, without articulation, and deprived of all movements of the shoulder; but the hand and forearm movements were preserved, and capable of being employed, when the arm was artificially supported. In such a case the only question could be between removal of the whole limb at the shoulder-joint, and resection below the insertion of the deltoid, with loss of humeral movements. And there can be little doubt that the possession of the impaired limb would be held by every one to be far preferable to its total absence.

The cases which have come under my notice would lead me to conclude, while admitting as a principle always to be followed that as much *uninjured* bone is to be preserved as possible, that a fair section of the shaft immediately below the limit of the lesion gives the patient a prospect of a more serviceable limb after recovery than simple excision of fragments or splinters which are detached or nearly detached. M. Baudens mentioned having removed in one case only half of the head of a bone in accordance with his rule just named The three preparations sent to Netley of the portions of bone resected in the

* Op. pic. p 224.

† Op. Cit., p. 13.

cases of privates Grimes, Yates, and Holmberg, show that the resection was performed in each instance admirably at the limit of the termination of the lesion which had been done by the shot, no sound bone being unnecessarily sacrificed, and though in one of these cases, a large portion of the head from which a portion was splintered off might have been left in situ, I cannot think the result would have been so satisfactory as it has been with the injured portions wholly removed. The preparation in Private Doward's case does not show whether resection was performed, or only excision of the detached head ; in the instance of Corporal Law it is stated that the splintered portions of the shaft were removed by cutting pliers.

A question arises in studying these cases as to the proper treatment to be pursued on a long voyage having to be undertaken by men convalescing from the effects of resection of the shoulder after gun-shot wounds from the seat of war to the invaliding hospital in England. This necessity must frequently happen in the British service. In the six cases under notice the arms of the patients in whom the operation had been performed were closely bandaged to their sides, under their dress, as a precautionary measure against the falls and various accidents to which partially disabled and weakly men may be subjected on shipboard from the rolling and pitching of the vessel. Five of the six patients were apparently protected from direct injury by these means ; or at least, their limbs met with no blow or other violence during the voyage home. The sixth patient (see Private Hannighan's case) did, however, fall, and the effects of the fall seemed to have been aggravated by the fixed condition of the limb; for the whole weight of the collision came upon the elbow without any power on its part of yielding or slipping aside from the blow. The man's impression was that if the arm had been in a sling outside his clothes, the force of the blow would not have been so severely felt. As a set off against the security from accidents which was obtained by the limbs being secured under the clothes to the body, must be noted the atrophy and loss of muscular strength which was found to be the result of the long confinement and disuse of the limbs, in consequence of the bandaging, when the patients landed at Netley. Under all the circumstances, it appears to me that a better plan in such cases would be for the arms to be supported during the voyage in the ordinary way by suspending the forearm in an appropriate sling outside the clothes, and under the directions of the surgeon in charge, for a certain amount of passive motion of all the joints to be carried out regularly morning and evening in the sick bay, or at such other times as the surgeon may appoint, whenever the weather permits. The thickened and weak tissues of the arm might also have the benefit of shampooing and daily sea-water bathing. When not undergoing the treatment named, the arm might with advantage, perhaps, be not merely suspended by the arm sling, but might also be padded and secured, both arm and forearm, to the side in whatever way might be most convenient, so as to obviate the risks of collisions with the various objects which the movements of the vessel may render the patient liable to come into contact.

The average length of time passed by the patients in the Royal Victoria Hospital was between five and six weeks. The desire of the men to return to their homes, and the fair way they were then evidently in for gaining still further improvement and power in the use of their arms, which of necessity would be a process extending over a considerable period, rendered it unadvisable to detain them longer. It was remarkable how great the improvement was in the time named after discarding the restraints to which the limbs had been so long subjected, and from the careful application of regulated movements of their several structures. One patient only, Private Hannighan, was detained for a comparatively long period in hospital, namely, for sixteen weeks, on account of the additional injuries he received on board ship, and of other circumstances which will be found detailed in the history of his case.

The histories of the six resections referred to in the previous remarks now follow. They are given as completely as the available materials will permit. The accounts of the early periods of the injuries and their treatment sent with the men from New Zealand were only abstracts, and furnished very limited information respecting them ; but these records have been supplemented, as far as possible, by careful questioning and examination by myself of the patients at Netley, and by observations of the principal parts removed

in the operations. Assistant-Surgeon W. Jobson, M.D., also made careful notes of the cases in the hospital case-books while the patients were at Netley.

Case No. 1.—No. 3,008, Private J. Doward, 1st Battalion 12th Regiment, aged 29 years, of ten years service, was admitted into the Royal Victoria Hospital on the 21st of July, 1864, suffering from the effects of resection of the head of the right humerus, performed in consequence of a gunshot wound. The patient received his wound in action at Rangiriri, New Zealand, on November the 20th, 1863, and arrived at the Queen's Redoubt field hospital on November the 22nd. The projectile, a musket ball, entered from behind on the inner and back part of the arm, about two inches below the angle formed by the posterior folds of the axilla. There was no wound of exit.

The man was in a stooping attitude, taking aim, at the time he was struck, and, as subsequently shown, the projectile passed upwards and forwards from the point at which it entered until it lodged in the humerus just below the anatomical neck. Being hit from behind, the patient was unable to say from what distance the ball which struck him was discharged. A considerable amount of constitutional disturbance ensued, with much swelling of all the structures around the joint. Subsequently fracture near the articulation was diagnosed, and it was then determined to make an exploratory incision down to the head of the bone, and to resect it if necessary. This exploration was made on December the 8th, 1863, being the 18th day after the receipt of the wound, by Surgeon Mackinnon, 57th Regiment, when a transverse fracture was found to exist below the anatomical neck. A round ball was also at the same time found imbedded in the bone on its inner side, just below the seat of fracture. (See description of the head of the humerus and projectile at the end of the report of this case.) The head of the humerus was at once excised, and several loose spiculæ of bone were extracted. The long tendon of the biceps muscle was uninjured. The operation was borne well, and much relief was experienced by the patient, both locally and constitutionally, for some days afterwards. The progress of the case towards recovery subsequently became retarded by the formation of several abscesses posteriorly; and at one time it was thought that inflammation of the whole shaft of the humerus would ensue. By free incisions, however, to evacuate pus as soon as its existence could be ascertained, together with the aid of the internal administration of the sesquichloride of iron and other tonics, improvement was gradually effected, and about the middle of February a most beneficial change had occurred in all respects. On the 24th of February, 1864, when the patient was about to be discharged from the Queen's Redoubt field hospital, in which he had been treated, Staff Assistant-Surgeon Watson reported—"The wounds have now all healed, though occasional deep-seated pain gives rise to apprehension that further mischief may occur. The patient's general health, which has been much disordered throughout, now seems re-established."

Private D. did not improve during the voyage from New Zealand to England; on the contrary, from his own report, and from the contrast between his condition on his arrival at Netley in July, and his state of health noted on the 24th of February by Assistant-Surgeon Watson, it was evident that he had gradually retrograded constitutionally, and that the shoulder was also in a less satisfactory state than when he left the Queen's Redoubt Hospital. He was weak and anæmiated, and was in the habit of resorting to opiates at night to allay irritation, and to procure sleep. He experienced pain at the upper part of the humeral region, and also deep-seated pain at the inside of the elbow-joint. There were openings, surrounded by fungous granulations at two spots, in the line of the incision made at the time the resection was performed, and from these a considerable amount of thin unhealthy purulent discharge exuded. Another opening existed at the back of the shoulder connected with a sinus, from which a similar discharge was oozing; this opening corresponded with the original wound of entrance made by the projectile. Rough bone could be felt on examining with a probe, both through the opening just named, and through one of the openings in front. The arm had been bandaged to the side, and the forearm equally closely secured under his clothes across the chest during the whole voyage from New Zealand to England; no passive motion had been employed. On examination, there was

found to be comparatively little deformity about the region of the excised joint. The recovery of motion in the injured joint, and, indeed, of usefulness in the whole of the injured limb, had been evidently seriously delayed by inferior dietetic and hygienic conditions incidental to living on board ship, and by the restraint to which the arm had been subjected during the long period passed at sea. The patient himself had scarcely any power of motion at the shoulder in any direction. The arm could be moved backwards and forwards passively at the shoulder to some slight extent, but scarcely any movement at all could be effected on trying to abduct the arm even passively from the man's side. The motions of the elbow-joint, wrist, and hand, as well as the actions of pronation and supination of the fore-arm, were found to be passively tolerably free; but all the parts were so weak from disuse, that the patient had himself scarcely any control over them. The coracoid process was not at all prominent, and in this respect the case differed from most, if not from all, of the other cases in which the long tendon of the biceps had been destroyed.

