

On gun-shot wounds of the extremities, requiring the different operations of amputation, with their after-treatment: establishing the advantages of amputation on the field of battle. To the delay usually recommended, &c.; &c.; with four explanatory plates / By G. J. Guthrie.

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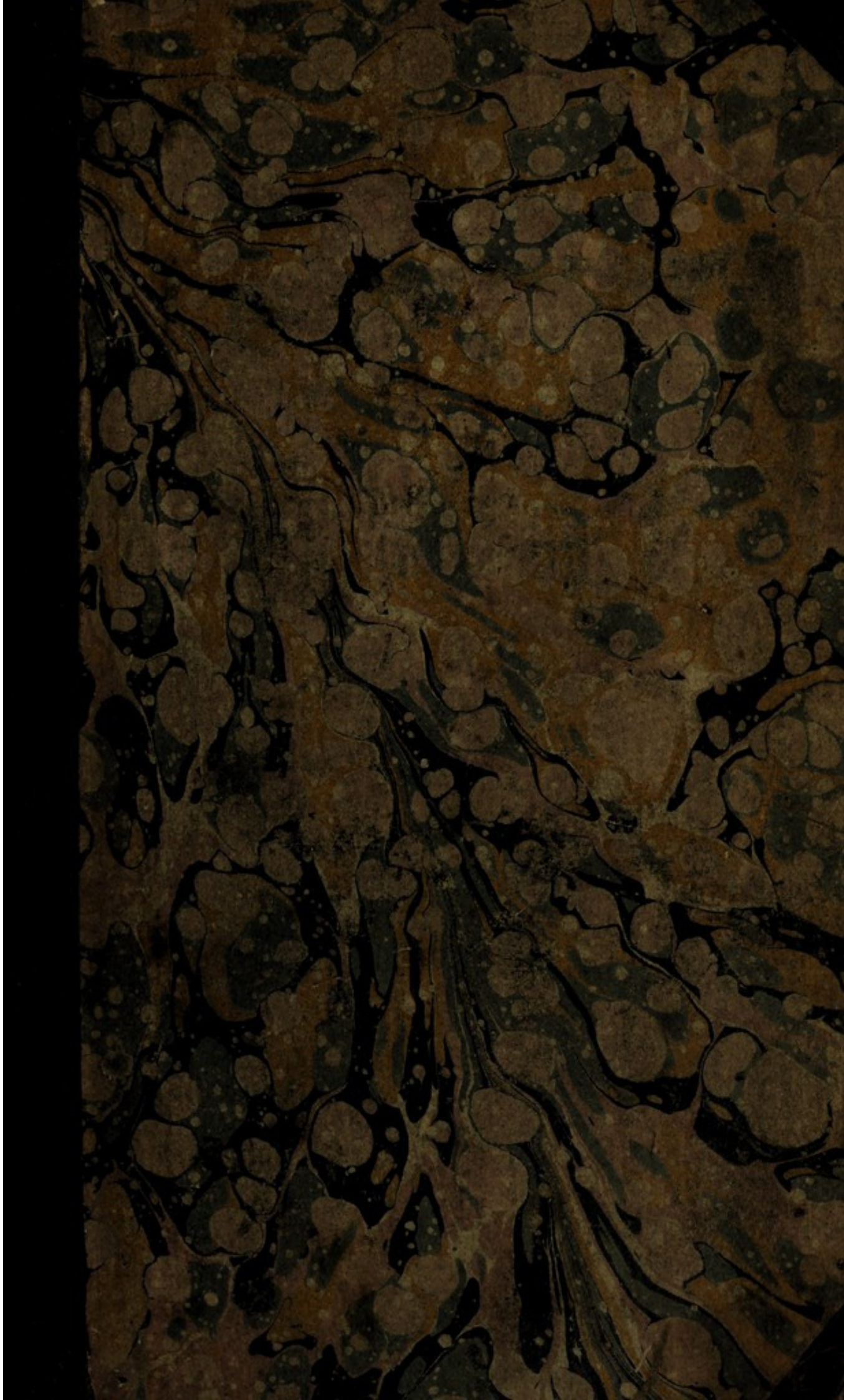