After the patient's arrival at Netley, the bandages and other restraints to which the limb had been subjected during the voyage were removed, and the fore-arm simply suspended in a sling, carried outside the clothes, from the neck. Frictions of the forearm and hand, with careful daily passive motion at the shoulder, were enjoined, at the same time that tonics, stimulants, and generous diet were ordered for the purpose of improving the general health. Under this treatment the patient soon began to improve in all respects. At the commencement of August a small sequestrum was removed from the wound of entrance at the back of the shoulder. The improvement steadily continued, and at the end of August, shortly before the man's discharge from the Royal Victoria Hospital, I made the following notes on his condition:—"30th August, 1864. The wound of entrance is now completely and firmly cicatrized. A small piece of bone, half an inch in length by a quarter in width, has made its own way out of the only opening which remains, *i.e.*, at a point about the juncture of the middle and lower thirds of the operation wound, and the arm has felt easier since. The patient still feels a pricking pain, however, on pressure, about the upper end of the shaft of the humerus, but no more necrosed bone can be felt by the probe. He has gained considerable power over the whole arm during the last fortnight. He can bend the fore-arm on the upper arm nearly to an angle of 45°. He cannot yet straighten the arm beyond an angle of 80°, owing to limitation of movement at the elbow-joint, but he is gradually regaining the lost power of movement at this articulation. The patient has now good grasping power of the hand; the power of pronation and supination, as well as the wrist movements, are perfect. The coracoid process now appears to be rather enlarged. The patient's power of moving the arm away from the side is still very limited, but he seems to be slowly acquiring some elevating power, as well as an increase of control over the lateral movements of the limb backwards and forwards. The arm will gradually gain greater strength, and will be in all respects a very useful limb."

Private D. was discharged as a pensioner on the 6th September, 1864, to his place of residence at No. 1, Queen's Terrace, Broadway, Hammersmith.

Description of the Head of the Humerus excised in Private D.'s case, with the projectile in situ, forwarded by Surgeon Mackinnon, 57th Regiment, to the Museum of the Army Medical Department at Netley.

The preparation consists of the head, anatomical neck, greater and less tubercle, of the right humerus, and an irregular splintered portion of the shaft, corresponding with the seat of fracture by which the parts above mentioned were separated from the rest of the bone. The projectile, originally a round ball, of the size usually employed by the Maories, is much altered in form. It has apparently struck the bone slightly from below upwards, and has penetrated immediately below the anatomical neck, behind and directly opposite to the situation of the bicipital groove. Had the ball passed completely through the bone, it would have made its exit through the bicipital groove in front. The ball has cut out and driven before it a fragment of the hard circumferential part of the bone into the cancellated

structure; and one of the sharp edges of this portion has nearly cut the ball into two parts while being thus compressed. The ball has thus become spread out and considerably flattened, and to this circumstance its lodgment is probably principally due.

The specimen is of much interest, for it well illustrates a fact which is often observed in these injuries, and one which is sometimes turned to a practical account in deciding the nature of the surgical interference to be adopted in certain cases. It is the following. When a projectile strikes the bone below the anatomical neck, the splintering does not extend upwards into the spongy head of the bone, but the fissures are chiefly directed downwards. This is the more marked if the wound has occurred in a young soldier. In like manner observation of other specimens shows that if the spongy head be struck fairly above the anatomical neck by a projectile impinging laterally or superiorly the fissures do not usually extend below the neck; while if a bullet impinges on either of the tubercles, or in any part of the groove which forms the anatomical neck, then fissuring both of the head and the shaft is the usual consequence. In the present instance, the articulating head, neck, and tubercles, of the bone removed from Private D. are quite entire, but the fissuring had evidently extended downwards, perhaps, to a considerable distance. Hence probably the great constitutional irritation, the formation of abscesses pointing on the posterior part of the arm, and all the symptoms which led those who treated the case at one time to suppose that the whole humerus was in a state of inflammation; the subsequent formation and elimination of the necrosed sequestra were also probably due to the same cause.

It appears from the history of the case sent from New Zealand that at the time the head of the humerus was excised, several loose spiculæ of bone were also extracted. These fragments were not forwarded with the head of the bone above described. It is not anywhere stated whether any portion of the shaft was resected by the saw, and it seems probable that in this instance the operation was confined to simple excision.

Case 2. No. 3793, Private T. Grimes, 40th Regiment, aged 27 years, of nine years' service, was admitted on the 21st of July, 1864, at the Royal Victoria Hospital, suffering from the effects of resection of the head of the left humerus after a gunshot wound.

This man was also wounded at Rangiriri on November the 20th, 1863, by a musket shot. The bullet, as shown by the cicatrices, entered the front of the left shoulder, one inch and a half below the acromion process and immediately external to the coracoid process of the scapula. It seems to have travelled inwards and backwards, lacerating the long tendon of the biceps muscle and fracturing the head of the humerus in its passage; then to have passed across the lateral wall of the chest for a short distance, and to have penetrated the dorsum of the scapula; and finally to have emerged about half an inch below the spine and three inches from the posterior border of the scapula. When the patient was first seen at the Queen's Redoubt field hospital the tumefaction was so great that no distinct diagnosis of the nature of the injury could be arrived at; but subsequently, it having been determined that fracture into the joint existed, it was resolved after consultation to perform the operation of resection. This was carried into execution on December the 4th, by an anterior incision extending for about five inches, and including the wound of entrance of the projectile. A longitudinal fissure through the head, and extending down to the surgical neck, of the humerus, was found to exist, while a fragment was also found detached from the outer side of the head and upper part of the shaft of the bone. These injured parts were sawn off, so that altogether about two and a half inches of bone were removed by the resection. Although the tendon of the long head of the biceps muscle had been much lacerated by the injury, sufficient was preserved to afford hopes that its action might be saved. The operation was borne well, and no untoward symptoms arose in the progress of the case. At the date this patient quitted the field hospital, Assistant-Surgeon Watson remarked at the conclusion of a brief history of the case that "the wounds have healed soundly, and the man has some power over the arm which is gradually increasing." The patient, however, did

not appear to have made much progress in recovery after leaving the field hospital so far as the movements of the upper arm were concerned, but there was a moderate gain of strength in those of the forearm and hand. On examination of the injured shoulder at Netley, there was found to be considerable depression in the situation of the joint, with marked prominence of the coracoid and acromion processes. The appearance of the excised joint was not unsatisfactory otherwise than in the great wasting of the surrounding muscles, especially of the deltoid and biceps muscles. The only comfortable position for the arm the patient stated to be that of close proximity to the side of the chest. This was evidently in a great degree due to the fact of its having been retained in that position by bandages during the whole period of the voyage from New Zealand. When the arm was in the position named, the forearm could be flexed so that the hand could touch the chin. Whenever an attempt was made on the patient's part, or by passive motion, to remove the upper arm away from the side of the chest, the limb quivered and trembled, and the attempt gave rise to great pain.