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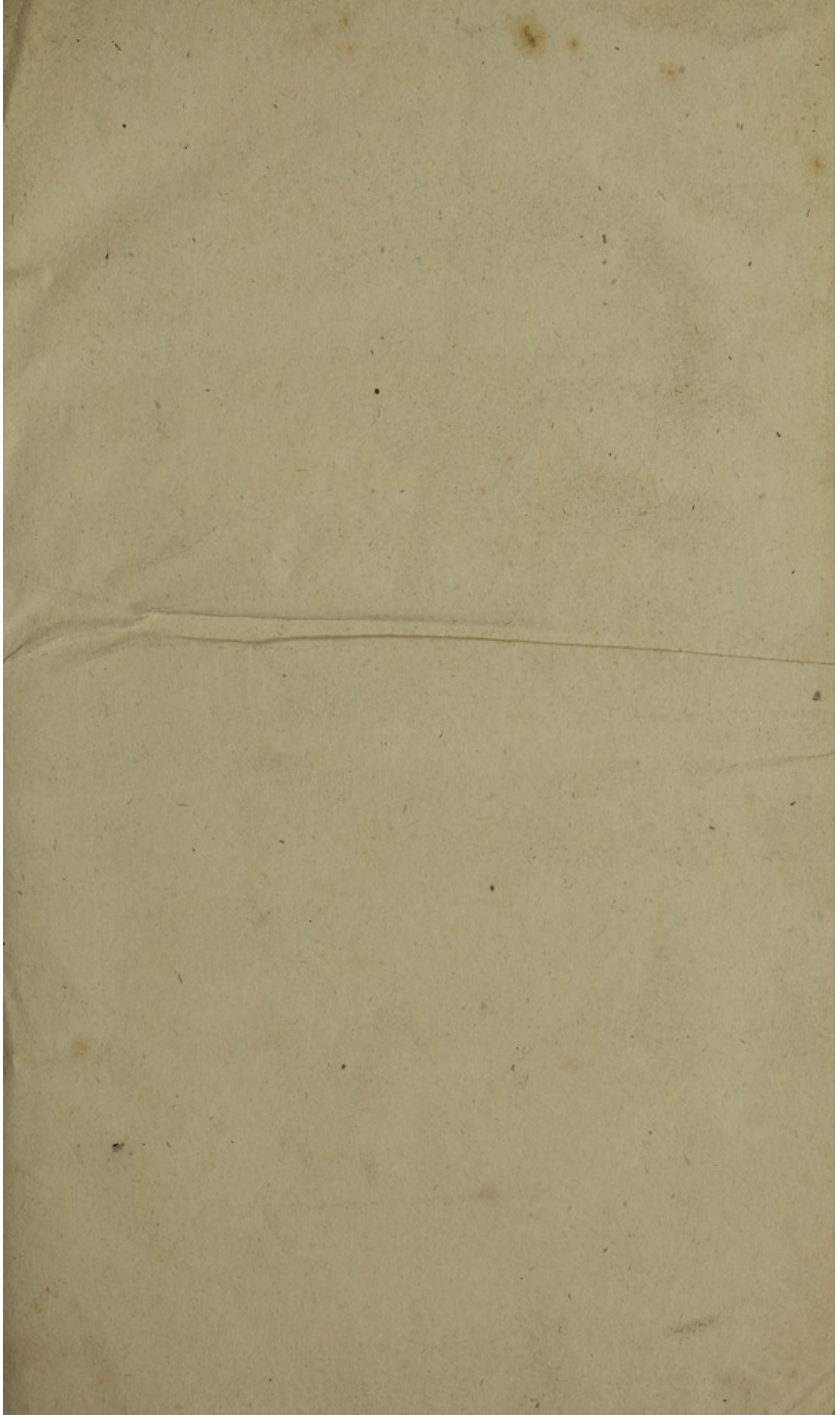
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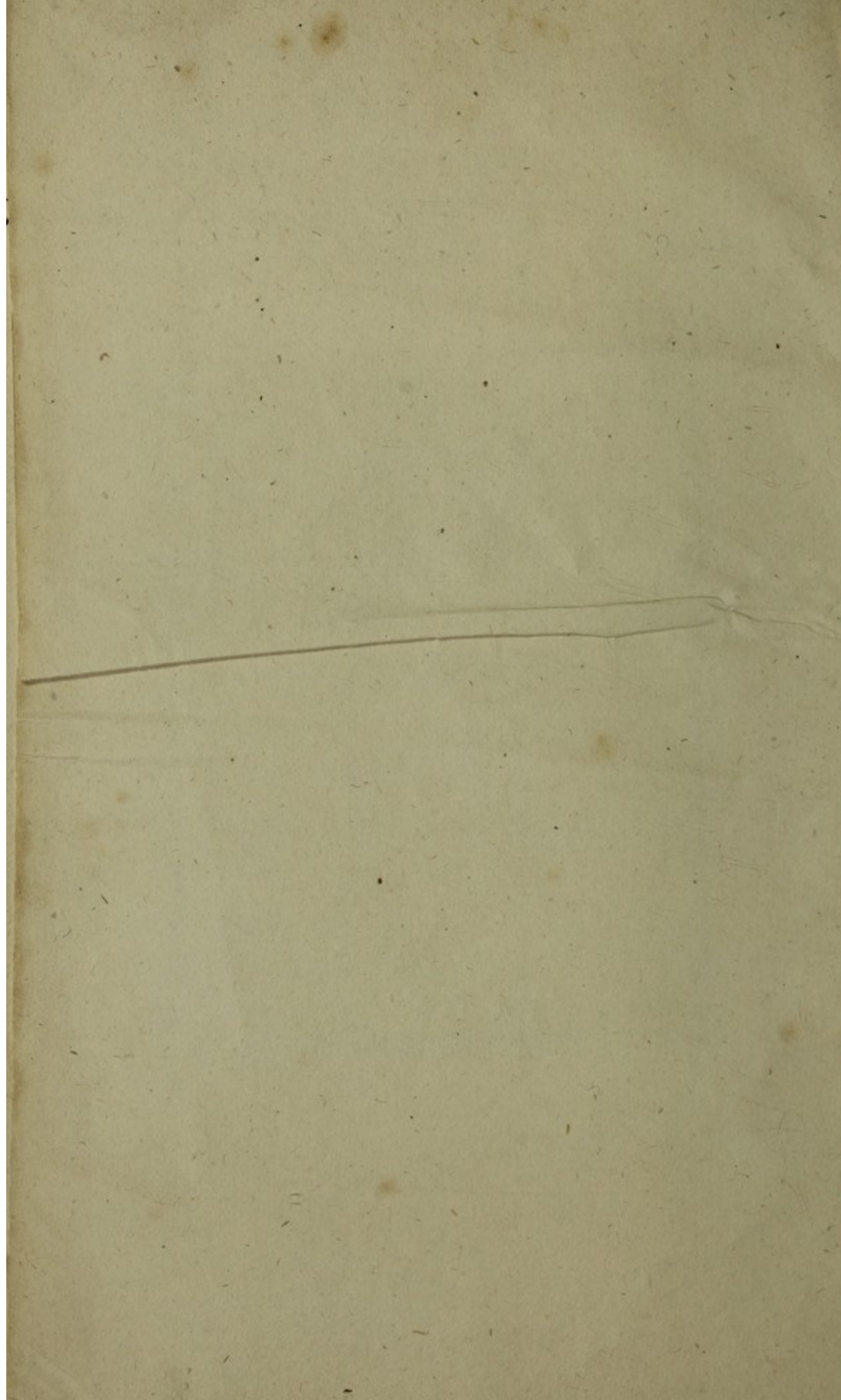
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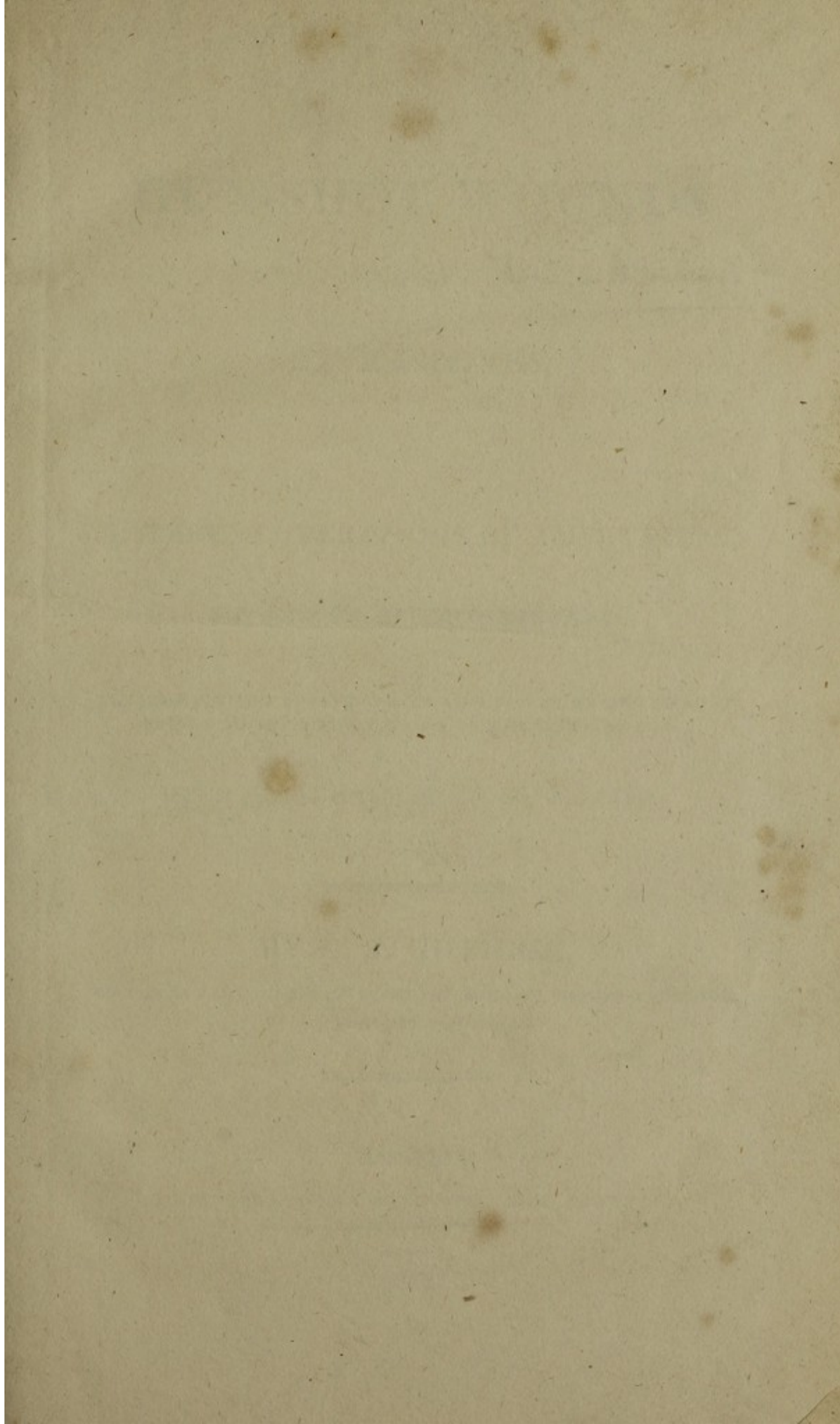
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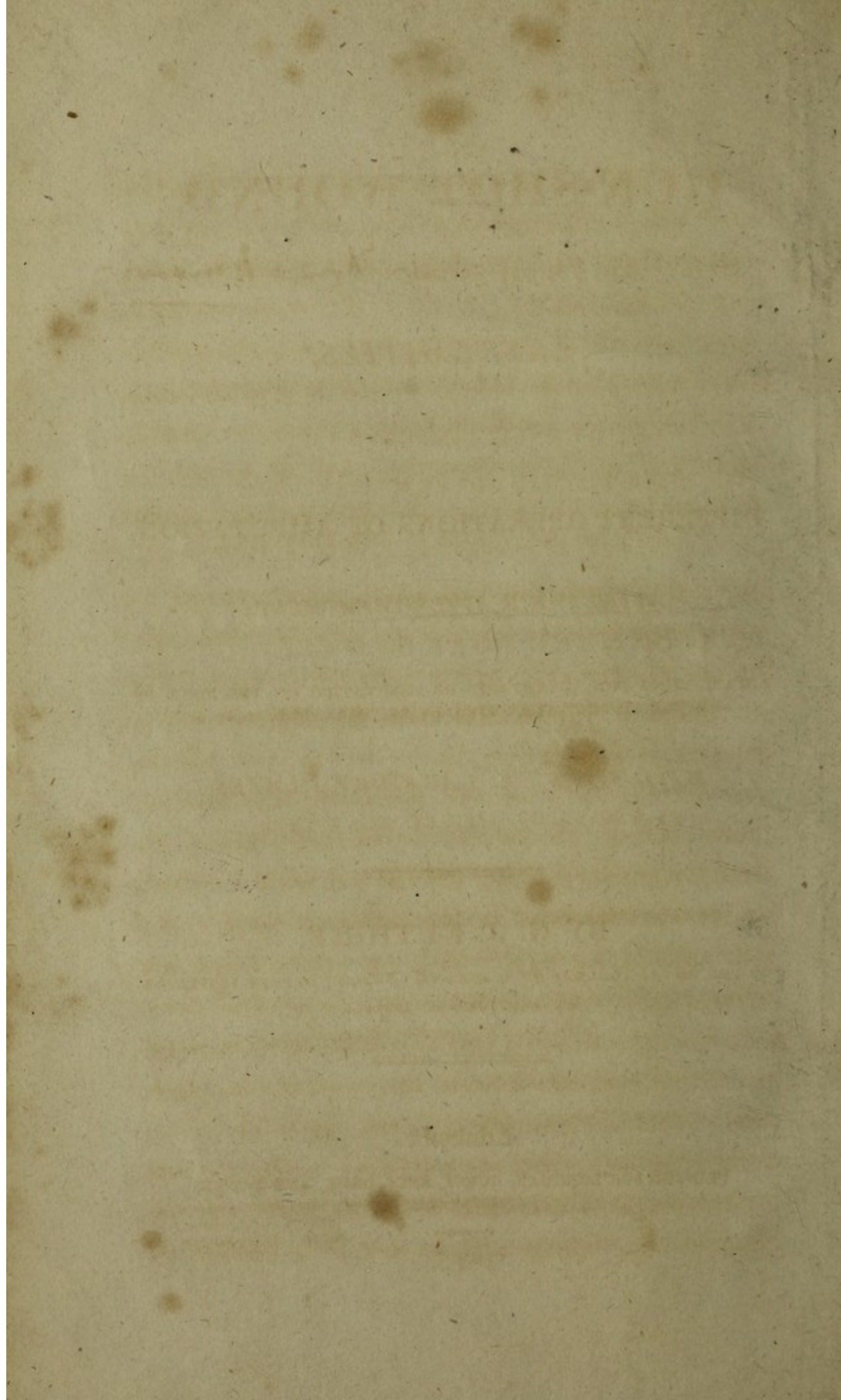
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21 March 1878