The patient, although a spare man, appeared to be in a good state of general health.

Private G. was discharged as a pensioner, on the 24th of August, 1864, to his place of residence at Naas, Kildare, Ireland.

Description of the preparation of the Head and portion of the Shaft of the Humerus resected in the case of Private G., and forwarded by Surgeon Mackinnon, 57th Regiment, to the Army Medical Museum, at Netley.

The specimen consists of the greater portion of the head and neck, and one inch and a half of the shaft of a left humerus. The smaller tubercle is entire; the inner portion of the larger tubercle, that bordering on the bicipital groove, alone remains. The parts of the head and neck which are wanting appear to have been grazed off by the projectile which inflicted the wound; they comprehend the whole of the outer aspect of the bone and extend in depth to about one-sixth of its whole width. A superficial portion of the hard circumference of the shaft is shown to have been carried away at the same time as the parts above named.

The projectile evidently came first into contact with the larger tubercle. A portion of the curved outline of the opening made by the projectile is still seen at this point, and from it the chief injury to the bone extends. The cancellated structure is here much bruised and shattered. Three fissures are also seen in the specimen to radiate from this same position. The uppermost fissure follows the direction of the anatomical neck, across the upper part of the bicipital groove and above the lesser tubercle; a second descends through the large tnbercle itself; the third, the most extensive and important, passes obliquely downwards and completely across the bone, separating what remains of the head, neck, and tubercles from their connexion with the shaft.

In this case the saw has been employed to resect the injured portions from the shaft, and the line of the saw has skilfully just cleared the lowest point of the third fissure above described. There is every reason to believe that no fissuring extended into the portion of the humerus which was left in the arm of the patient. The measurement from the upper surface of the head of the bone to the line of resection is exactly two and a half inches.

No smaller fragments accompanied the specimen.

Case 3. The history of the earlier period of this case, viz., the period while he was a patient in the field hospital at the Queen's Redoubt, is transcribed from a report by Staff Assistant-Surgeon E. M. Shane, forwarded with the patient.

"No. 273, Corporal N. Holmberg, 40th Regiment, aged 27 years, of five years' service, a robust subject, was wounded by a musket bullet in the right shoulder, at the attack on the Redoubt at Rangiriri, on the 20th of November, 1863. He was admitted into hospital here (Queen's Redoubt) on the 22nd of November. The ball entered anterior to, and near to the outer extremity of the right clavicle, just below the level of the acromion process;

passed backwards and a little downward; and made its exit through the deltoid muscle, about four inches from its entrance, and about the same distance above the posterior fold of the axilla. There was great pain in any movement of the arm, and partial paralysis of motion, but not of sensibility. Neither the joint nor bone was thought to be injured in the first instance. The discharge from the wounds was copious and healthy; and in it, on the 5th of December, a small fragment of bone was noticed, and again, on the 8th December, another portion was found protruding from the posterior wound. From these circumstances, and from a careful examination of the joint, the head of the humerus was diagnosed to be injured; and it was decided to perform the operation of resection. The operation was performed on December the 10th, by a single longitudinal incision, about three inches long, passing downwards from the edge of the acromion process and afterwards extended a little upwards. The deltoid muscle was divided down to the joint, when the capsular ligament was found to have been opened by the projectile, the long tendon of the biceps destroyed, and the head of the humerus fissured opposite to the wound of entrance, and thence as far down as its anatomical neck. The bony tissue was disintegrated near the fissure, and ulceration of the cartilage had also begun to spread from its borders. The operation was conducted after the usual manner. By the end of December the patient was in a state of great debility, and there was œdema of the feet. Abscesses formed near the acromion and were opened. From that period to the present date (22nd February, 1864) he has improved greatly in general condition. It is now 74 days after the operation, and the wounds are almost completely healed; the discharge is very trifling; there is no tenderness or pain about the shoulder, which he can move up and down; and, in fact, the case has progressed most satisfactorily."

"He was treated by anodynes at first to procure rest, and, as his strength failed, by the early exhibition of stimulants and a liberal allowance of nourishment. His strength was also supported by quinine, iron, and cod liver oil. Locally, when suppuration was copious, poultices were used, but afterwards water-dressings. Tents were employed to prevent the surface of the incision from healing, and latterly the wound of operation has been injected daily with a weak solution of Condy's fluid before dressing it, and the same fluid has been applied to the surface by means of lint."

This patient, a Swede by birth, of phthisical aspect, and presenting signs of condensation at the apex of the right lung, but, according to his own statement, never having suffered from chronic cough, was admitted with the others into the Royal Victoria Hospital on the 21st of July, 1864. On removing the bandages, the muscles of the injured right arm and forearm were found to be much wasted, owing to the prolonged disuse and the effects of the restraint to which they had been subjected. There was great absence of power of movement in any part of the arm or forearm; and even the weight of the arm itself, when permitted to hang down by his side in a state of quiescence, gave him considerable pain. The cicatrix of the wound of entrance on the outer side of the coracoid process was strongly marked, as was also that of exit on the posterior aspect of the shoulder just below the outer part of the spine of the scapula and close to the axillary border of that bone. The cicatrix of the incision was seen to extend from the anterior aspect of the point of the shoulder about four inches down the arm. No remains of the long tendon of the biceps muscle could be detected. The coracoid process was extremely prominent, and so large that one was almost led to doubt that the projection really consisted only of this process itself. Stretching downwards from this prominence, in the depression resulting from the loss of the excised joint, the tense hard tendinous fibres of the short head of the biceps muscle could be plainly felt. There was considerable wasting of the deltoid muscle, especially of that part of it anterior to the line of incision. A fixed hard process of bone could be felt just beneath the acromion, which, at first gave rise to some difference of opinion as to its nature and origin.

This patient quickly improved under the same treatment as was adopted in the previous cases, *i.e.*, comparative freedom of the limb, with careful and moderate occasional passive motion. After a short time he could not only bear without inconvenience the weight of the arm hanging extended by his

side, but he gained so much muscular strength that he was enabled to flex the elbow, and bring the forearm up to a right angle with the upper arm. He was afterwards soon able, when the forearm had been brought to right angles with the humerus, freely, although with a slow action, to flex it still further, so as to touch his chin, and even his forehead on bending his neck downwards. He could also pronate and supinate his hand with the arm in the semi-flexed position, as well as draw the humerus backwards and forwards to some extent, but the latter movements caused pain. He failed, however, to acquire any power of lifting the arm from the side by acting on the new shoulder-joint.

On the 30th of August, 1864, after a careful examination of this patient, I noted the following remarks :—" Grasping power of hand increasing greatly in strength. Wrist movements, pronation and supination of forearm and hand complete. The patient can straighten the arm to its full natural extent. He can also flex the forearm on the upper arm, so as almost to touch the shoulder, and quite to touch the clavicle near its sternal end. The power of advancing the upper arm forwards, and of drawing it backwards, is also improving gradually. The acromion process was evidently broken by the ball in its passage, and it seems strange that this was not noticed in the early history of the case. The " point " of the shoulder is now formed by the scapular end of the clavicle, instead of by the acromion. On following the spine of the scapula with the finger, we come to the broken acromion process, which is on a level beneath the end of the clavicle before mentioned. Part of the acromion process has been bent downwards, and remains firmly fixed and anchylosed, nearly at right angles, with the part of the acromion which remains in its normal relation to the spine of the scapula. It is probable that the bullet, immediately after its entrance, struck the under surface of the acromion process, producing the fracture, and that to this circumstance was chiefly owing the change in direction of the line in which the bullet was at first travelling. Just behind the end of the clavicle, above the spine of the scapula, and about two inches above the wound of exit of the ball, is a cicatrix of an incision which was made to evacuate an abscess. The patient informs me he was standing about six yards only from the man who fired at and struck him."

This patient was detained some time in hospital, owing to certain difficulties in sending him to his residence at Gothenberg, in Sweden. He was finally discharged as a pensioner on the 8th of December, 1864.

The fracture of the acromion, the manner in which the fractured margins had become joined, their position, the marked enlargement of the coracoid process, and especially the fact of the point of the new shoulder being formed by the end of the clavicle, were such peculiar and interesting features in this case, that I thought it important to preserve photograhic representations of the external aspect of the parts. The following lithographic portraits are taken from the photographs, and though on a small scale, sufficiently indicate the leading features above mentioned. (See Lithographs Nos. 7 and 8.)

Description of the Head and Neck of the Humerus removed by resection from Corporal N. H., 40th Regiment, by Assistant-Surgeon Dempster, and forwarded by Surgeon Mackinnon, 57th Regiment, to the Army Medical Museum, at Netley.

The specimen consists of the head and neck of a right humerus, with a very small portion of the shaft on the outer side below the greater tubercle.

In this case the ball has struck directly against, and grooved the superior margin of the greater tubercle, and has partly involved the upper margin of the bicipital groove. It has split off the remaining portion of the great tubercle from the rest of the head, by a fissure which descends at its lowest point to nearly an inch below the protuberance. Above the point of impact there is a pit or hollow, from loss of some of the cancellated structure of the head, as if the bullet had indented it ; but this, I am informed by letter, did not originally exist, but occurred accidentally in making a dry preparation of the bone in New Zealand. When first removed there was simply the grazing of the large tubercle, and of the surface of the bone immediately above it, as well as the fissure before named descending from the point of impact. The remainder

of the articulating surface, the smaller tubercle, and the greater part of the neck are entire.

The specimen has been removed by resection, and in this case again the line of section by the saw has just cleared the limits of the fissuring. On the inner aspect the section has been made close up to the smaller tubercle, and to the groove constituting the anatomical neck of the bone.

Case No. 4.—Private J. Yates, 1st Battalion 12th Regiment, aged 23 years, of five years service, was admitted into the Royal Victoria Hospital on July the 21st, 1864, suffering from the effects of resection of the head of the left humerus, consequent upon a gunshot wound of the shoulder-joint.

Private Y., a man of rather a scrofulous diathesis, was wounded in action at Rangiriri on the 20th November, 1863, by a musket ball, which entered on the anterior and upper aspect of the shoulder, about one inch and a-half below the acromion process, passed obliquely inwards, and lodged. He was received into the General Field Hospital on November the 22nd. The projectile was discovered and extracted seven days afterwards, by an incision through the integument and superficial structures, close to the spinous process of the first dorsal vertebra. Much swelling and pain occurred after the receipt of the injury, and after a time, the patient's health began to suffer from constitutional irritation. The bone was not suspected to be injured at first; but on the 10th of December, twenty-one days after the wound, the nature of the injury became apparent, and it was resolved to perform the operation of resection. On the 12th of December, the joint was cut down upon by Surgeon Mackinnon, 57th Regiment, the incision being about four inches in length, and immediately over the bicipital groove, when the head and neck of the humerus were found to be split completely through and otherwise injured. The fractured bone was then removed, about three inches altogether being taken away. The long tendon of the biceps muscle was lacerated, and much general injury existed in the soft tissues round the joint. Feverish symptoms continued for some days after the operation. Subsequently a large abscess formed at the root of the neck, near the point of entrance of the bullet, at the outer end of the clavicle, which was opened, and continued to discharge profusely for some period; and at another time some pneumonic symptoms excited uneasiness, but on the whole the case progressed favourably. On the 1st of March, 1864, Staff Assistant-Surgeon J. Watson reported:—"Private Y.'s health is now quite restored, and the amount of power which he even now possesses gives hopes of a comparatively useful limb."

As in the instances of the other patients, when the bandages which had confined this patient's arm to his side and chest during the voyage, were removed, he was found to have very little power over the injured limb. The muscles of the forearm, as well as those of the humeral region, were considerably atrophied. Pronation and supination of the forearm, and flexion of the elbow-joint could be passively performed without any impediment. His general health was good. Under similar treatment to that pursued in the other cases, viz., causing the arm to be worn in a loose sling outside the coat, subjecting the joints to passive motion, repeated at frequent intervals, but only for a short period on each occasion, and encouraging efforts, on the part of the patient to make use of the several muscles of the limb, the movements of the forearm and hand were gradually restored, and some of the humeral movements much improved. The pectoralis major particularly recovered power in drawing the arm towards the chest, and within the third week after admission he was able to touch the top of his head with the hand of the injured arm, by assisting the movement with the hand of the opposite side.

The portion of the deltoid muscle, anterior to the line of incision, remained much wasted; but its middle, or vertical portion, were increasing in development and strength when the patient quitted Netley, contemporaneously with the recovery of tone in all the other muscles of the injured limb.

In this case the bullet, after traversing the shoulder-joint, evidently passed between the scapula and the posterior wall of the chest. There was no hæmoptysis, however, after the injury, and percussion, as well as auscultation of the left side of the chest at Netley, elicited no abnormal sounds.

Private Y. was discharged from Netley, a pensioner, on the 22nd August, 1863, to his residence at Manchester.

Description of the Head, Neck, and Portion of the Shaft of the humerus, removed by resection from Private J. Y., 1st Battalion 12th Regiment, and forwarded by Surgeon Mackinnon, 57th Regiment, to the Museum of the Army Medical Department, at Netley.

The specimen consists of a portion of the head, neck, and of about three-quarters of an inch of the shaft of a left humerus. The greater part of the upper aspect of the articulating service is wanting, and a portion of the greater tubercle.

The projectile has first come into contact with the upper part of the greater tubercle where it borders the bicipital groove, and has passed, rather slantingly upwards, through the joint, carrying off the surface of the head of the bone as it coursed along. A curious complication was caused by the collision of the ball with the great tubercle. A triangular portion of the process was struck off and driven down into the cancellated structure of the articulating head as the ball glanced onwards, and this fragment, acting as a wedge, split the head into two nearly equal portions. The lowest point of this split descended to three-quarters of an inch below the level of the smaller tubercle.

Resection of the fractured head has been performed by the use of a saw, and the line of section has been adroitly carried precisely through the part where the splitting above mentioned terminates, and, therefore, through unwounded structures. The remaining portion of the humerus would be necessarily quite free from fissuring.

The distance on measurement from the line of resection to the upper portion of the head in the specimen is one inch and three quarters.

Case No. 5.—No. 2,164, Private A. Law, 65th Regiment, aged 37 years, of nearly 20 years' service, was admitted on the 21st of July, 1864, at Netley, for the effects of resection of the head of the right humerus, consequent on a gun-shot wound.