ON
GUN-SHOT WOUNDS

OF THE

Thomas Windsor

EXTREMITIES,

REQUIRING THE

DIFFERENT OPERATIONS OF AMPUTATION,

WITH THEIR AFTER-TREATMENT:

ESTABLISHING THE ADVANTAGES OF AMPUTATION ON THE FIELD OF
BATTLE TO THE DELAY USUALLY RECOMMENDED, &c. &c. &c.

WITH FOUR EXPLANATORY PLATES.

BY G. J. GUTHRIE,

OF THE ROYAL COLLEGE OF SURGEONS, LONDON; DEPUTY INSPECTOR
OF MILITARY HOSPITALS.

London :

PRINTED FOR LONGMAN, HURST, REES, ORME, AND BROWN,
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GUN-SHOT WOUNDS

Second Edition



DIRECT TREATMENT OF WOUNDS

WITH THE LATEST TREATMENT

OF THE VARIOUS WOUNDS OF THE BODY BY
THE LATEST TREATMENT

WITH THE LATEST TREATMENT

BY O. J. GUTHRIE

OF THE ROYAL COLLEGE OF SURGEONS, LONDON; DEPUTY LECTURER
OF WOUNDS, HOSPITAL

LONDON :

BARNARD AND FARLEY,
SKINNER-STREET, LONDON.

TO
SIR JAMES M'GRIGOR, KNIGHT,
M. D. F. R. S. E.
FELLOW OF THE ROYAL COLLEGE OF PHYSICIANS,
EDINBURGH,
INSPECTOR-GENERAL OF THE MILITARY HOSPITALS
OF THE ALLIED ARMIES IN THE PENINSULA,
LATELY UNDER THE COMMAND OF
HIS GRACE THE DUKE OF WELLINGTON,
THE FOLLOWING OBSERVATIONS
ARE OFFERED,
AS A MARK OF RESPECT AND ESTEEM,
FOR HIS
PUBLIC CHARACTER AND PRIVATE FRIENDSHIP,
BY
HIS MOST OBEDIENT HUMBLE SERVANT,
THE AUTHOR.