Private L. was wounded in action at Rangiriri on the 20th of November, 1863, by a bullet which entered on the anterior aspect of the shoulder, and made its exit posteriorly and nearly opposite to the point of entrance. He was admitted at the Queen's Redoubt field hospital on November the 22nd. At first it was thought that the projectile had only traversed the soft parts without opening the capsule or injuring bone. The reports state that eleven days after the injury, the dingy sero-purulent character of the discharge showed that the joint had been injured, and that this was confirmed by loose pieces of bone being detected by the probe. Resection of the head of the humerus was performed on December the 9th, nineteen days after the date of the original injury, by Surgeon Mackinnon, 57th Regiment. The steps of the operation were rendered difficult by the great shattering of the head of the bone which was split into several fragments, as well as by the splintering of the upper part of the shaft. The long tendon of the biceps muscle was found to have been divided by the bullet. The detached pieces of bone were extracted, fragment by fragment, and several splinters were cut away by aid of the bone forceps. Altogether about three inches of the upper part of the humerus were removed. Assistant-Surgeon Watson states in the history of the case sent with the man from New Zealand, that "the progress of the case after the operation towards recovery was unchecked. Scarcely any constitutional disturbance occurred. A healthy granulating process commenced and continued throughout. The bullet wounds healed up before cicatrization commenced in the operation wound. Scarcely any power now exists over the upper arm, but the fingers and wrist are becoming gradually more flexible. His general health is good." This report was dated the 24th October, 1864. This patient, on his arrival at Netley, like his comrades, exhibited the effects of the long-continued bandaging, and disuse of the arm, in a generally atrophied and powerless condition of the muscles of the limb. About three weeks after his admission, the following account of the appearance of the shoulder, and of the general state of the arm, was noted by Assistant-Surgeon Dr. Jobson, "The cicatrices of the original wound are situated on the front and back of the right

shoulder, about two inches above the anterior and the posterior commissures of the axilla. The anterior cicatrix is the larger, and is not adherent; the posterior is puckered and depressed. The excision of the joint has left a perpendicular cicatrix extending about five inches down from the anterior part of the acromion, and about three-quarters of an inch external to the anterior wound of entrance. The coracoid process is immediately to the inner side of this wound. It is prominent, and from it the tense short head of the biceps muscle can be felt passing down the arm. The end of the humerus is felt about two inches from the acromion process, and any movement of the arm which presses this end forwards upon the skin or inwards amongst the nerves causes pain. There is considerable atrophy of the muscles of the injured arm; but the patient states that their tone and bulk are increasing rapidly. There is no general anæsthesia of the arm, nor tingling sensation, although slight numbness is complained of, extending along the inner aspect of the arm as far as the elbow. He can flex the arm from a very obtuse angle up to his chin and mouth; but he cannot completely extend it so as to let it swing at full length by his side. He cannot raise his elbow from his side, so as to extend the shoulder at an angle with the chest. He has full power over all the other articulations of the limb. The portion of the deltoid muscle anterior to the longitudinal incision appears especially atrophied."

This patient left hospital within five weeks after his admission, being discharged on the 22nd of August to his home at Castlebar, County Mayo, Ireland.

Description of the broken portions of the Head, Neck, and part of the Shaft, of a right Humerus, removed from Corporal A. L., 65th Regiment, and forwarded by Surgeon Mackinnon, 57th Regiment, to the Army Medical Museum at Netley.

The fragments in this case sent are eight in number. The head of the bone is divided into four portions. A fifth fragment consists of the lower segments of parts of the two tubercles, with a corresponding portion of the bicipital groove between them; the three remaining portions belong to the shaft. No evidence remains of the precise situation at which the bone was struck by the projectile; but as the long head of the tendon is stated to have been divided by the projectile, and as an inch of the bicipital groove remains entire in one of the fragments above mentioned, it was probably struck between the two tubercles, and at the upper aspect of these protuberances.

One of the splintered portions of the shaft is only one-eighth of an inch less than three inches in length, and the length of a second is two inches and three-quarters. The extremity of one fragment bears evidence of the use of cutting forceps, by means of which it was resected from the remaining part of the shaft. It is remarkable that there should have been at any moment an uncertainty in the diagnosis of the nature of this case, as the bone was so extensively comminuted.

Case 6. No. 697, Private J. Hannighan, 2nd Battalion 14th Regiment, aged 24 years, of five years' service, was admitted into the Royal Victoria Hospital, on November the 21st, 1864, for the effects of resection of the head of the left humerus, consequent on gunshot injury. This patient was wounded at Rangiriri on November the 20th, 1863, by a musket bullet which struck the front aspect of the right shoulder, just above the anterior fold of the axilla, and one inch to its outer side, penetrated, and lodged. He was admitted into the General Field Hospital on the second day after the wound was received. There was very great tumefaction, and to this cause was chiefly owing the fact that the nature of the injury was not then ascertained. Thirteen days after the date of the original injury it was ascertained that the joint was implicated, and the head of the humerus fractured. Resection was then performed by Inspector-General Mouat, V.C., C.B., and about three inches and a half of the head and shaft were removed, the bone having been splintered to that extent. In the abstract history of the case sent with the man from New Zealand, and signed by Assistant-Surgeon Dr. Melladew, it is stated that "the bullet was ascertained to be imbedded in the soft parts in the axilla so close to the vessels that its removal could not be effected without great danger, so it was left to come away naturally." This, as will be seen

subsequently, was a mistake ; the supposed foreign body may, perhaps, have been a fragment of bone. Dr. Melladew writes from the Queen's Redoubt Hospital, on February the 24th, 1864 :—"The subsequent progress of this case has been satisfactory on the whole, though there have been, from time to time, abscesses and constitutional disturbance, owing to the detachment of small splinters and comminuted pieces of bone due to the original injury. The operation wound has gradually filled up and is now closed, excepting a part not more than one inch and a half in extent corresponding with the situation of the wound of entrance. From this opening there still exudes a little healthy pus, and as the edges are fungoid, it is probable that more splinters are yet to come away. A second opening exists in the anterior boundary of the axilla from which a little pus comes away ; it was made with the knife in searching for the bullet which was thought to be presenting there. The man's general health is at present very good." The condition of the long head of the biceps muscle is not mentioned in any of the reports of this case.

When this patient was admitted into the Royal Victoria Hospital on July the 20th, 1864, he was suffering greatly from pain and swelling of the injured arm, and from much constitutional disturbance. On examination, a large collection of matter was found to be occupying the situation of the cavity left by the resection and its neighbourhood. This was due to a fall he had on board ship about three weeks before he landed. He had slipped and fallen on his left side, and the weight of his body was brought to bear upon the elbow of the injured arm as it lay secured against the side of his chest. As soon as the patient had been put to bed and had properly rested, the abcess was opened, and ten ounces of pus were evacuated. This was rapidly followed by relief of all the patient's general symptoms. Shortly after admission also the wound of entrance of the bullet reopened, and the probe detected a sinus extending downwards and backwards with some rough bone at its extremity. No loosened sequestra were, however, found. The bullet still remained lodged, and careful exanination for a long time led to no discovery of the site of lodgment. It was ascertained that the man's left arm was elevated in the act of supporting his rifle whilst he was aiming, when he was struck by the bullet, which was fired from above and in front of the position where he was standing. According to the patient's statement the exploratory incision made on the pectoral wall of the axillary triangle was employed to evacuate an abscess and not to search for the ball, as stated in the abstract sent from New Zealand. This opening was not yet closed when the patient arrived at Netley, but had left a sinus whose orifice was on the inner wall of the chest two inches below the apex of the axillary space. When a probe was passed along this sinus, its progress seemed to be arrested by contact with indurated cellular and muscular tissues at a few inches distance from the orifice. The direction in which it passed most easily was backwards and downwards. Between the papilla at the opening of the sinus, and the axillary border of the scapula an extensively diffused swelling was found to exist over the wall of the chest, and, judging from the direction from which the ball was fired, the situation of the wound of entrance, the position of the patient's arm when he was struck, with the fact that the ball could not be discovered at the time of operation, there seemed no doubt but that this swelling was in some way due to the presence of the projectile. Occasional efforts were therefore made in this direction for the discovery of the projectile, and, at last, in September, a probe came into contact with it lying beneath the scapula on its pectoral aspect, and at a short distance above its inferior angle. A scale of lead was at first brought away by a pair of bullet forceps along the sinus, and through the opening at the margin of the axilla. The bullet itself was then grasped, but could not be extracted. Various kinds of extractors were employed, but with no success ; the bullet appeared to be brought forward for a limited distance, and then to meet with some obstacle, which could not be overcome without using an unjustifiable amount of violence. The attempts at withdrawing it by the sinus were then abandoned ; and subsequently an incision was made immediately below the lower angle of the scapula, and by passing the finger upwards, after some little effort it was removed. The difficulty which had been previously experienced was at once