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PREFACE.

IN offering to the public the following observations on Gun-shot Wounds of the Extremities, and the operations of Amputation in Military Surgery, I have not the vanity to think they can afford any instruction to the senior members of the military department, from the aid of many of whom I have been much benefited ; or, to the senior members of the profession in general. It is to the students in surgery and the younger branches of the medical military department that I particularly address them, from the conviction that they will be useful to them ; a conviction, not originating in idea alone, but fairly deduced from having seen young men sent out from England to the Peninsula, incapable of performing any operations in military surgery,

become able operators, in a short time, from the practical lessons inculcated in our dissecting rooms, in our hospitals, and on the field of battle. In offering, therefore, to the younger officers in general, the same instructions which I have, on every opportunity, publicly delivered and demonstrated, and which are the result of the experience of the Peninsular war, I hope to render them bolder, if not better surgeons.

Military surgeons have not, in the course of the late war, given to the public many observations on military surgery ; but it must not be supposed they have been inattentive to the improvement of surgical knowledge, or that their practice has alone remained stationary for a period of twenty years, when surgical science has in general so much advanced. Their opinions have been widely diffused, although they have not been promulgated in print ; and many authors have availed themselves of those opinions, and introduced them into their writings, without any acknowledgment of the source from whence they were derived ; whilst others have conceived, that they still continue to follow in the track laid down by their predecessors,

without an effort at improvement, and almost without the ability to improve. Another object, then, of the present publication, is to state, what has been the practice of the surgeons of the British army during the Peninsular war, to preserve for them the credit of improvements, which they alone have introduced into military surgery, and particularly in the operative part, in which they have been eminently successful. With this view, I do not presume to give these observations as my own. I rather wish them to be considered, in every thing that is useful, as the result of the general experience of the whole. There are many opinions in opposition to those received in common by the profession, and even now taught, in regard to military surgery ; but they have been formed from experience, and, for the most part, confirmed by a very extensive practice. In referring to my professional brethren that credit which is their due, I by no means wish to exonerate myself from any of the blame that may be attached to the practice recommended. I am aware that some of the opinions are not common to the whole of the military profession ; because they have not

all alike had the same opportunities for observation ; and on these points I consider myself particularly responsible. I have endeavoured throughout to state nothing but facts, and to trust in no part to theory, or the opinions of authors not supported by actual experience ; and if objections should be made to what I have advanced, I hope they will be made and supported in the same manner.

In venturing to object to the opinions of Mr. Hunter, I do it with the greatest deference and respect ; and, if a sense of public duty did not make me feel it necessary to controvert what he has advanced relative to amputation in gun-shot wounds, where it is not supported by fact, I would most willingly have avoided it ; for it would have been more grateful to me to confirm the opinions of the man whom all British surgeons must venerate as the founder of modern surgery, than to oppose them.

It may be said, that the description of many of the minor operations is superfluous to the student, who has been regularly educated in the many celebrated schools in Great Britain and Ireland. I would reply to

this objection, that the great operations of the hip and shoulder-joint, as well as many others in military surgery, which our ample experience has proved to be simple, and in many instances safe, are but little practised in surgery in civil life, and one of them, that at the hip-joint, is rejected by, I believe, all our teachers, both in their works and in their lectures; and that, in adding the description of the minor operations to them, I have done it with the view of rendering the whole more complete. -I would also reply, that the increase of the military force of the nation, with the hardships to which the junior medical officers of the army are unavoidably exposed on service, hardships unknown, even in idea, to those who have not experienced them, brought into the service as medical officers, several, who were incompetent to the performance of any operation, or almost any medical duty whatever; and, as the arrangements of our peace establishment have not made the medical department more respectable, or the situation more advantageous, the acquirements of our future candidates are not likely to be more numerous than heretofore, or any

mode of communicating that knowledge derived from experience, less necessary.

This incapability of some of the junior members of the profession imposed a greater share of labour on the seniors, and the dispatches of the Duke of Wellington have borne honourable testimony to their exertions in the field. It was not only on the field of battle that these exertions were conspicuous. I might almost say, it is not on the field of battle they are most useful; it was in camp, in quarters, in hospital, and on the march, that the medical department, uniting with their professional duties the authority of military discipline, were enabled to prevent disease, or obviate its baneful effects when produced by the labours, the fatigues, the privations, and the accidents of military service. It is a very mistaken idea, that a medical officer of a regiment, division, or hospital station, is purely a professional man. It is absolutely essential that he should have no military authority or rank that could in any way interfere with military command; but it is essential that he should have a relative rank and authority, or his labours will little

avail ; for the very best professional man in England would make but a bad military surgeon unless he possessed a truly military spirit, and until he had acquired a knowledge of the habits of a soldier ; and it is only by passing through the several gradations of the military medical service that this knowledge can be thoroughly acquired. When the junior officers are aware that their several duties are well understood by their chief, and that he can therefore judge of their exertions, they labour to attract his notice ; and when a spirit of emulation is excited among them, by the certainty that diligence and ability will meet with its reward, they strive to follow the example set by their seniors, and, in benefiting themselves, they are of incalculable advantage to the service.

The confidence the Duke of Wellington reposed in Sir James M'Grigor, the Inspector-General of Military Hospitals in the Peninsula, in giving him the uncontrouled management of the department, enabled him to enforce the strictest military discipline amongst us, on the one hand, whilst he encouraged ability, excited emulation, and rewarded merit, with the other. Every officer

of the department endeavoured, by a zealous discharge of his duty to deserve his attention, and, by keeping the army effective in the field, to prove to their brethren at home, that although they were less profitably, they were not less honourably employed in the service of their country.

The good effects of this system of arrangement, however inconvenient it may have been to individuals, are strikingly exemplified in referring to the state of the army from the battle of Salamanca, in July 1812, to that of Vittoria, in July 1813. After the battle of Salamanca the British army marched to Madrid, where, separating into two corps, one remained under Sir R. Hill, in its vicinity, the other proceeded, under the immediate command of Lord Wellington, to Burgos, from whence, after considerable labour and fatigue, it became necessary to retire on Salamanca, and subsequently to Portugal, under circumstances of privation and exposure, extremely unfavourable to a British army. The troops, from June to December, had suffered much from the weather, both as regarding the heat of the climate, and the rainy season in the latter part of the year.