explained by examination of the bullet. The bullet, a rifle ball, and apparently an Enfield one, had been greatly altered in form. One portion was flattened and spread out like an extended wing, being prolonged for nearly three-quarters of an inch from the main part, and this portion had become fixed between the subscapularis muscle and the bone. The lead surrounding the hollow base of the projectile was marked with the indentations of the forceps by which it had been grasped in the unsuccessful attempts at withdrawing it through the axillary sinus owing to its flattened part having been held by the muscular fibres in the manner described*. It would have been better if these attempts had not been made but the incision at the inferior angle of the scapula adopted as soon as the site of lodgment had been discovered, for it afforded a favourable dependent opening for the escape of pus; but the circumstance of the bullet being so readily grasped by the forceps through the sinus, naturally led to attempts at taking it out in that direction. After the removal of the projectile the whole sinus rapidly closed, the axillary opening becoming first healed. The thickening of the tissues between the edge of the scapula and the axilla gradually disappeared at the same time.

On account of the circumstances before named, but more especially on account of the evidence of some necrosed sequestra requiring to be removed from the humerus, this patient was detained to a much later period than any of the others who arrived with him. It was not until the 21st of October that the last sequestra were sufficiently detached to be removed. Two spiculæ were removed on that date, both being portions of the tense outer cylindrical portions of the upper end of the shaft, and the larger of the two being one inch in length. No more necrosed portions could then be detected, and the healing process was no further interrupted.

On the 8th of November, 1864, the day before Private H. quitted hospital, I made the following notes on his condition. "The opening of entrance made by the bullet, as well as the openings made for the evacuation of the abscess, and for the extraction of the bullet below the scapula, are now quite healed. There is not much power in the deltoid muscle yet, but every prospect of fair development in future. Scarcely any of the origin of this muscle has been destroyed. The patient can now flex the forearm on the upper arm by its own muscular power to an angle of 135°. The stiffness which for some time existed about the brachialis anticus, and the body of the biceps muscles, as well as about the elbow joint, have disappeared. The coracoid process is much enlarged, though not so prominent as in some of the other cases, and the coracoid action of the biceps muscle has gained considerable power. There is no evidence of the glenoid origin of this muscle existing. The actions of the pectoralis major and latissimus dorsi muscles are much increased in vigour. The grasping power of the hand is now strong; the wrist movement, and the power of supination and pronation are complete. There is no sensation of numbness, or tingling of the arm or hand, which he says he suffered from for some time after the injury; but the temperature of the hand and forearm of the wounded side appears to be generally higher than that of the sound limb, and the skin of this region perspired more freely than elsewhere. Neither anœsthesia, nor hyperœsthesia, of its surface exit. The general muscular development of the arm is now fair, as shown by the comparative measurements of the sound and the injured arms."

Measurement of circumference of wounded arm four inches above elbow 11 inches; sound ditto 11⅛ inches; wounded arm three inches below elbow 10¼ inches; sound ditto, 11½ inches.

This patient was discharged to his place of residence in the town of Kildare, Ireland, on the 9th November, 1864.

The bone removed in the case of Private H. was not forwarded to the Museum of the Army Medical Department.

* The bullet is preserved in the Army Medical Museum.

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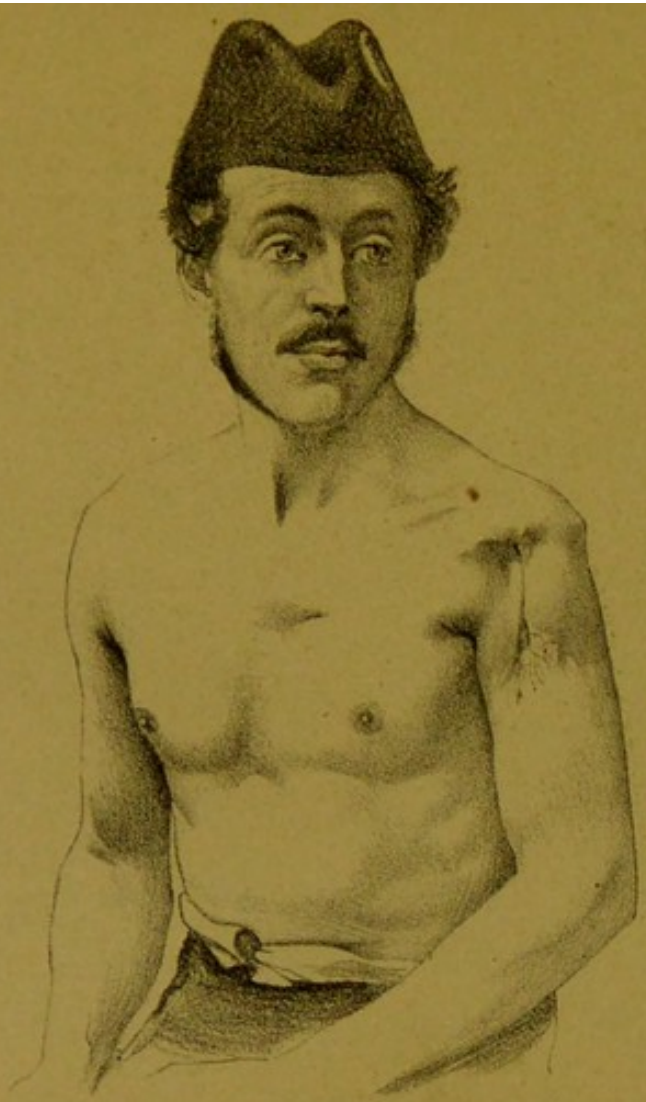
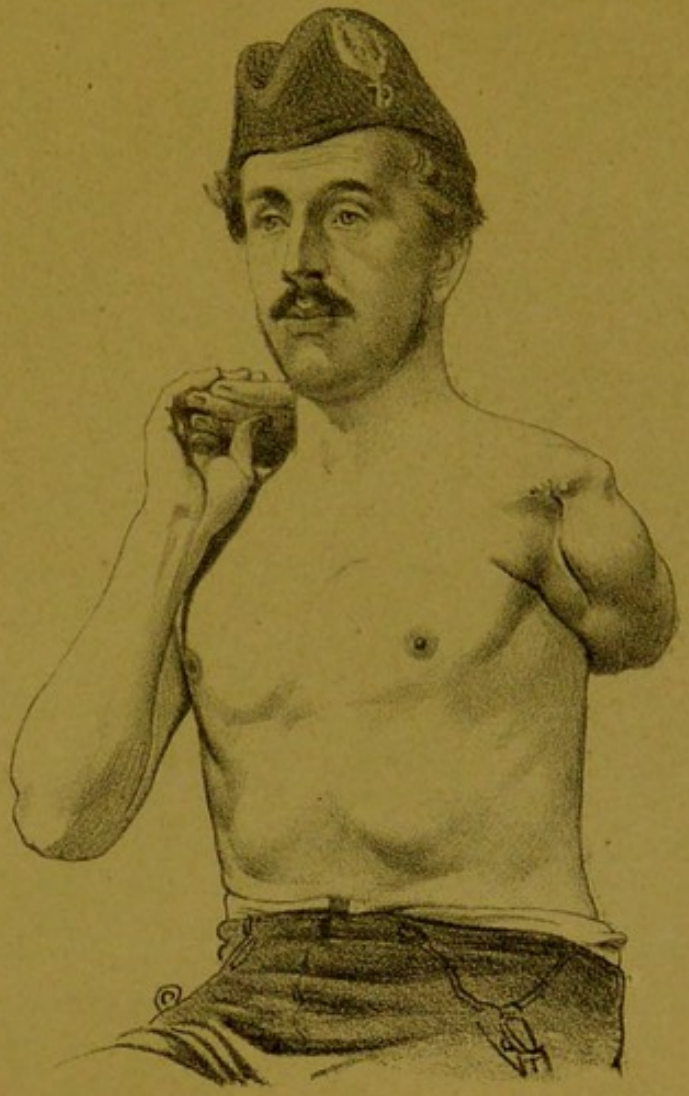


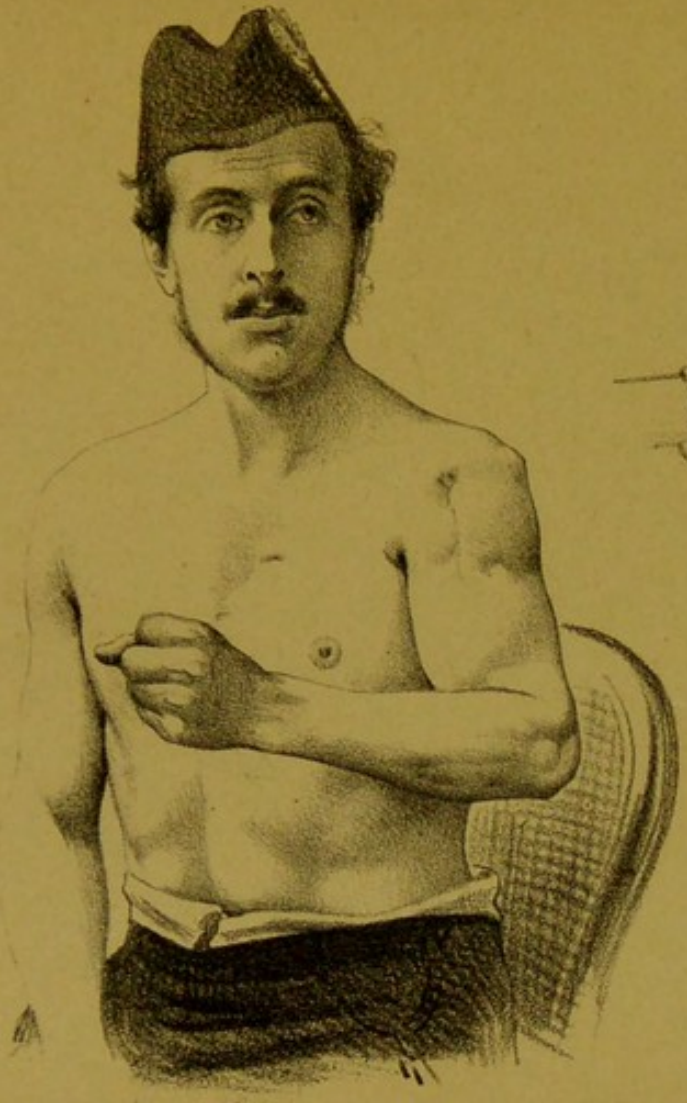
Case of Serj^{t} Macdonald. Drawing to show the line of incision.



Day & Son (Limited) lith.

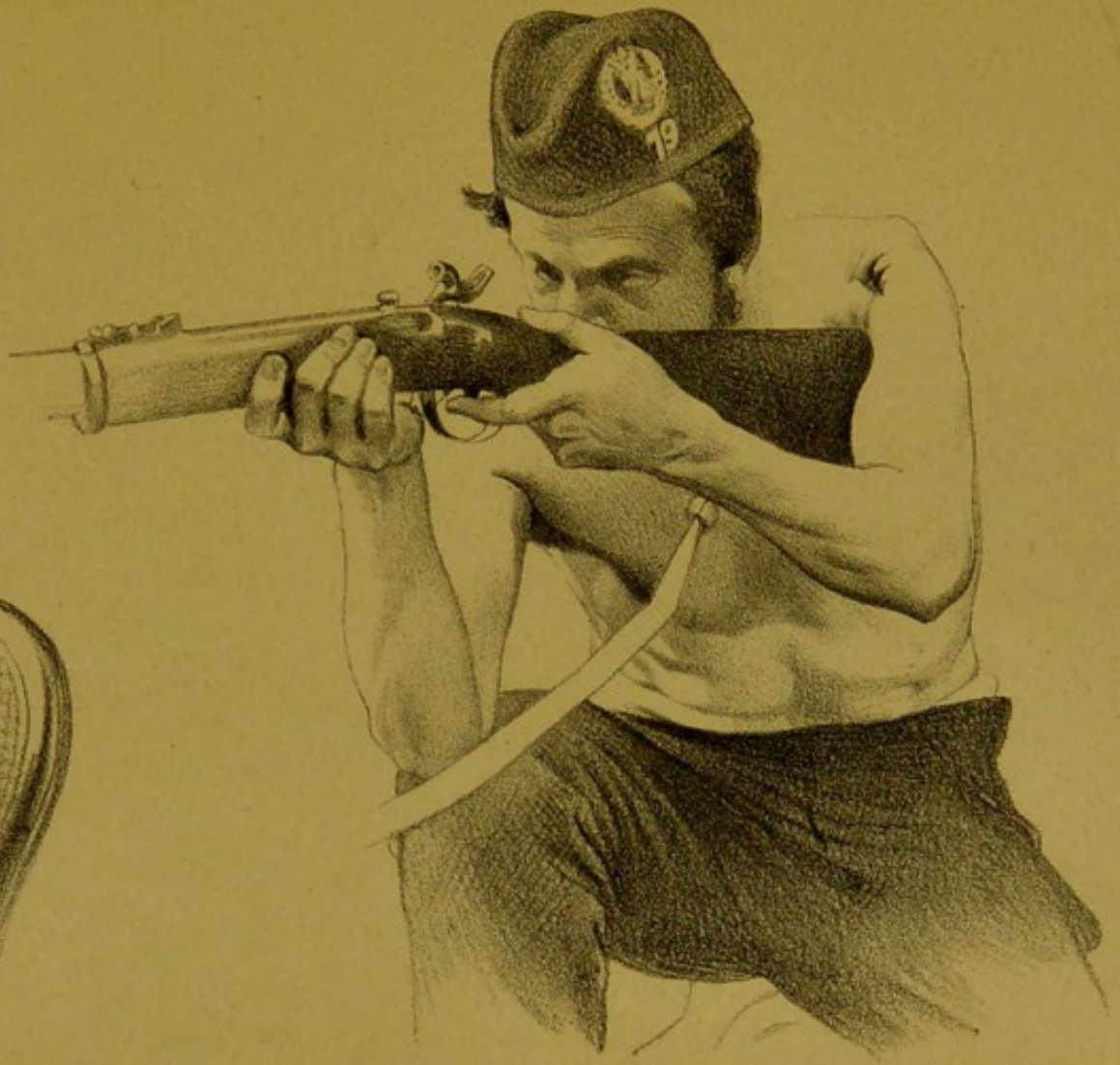
Case of Serj^{t} Macdonald. Drawing to show the absence of bone between the Acromion & the divided upper end of the humerus. The arm is completely twisted on itself round the Serjeants neck, the back of the hand being shown over the