They were, from necessity, in want of clothing; and contagious, and other diseases, had commenced their destructive ravages among them. The nature of the country, the means of conveyance and other causes, did not admit of the sick being collected in great hospital establishments; and it was not thought advisable to do so, when it could be avoided, even where local circumstances permitted it. The sick and wounded, collected during the campaign, were especially in the charge of the hospital staff, whilst those who became sick after the arrival of the troops in quarters, were more immediately under the direction of their own surgeons, subject to a rigorous inspection, both of the military officers and of the inspecting officers of the medical department. In this way every one was fully employed; each strove, by attention to duty, to render himself conspicuous; and the success of such a system was, as might be expected, truly great. It is a fact well ascertained, during the last century, that the retreat of a British army, for any distance, has always been disastrous, and followed by an almost total disorganization of the troops, who, from disease, became in-

capable of service for many months. It is a fact also well known, that a retreat before an active enemy must very much harass the troops, and expose them to many hardships and privations, if it be of long continuance and in bad weather; during the retreat from Burgos the whole of these causes were in operation; and, on the arrival of the troops in quarters, the greatest exertions were necessary, from all departments, to render them again effective; and here the value of a medical department guided by a vigorous hand, and having emulation for its basis, was particularly conspicuous.

The following returns will shew the number of sick and wounded during a period of ten months, from the 20th of September 1812, from the siege of Burgos, to the 20th of July 1813, after the battle of Vittoria.

RETURN of the Sick and Wounded of the British Army in the Peninsula, from the 20th of September 1812, to the 20th July 1813, from the siege of Burgos to the battle of Vittoria, both inclusive.

IN GENERAL HOSPITALS.

	Remained.	Admitted.	Admitted by transfer.	Discharged.	Of these were discharged by transfer.	Died.	Remaining each month.
Remained 20th Sept. 1812	9,865	6,602	3,766	7,125	2,091	1,037	8,305
Admitted bet ⁿ 21st Sept. & 20th Oct.		9,058	8,560	12,751	4,064	739	3,873
21st Oct. & 20th Nov.		9,001	4,056	4,544	2,775	929	7,401
21st Nov. & 20th Dec.		4,396	308	3,941	253	1,371	6,485
21st Dec. & 20th Jan.		2,495	996	3,467	581	607	4,906
21st Jan. & 20th Feb.		1,466	1,215	2,258	579	281	3,833
21st Feb. & 20th Mar.		1,320	858	2,585	627	147	2,421
21st Mar. & 20th Apr.		3,248	2,848	2,157	581	79	3,433
21st April & 20th May		1,623	1,616	2,402	488	78	2,576
21st May & 20th June		8,233	3,523	5,403	951	367	5,039
21st June & 20th July							
Total	9,865	47,442	27,809	46,633	12,990	5,635	

Included in the foregoing Return are French Prisoners and Extra Patients*, as follows.

	Remained.		Since admitted.		Discharged.		Died.		Remaining.	
	Pris.	Extra Patients.	Pris.	Extra Patients.	Pris.	Extra Patients.	Pris.	Extra Patients.	Pris.	Extra Patients.
Remained 20th Sept. 1812	841	248								
Admitted between 21st Sept. & 20th Oct.			288	248	774	235	90	50		
21st Oct. & 20th Nov.			127	158	277	229	17	21		
21st Nov. & 20th Dec.			396	272	145	138	27	19		
21st Dec. & 20th Jan.			175	113	16	186	29	35		
21st Jan. & 20th Feb.			95	107	25	110	12	15		
21st Feb. & 20th Mar.			55	57	6	91	10	11		
21st Mar. & 20th Apr.			80	29	226	84	4	3		
21st Apr. & 20th May			163	70	27	44	7	1		
21st May & 20th June			152	108	394	99	13	3		
21st June & 20th July			1,621	101	310	61	159	5	1,405	91
Remaining - - - - -	841	248	3,152	1,263	2,200	1,277	368	163		
Total										

* Women, private servants, &c.

In Regimental Hospitals during the same Period.

	Remained.	Since admitted.	Discharged.	Of the discharged were transferred to General Hospital.	Died.	Remaining.
Remained 20th Sept. 1812 - - -	2,228					
Admitted between 21st Sept. & 20th Oct.		6,232	6,058	1,675	142	
21st Oct. & 20th Nov.		7,617	8,178	4,496	55	
21st Nov. & 20th Dec.		7,058	6,204	1,281	120	
21st Dec. & 20th Jan.		7,556	4,715	55	481	
21st Jan. & 20th Feb.		7,624	6,197	415	692	
21st Feb. & 20th Mar.		5,621	6,126	672	296	
21st Mar. & 20th Apr.		4,825	5,923	258	201	
21st Apr. & 20th May		5,213	6,817	2,267	75	
21st May & 20th June		4,822	4,751	1,128	47	
21st June & 20th July		7,054	7,283	2,572	35	1,454
Remaining 20th July - - -						
Total	2,228	63,622	62,252	14,819	2,144	

The total number of sick and wounded, of the British army and its followers, during the ten months, being as follows :—

Remained on the 20th of September	
1812 - - - - -	12,093
Admitted 111,064, of which 27,809 were by transfer from one hospital to another, leaving of original diseases - - - - -	83,255
Total	<u>95,348</u>
Discharged 108,885, of which 27,809 were by transfer from one hospital to another leaving of original dis- eases - - - - -	81,076
Died, of which 531 were not soldiers	7,779
Remaining on the 20th of July 1813, of which 1,496 were not soldiers -	6,493
Total	<u>95,348</u>

The number of sick in the months succeeding the retreat, viz. December, January, and February increased, and the loss was proportionably severe ; but the great exertions made, as I have before stated, in every

possible way to restore the troops to health, had the desired effect, and the army took the field in May, 1813, in the healthiest possible state. The number of sick being under 5,000, or one tenth of the effective force ; and of this number half were convalescent. For twenty-four successive days the army marched towards Vittoria, fought the battle so named, and was, within one month after it, within thirty men as strong as when it fought the battle, and this without receiving any reinforcements from England ; a proof of the excellence of the military and medical arrangements, and of the uncommon attention of the whole of the medical officers of the army.

Without attempting to detract, in the slightest degree, from the foresight or ability of the arrangements of the military departments of the army, during this or any other period, I contend, that they would have been insufficient to keep it effective in the field, without that spirit of emulation and attention to duty had existed in the medical department, and without which a British army can never be maintained efficient.

In asserting that the services of the medical officers were of the greatest importance

on this occasion, I advance nothing but what is fairly deduced from the state of the army, and the services it performed, when compared with the state of other armies on similar occasions. It is done with the view of acquainting military men in general, that without their medical department is highly respectable, their own exertions will ultimately fail; for, although the duty of a professional man is not obtrusive on the public notice, it is not less beneficial to the country than the more brilliant exertions of the soldier; it is, indeed, on the laborious exertion of the medical officer, that those of the purely military officer are erected, and in the ability and respectability of these officers they have the best guarantee of their own success. For I know, from an intimate acquaintance with military duty, that a good surgeon will keep a regiment of eight hundred men stronger in the field, than a bad surgeon will a regiment of one thousand men; and where the principal medical officer of a division* thoroughly understands his duties, he will, in like manner, keep a division of inferior force more

* A division of the British army is under the command of a Lieutenant-general, and generally composed

effective, than a stronger one in less able hands.