Nº 3



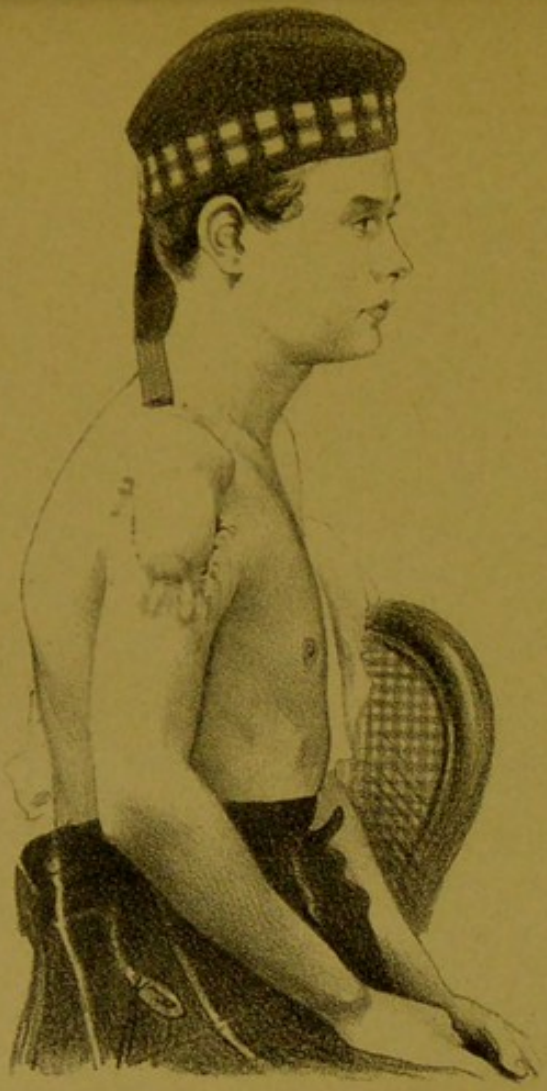
Case of Serjt Macdonald. Drawing to show the power of flexing the forearm on the upper arm, & the muscular development.

Nº 4.



Day & Son (Limited) lith.

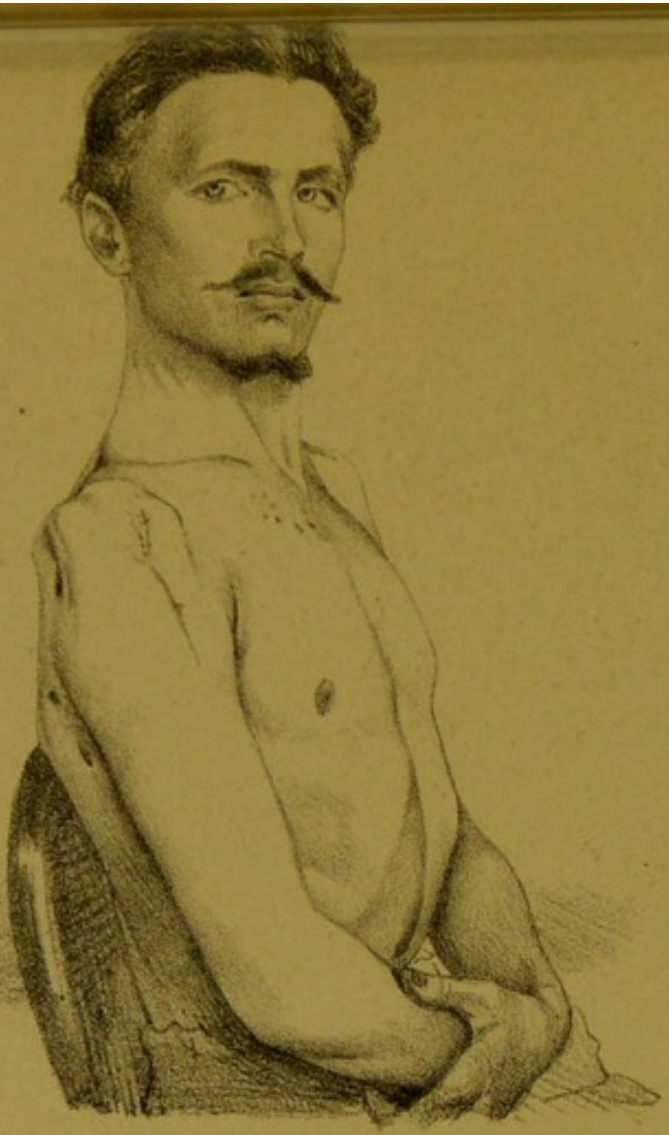
Case of Serjt Macdonald. Drawing to show the use of the arm in discharging a Firelock.



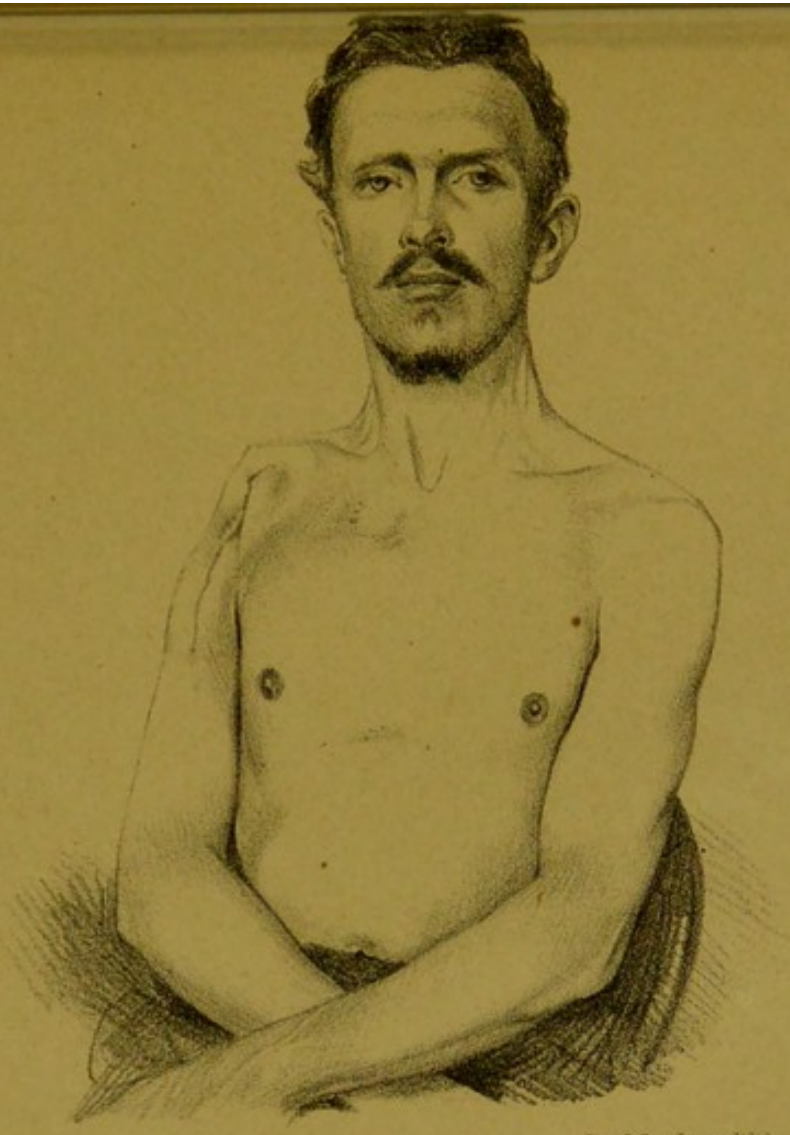
Case of Private Campbell. Drawing to show the course of the incision.

Day & Son, Lith to the

Case of Private Campbell. Drawing to show the extent of abduction admissible when made by an assistant. The hand rests supported by the stick.



Case of Nicholas Holmberg, 40th Regt. The Drawing shows the relations of the wounds of entrance & of exit of the projectile: the cicatrix of the resection incision: the enlargement of the coracoid process: and the relative positions of the fractured acromion & the scapular end of the clavicle.



Day & Son (Limited) lith

Case of Nicholas Holmberg, 40th Regt. The Drawing shows the scapular end of the clavicle forming the point of the shoulder instead of the acromion, and affords a front view of the enlarged Coracoid process.