Not having, until within a few months preceding the peace, an intention of publishing the following observations, I have not preserved the particulars of many valuable cases, which I should have done, if I had had any such intention at an earlier period; indeed, the great extent of duty which generally devolved upon me after the great battles at which I have been present, prevented in a great measure, these memoranda being made or preserved, and will account for the want of the detailed particulars of many cases and circumstances to which I have directly, or indirectly alluded.

In giving a short account of the opinions of authors, on any of the subjects noticed in this work, I have not thought it necessary to go farther back than the last century, and I have selected such only as particularly suited my purpose, that I might not unnecessarily

of three brigades, of three or four regiments each, according to their strength, to which, on commencing a campaign, a Deputy Inspector of Hospitals should be attached, as the principal medical officer, with a proportionate number of staff-surgeons and hospital assistants.

increase by quotations the size of the book.

As I have availed myself in many places of the surgical observations of Baron Larrey, supporting some of his opinions, and disputing others, it may not be improper to mention, that I never saw, or read his work, until lent me by M. A. Larrey, his uncle, and professor of anatomy at Toulouse, and my opinions, which are in unison with his, were generally known, and often publicly expressed before the British army ever entered France. On these points, I have no wish to claim any priority as to time; on the contrary, I am satisfied to find they agree, in both arising from observations made without any communication with each other. On seeing M. Larrey at Paris, I complimented him on the decided manner with which he had supported the propriety of amputation on the field of battle, and in some cases of gangrene; and which was, I believe, very satisfactory to him, as the opinions in France, amongst those who have had no personal experience on these points, are still very much divided.

If I had seen Mr. Hodgson's book on the Diseases of Arteries prior to the printing of these sheets, I might have spared the remarks I have made on the necessity of not

treating wounded arteries on the same principles as when affected by aneurism. I was not even certain that the cases of mine he has noticed, were printed, for the editors of the New Medical and Physical Journal having omitted to comply with the request of transmitting me the number in which they intended to publish them, I had never seen them until his book came into my hands, in which part of them are introduced, and I am happy to think they were sufficiently interesting to be thus quoted. They allude to a point in surgery that is now, I hope, definitively settled, that of the absolute necessity of securing both ends of a wounded artery of any magnitude. I consider myself as the first who distinctly insisted upon this fact, in military practice, after the battle of Albuhera in May, 1811; and although some of the operations mentioned were performed after I had clearly proved they could not succeed, I have great pleasure in saying, that the gentlemen who were at that time of a different opinion, are now amongst its warmest advocates. The case of the radial artery, which I have stated to have been successful, was under the care of Mr. Murray, now Surgeon to the Forces, and he has since informed me it

was ultimately the reverse. I trust I shall be excused insisting upon this point, for I know that the fact is not generally acknowledged, and that the femoral artery has been twice tied within the last year, as in the popliteal aneurism for a wounded popliteal artery.

I have found it necessary to quote particularly Mr. Hey's observations on the flap operation of the leg, and Dr. Jeffray's on the excision of the head of the humerus and of the elbow-joint; in doing this, I have preferred making use of their own words, with a reference to their works, to which I hope they will not object, for I considered it more just than to give their remarks as my own, which I might readily have done with a little alteration of language. Having no other object in view than the benefit the diffusion of their observations, among the juniors of the medical military profession, may occasion, I trust they will receive this as a sufficient apology.

When the Observations on "Amputation at the Shoulder-Joint" were circulated in the army in 1813, the anatomy of the parts about the shoulder was copiously explained. I have retained now, in this operation, and that at the hip-joint, such points only, as may more

materially bring to the recollection of the younger officers the principal parts to be divided.

In prosecuting the remainder of the work I have undertaken, I shall be happy to receive from my professional brethren any hints or cases which they may think illustrative of any part of the treatment of gunshot wounds.

If I have not noticed the practice of the medical officers of the navy in the course of these observations, I beg it may be understood to arise from my being but little acquainted with the officers of that service, for I am well aware that there are a great many very able men amongst them, whose opinions and practice would have been of essential service to me, and I shall feel obliged by any communication on the subject, these gentlemen, (to whom I am a stranger) will do me the favour to address to me.

If these observations should be found useful, I shall receive, in the knowledge of their utility, the only reward which I expect.

March 24th, 1815.

36, Jermyn-street, St. James's.

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GUN-SHOT WOUNDS,

OF THE EXTREMITIES.

ON AMPUTATION.

AMPUTATION, or the removal of a part, or the whole of a member, or extremity of the human body, is considered as the last resource in surgery, by which an evil can be remedied that is incurable by other means. This attempt to remove the disease by cutting off the affected part, has been known since the earliest ages of surgery; and the operation was formerly regarded with the greatest horror, as not only depriving the unfortunate sufferer of a limb, but most frequently of his life, in consequence of the length of time, and the almost insurmountable difficulties attending the cure. The operation was therefore seldom resorted to, was generally unsuccessful, and the patient was allowed to sink under his disease, from the very doubtful nature of the remedy proposed for his relief.

The almost constant failure of the operation even within the last century, induced some surgeons to consider it as unworthy the practice of surgery;

and the general ill success attending it, from the inattention paid to the time of performing it, and the mode in which it was accomplished, induced others to deprecate its performance in almost every instance; and to trust to the powers of nature aided by art for the perfecting of a cure, even where the powers of both were obviously unequal to the task. Founding their opinion on the general ill success of the operation when performed, and on the shock humanity receives from so dreadful an operation; but principally from the little good resulting from the use of a remedy, whose success was worse than doubtful.

The improvements generally introduced into surgery have made amputation less formidable, and its success more certain; and the nature of the instruments used in modern warfare, has caused it to become the most frequent operation of importance resulting from gun shot wounds.

Although military surgeons have agreed in general, as to the necessity of the operation in particular cases, yet they have disagreed very much, and still disagree, as to the precise time when it should be performed; some recommending it to be done as soon as possible after the receipt of the injury, others again deferring it until after a period of from three to six weeks, when the first inflammatory symptoms shall have abated, suppuration be duly established, the patient's constitution accustomed to disease, and as they suppose, in a better

state for undergoing an operation. This difference of opinion exists in some places at present, and both sides of the question have been supported by the highest authorities in our profession.

In England, * Wiseman, Surgeon to King Charles the Second, who had served during the war of the rebellion in the army, and also in the navy against the French, has the following passage in the fifth edition of his Work published in the year 1719. "In heat of fight, whether it be at sea or land, the chirurgeon ought to consider at the first dressing, what possibility there is of preserving the wounded member; and accordingly if there be no hopes of saving it, to make his amputation at that instant whilst the patient is free of fever, &c." at page 175, he says, speaking of the operation being necessary, "and then it must be done in its proper time, that is to say, suddenly upon the receipt of the wound, before the patient's spirits be over-heated either with pain, fever, &c. Of the necessity of doing it speedily, I shall here give you one remarkable instance. A Scottish soldier was brought to me, out of the field of battle of Worcester, shot with a musket-bullet into the elbow joint, which fractured not only the ends of the radius and ulna, but likewise that of the adjutorium; upon sight whereof, I called Will Clarke

* See Wiseman's Chirurgical Treatises.

(now a chirurgeon at Bridgenorth) and other my servants (assistants) about me, to cut off the arm: and the while I endeavoured to encourage the soldier to endure it, in answer thereto he only cried, 'give me drink and I will die;' they did give him drink, and he made good his promise, and died soon after, yet had no other wound than that. By which may be perceived the danger in delaying this work to the next day, when the foresaid accidents have kept them watching all night and totally debilitated their spirits, which happens not, if it be done in heat of fight; therefore while they are surprised, and as it were amazed with the accident, the limb is taken off much easier: and if it be the arm, some of them will scarce be kept in the hold while the ship is close engaged in fight. In the heat of fight I cut off a man's arm, and after he was laid down, the fight growing hotter, he ran up and helped to traverse a gun. And a Walloon earnestly begged me to cut off his shattered leg. Also others have begged me to dismember their shattered limbs at such a time, when the next day they have professed rather to die. But amongst us abroad in that service, it was counted a great shame to the chirurgeon, if that operation was left to be done the next day, when the symptoms were upon the patient, and he spent with watchings."

Le Dran, consulting surgeon to the French army, and a man of considerable experience in military surgery, in his work on gun-shot wounds,

published about the year 1740, is decidedly of the same opinion. His ninth aphorism expressly states, "That when the amputation of a limb is indispensably necessary in the case of a gun-shot wound, it ought to be done without delay;" and at p. 209, of his second edition, he says, in speaking of wounds of joints, "That if there is a sure means of preventing the inflammatory symptoms, or bad consequences resulting from them, it is that of quickly removing the limb."

Ranby, Surgeon to King George the Second in his campaigns in Flanders, confirmed the opinion and practice of Wiseman; and stated in fact the soundest principles in military surgery on the subject of amputation, although in a casual manner, in a small treatise on gun-shot wounds, published in 1760, the object of which appears principally to be the recommendation of bleeding and bark. He says, p. 29, "If a wound be of such a desperate nature as to require amputation, (which is always the case when it happens in any principal joint) it would certainly be of consequence could the operation be performed on the spot, even on the field of battle: least by deferring it an inflammation may come on, which one may very reasonably expect should obstruct a work, that ought rarely to be entered upon during the continuance of so calamitous a circumstance. The neglecting this critical juncture of taking off a limb, frequently reduces the patient to so low a state, and subjects the blood and juices to such an alteration, as must unavoid-

ably render the subsequent operation, if not entirely unsuccessful, at least exceedingly dubious. And in wounds even where no amputation is required, 'tis equally advisable not to defer the care necessary to be taken of them: lest by the parts being exposed to the air there might arise a series of very dangerous symptoms." At p. 84, he says, "A General of the Hanoverian forces, an officer of established merit of about seventy years of age had his ankle, with the neighbouring parts all terribly shattered by a cannon bullet, and lay under the management of his own surgeon. My assistance was applied for the third evening after the accident. On examining the wound, I judged it a case that plainly required an immediate amputation. Accordingly at the solicitations of the gentleman who attended him, I instantly cut off the leg, that night he rested tolerably well: and, on the next dressing every thing seemed to carry so good a face, that I began now, notwithstanding his advanced age, and the circumstances of the operation not being performed sooner, to indulge some hopes of a favourable issue in the affair." The case terminated unfavorably, but Ranby in these two extracts expressly declares, in the first that, "it would be of consequence if the operation could be performed on the spot," and in the second he states, "the circumstance of the operation not having been performed until the evening of the third day, as a disadvantage."

This great distinction of the British Surgeons as

to time, was unknown, or little attended to by many surgeons abroad; for Bilguer, the Surgeon-General to the Prussian army, in a treatise published in the year 1762, against amputation in general, appears not only ignorant of it, but relates the case of Count Meerfeldt's suffering amputation in the field of battle as something extraordinary. A proof that he was not an impartial judge, in declaiming in the manner he has done against amputation, as an operation that could seldom succeed, when in fact he had never given it a fair trial. He carries his opinion so far, as to deny, even the necessity of amputation where the limb has been torn off by a cannon shot, and the parts hanging contused and lacerated about a shattered bone; shewing, that the prejudice he had entertained against amputation had prevented his acquiring any practical knowledge on the subject; for if human nature was the same sixty years ago as it is now, he must have found on trial, that a clean wound was much less likely to cause the death of the patient, than the dead parts, and shattered end of the bone: the separation of which must be a work of much time, accompanied by considerable pain, and attended by all the ill consequences that in those days followed amputation. At p. 40. Sect. XX, he clearly proves he did not know the point of practice established by Wiseman, as he says, "Those who follow this method, amputate within a few days of the accident, while the patient is vigorous,

and without waiting for the event of any other kind of treatment, for if the patient be weak, old, or very ill, even with the consequences of the wound, they do not venture upon the operation."

This is not however the practice of the English surgeons, Wiseman and Ranby, or of Le Dran, who precisely declare, the operation should be performed on the first day, and not within a few days of the accident; and this, with other statements, induces me to believe, that he had never fairly tried the practice, and was therefore unqualified to decide against its efficacy.

In consequence of this opinion, he suffered no amputations to be performed in the Prussian army, and gives the following statement of his success: "I had at one time during the war in a military hospital 6618 wounded patients, who were all treated according to my direction, and part of whom I attended myself. Of these 5557 were perfectly cured; 195 were able to do duty in person, or to work at any trade; 213 remained incapable of any labour civil or military; and 653 died. The 195 and 213 invalids were of the number of those who had their bones broken and shattered, of those, in a word, whose wounds were called complicated and dangerous. At page 61, he supposes, of the 653 that died, 408 only died from shattered bones, the remainder of fevers, fluxes, and other injuries." He then says, "this number

408, is equal to that of those who were cured without amputation, although their wounds had been of the same kind. If, after making these calculations, we compare them with the prodigious number of wounded men, who, at the beginning of the war, had their limbs taken off on account of dangerous wounds, of whom scarce one or two escaped with their lives, we may very safely conclude that much the greater part of these 408 men, cured and sent to the invalids, would have died if amputation had been performed upon them, and this shocking artificial wound, added to what they had already received. It would be trifling to pretend that amputation would have saved a great many of those who died, had it been timely and properly performed."

These statements of Bilguer have been frequently noticed, as much applauded, and in some countries held up as doctrines to be followed. Those who write from theory alone see not the errors he made in his calculations. The loss in numbers appears small; but Bilguer states, it is from men actually in hospital, and acknowledges, the men whose thighs were torn off, &c. on the field of battle died without any assistance. Military surgeons also know, that the loss of men is principally on the first four or five days prior to their being brought into the hospital. His soldiers, then, who died in this period are not included in his cal-

culation, which, therefore, gives no just idea of the loss of the Prussian army, except in cases of broken limbs, and not even of them; for he excludes, as dead, those cases of broken limbs who were lost of the field of battle for want of surgical aid. And in reference to modern surgery, what would have been the result of the 408 cases deceased, which he presumes would have been amputated without his interference? 300 would have lived, and been able to work at any trade; of his 213 incapable of any labour civil or military, 150 at least would have been capable of earning their subsistence in health and comfort, instead of dragging on a miserable existence.

Bilguer therefore, on this subject, ought never to be quoted as any authority for modern times; and I am satisfied, he was not even good authority for 1762; for there is no reason to think that he would have met with different results than Wiseman, Ranby, or Le Dran, if he had followed the same mode of practice.

The French Academy of Surgery, zealous in every branch of surgical science, bestowed considerable attention on the treatment of gun-shot wounds; and endeavoured to decide the point of the proper time for operating, by making it the subject of their prize question for the year 1756. Of the memoirs transmitted to the society, two only were considered to contain the information de-

manded ; those of * M. Faure, a military surgeon, and of M. Le Comte, a surgeon in practice at Arcueil, both determining in favour of delaying the operation in all cases in which it was practicable to do so, although it should be indispensably necessary from the first. The academy decided in favour of M. Faure, not because his memoir was the best, but because it was supported by experience, whilst M. Le Comte's was entirely theoretical. The academy, in coming to this decision, appeared to adopt the only fair mode of judging the question ; and there can be no doubt, that the memoir of Faure, thus sanctioned, not only had great weight at the time, but, that it also biassed the minds of many subsequent surgeons. The members of the academy who thus decided in favour of Faure, were not however unprejudiced judges ; many of them were teachers, and nearly all of them believers in doctrines, according to which it was impossible — immediate amputation, or that performed shortly after the injury, could succeed ; and when they found Faure relating ten cases of delayed amputation, all successful, which were expressly reserved for the experiment after the battle of Fontenoi, in 1745, whilst the advocates for the opposite practice could

* See *Prix de l'Academie de Chirurgie*, tom. 8. duodecimo, Paris.

only produce four out of nine, they considered the matter beyond dispute.

M. Faure acknowledges what his successors in opinion have overlooked ; that many wounds, requiring amputation, would destroy the patient before the proper period of performing it, but he passes over this objection (which in more modern surgery is most important) by stating, that these persons must die, whether they were amputated or not ; and concludes, they would only die the sooner for the operation. He allows, however, six kinds of wounds, and Le Comte seven, requiring amputation without delay. In these cases, which are of the worst kind of gun-shot wounds, they also acknowledge, that the danger of amputation is not equal to that which is likely to ensue, if the shattered limb be retained.

M. Boucher, having had Faure's observations communicated to him by the academy, replied to them in a very excellent memoir*, that well deserves the attention of the military surgeon ; and points out, very distinctly, three proper periods for amputation.

Firstly, The period between the receipt of the injury and the appearance of the inflammatory symptoms. For the usual consequences of gun-

* Memoires de l'Academie de Chirurgie, seconde partie, tome 6. duodecimo, Paris, 1753.

shot wounds, tension, swelling, throbbing, acute pain, fever, &c. do not take place at first, but follow, sooner or later, according to the extent and complication of the wound, and the nature of the constitution of the patient.

Secondly, When the inflammatory symptoms have commenced, and are more or less capable of disturbing the animal economy.

Thirdly, When the violence of the inflammatory symptoms and symptomatic fever have abated; the period pointed out by Faure as advantageous for amputation.

In enquiring into the success attendant on amputations performed at these periods, he proves very correctly, that many limbs must be amputated on the field of battle to give the sufferer a chance of life; and that these operations were not always followed by the bad consequences usually attributed to them. He therefore considers Faure to have drawn his conclusions from the bad success, which he also acknowledges to attend amputation performed at the second period, and which he thinks Faure did not duly discriminate. In allowing him due credit for the success of his ten operations performed at the third period, he satisfactorily proves from his own experience, as well as that of others, and especially of M. Vandergracht, who had charge of a part of the wounded after the same battle of Fontenoi; that many must die in waiting for this third and favourable period, who

would have a fair chance of recovery, if amputation had been performed in the first. He concludes his memoir by upholding the aphorism of Le Dran, "that when amputation is necessary in a case of gun-shot wound, it should be done as soon as possible after the receipt of the injury as the state of the patient will permit;" a doctrine that militated too much against the received theory of the day; and which was therefore rejected, although supported by experience.

It would appear almost impossible, that there should be so much difference of opinion upon a subject that might, and could only be decided by actual experiment; it is a proof, however, of the readiness with which the mind may be biassed in favour of any thing, that it may have presupposed from reading and reflection; and how readily observation and experience are made subservient to our opinions. No one can suppose, that any of these authors wrote what he did not himself believe to be true; and if part of them and their advocates did adopt the sentiments of others, without much actual experience of the subject upon which they treated; still many of them must have had sufficient opportunities of ascertaining the fact, if they had attended properly to it. But prejudiced for the most part in favour of delayed amputation, from its coinciding with their opinions, they would not attend to those of its opposers; or, when they did give them a trial, it was not with due attention to

their injunctions as to the precise period of operating. The adversaries of delayed amputation could not support their facts by the received hypotheses of the schools; and as the bare assertion of facts is even at this period insufficient to overturn a favourite opinion, it is not surprising that it should then have been disregarded.

A great and important alteration in the method of treating amputations, was introduced to public notice in the year 1782, by Mr. Alanson*, that of procuring union of the parts divided without waiting for suppuration, by bringing them into contact immediately after the operation, by which, and other improvements of that period, the mortality after amputation has been considerably diminished, when compared with the practice of the preceding forty years. It was reasonable to suppose, these improvements would have had some effect on the operation as required in military surgery; and there can be no doubt that the same good effects would have been followed, if they had been duly practised, as at the present day. Authorities were however against the performance of the operation, except at a late period. When it was performed earlier, the due time of doing it was not sufficiently attended to, many of course died who had submitted to it; and when a soldier did survive, it was

* See Alanson on Amputation.

considered more as a piece of good fortune than of good practice. Military surgeons neglected, or did not make themselves acquainted with the opinions of each other, and feared to deviate from the road marked out for them by their teachers.

In the year 1792, M. Percy, now Inspector-General of the hospitals of the French army, published his *Manuel de Chirurgien d'Armée*, a book for many years received, and indeed is still received, as a standard work in France ; in which, after relating several cases of severe gun-shot wounds, and giving directions for their treatment, he says, at page 168, "But I stop here to avoid entering into discussions foreign to my subject, and particularly to avoid that of the necessity of immediate or delayed amputation, in cases of wounds of the joints, which has so long occupied the attention, and divided the opinions of practitioners."

In his second part he gives the opinions of La Martiniere, Louis, Andouillé, Sabatier, and Des-sault, as well as his own, in an uninterrupted discourse, the tendency of which is against amputation on the field of battle, where it can be avoided ; giving the preference to the delayed operation, even in such cases as clearly require amputation at first. He allows, there are cases demanding amputation on the field of battle ; but so far from recommending that it should be performed in every case where it is requisite, he has left the impression on the minds of the French surgeons, that it ought to be delayed ;

and I have accordingly been referred to his work, by a French surgeon in chief of an army, as containing opinions worthy of consideration, in opposition to those of M. Larrey, on the advantages of immediate amputation.

The year after, in 1793, although the work was not published until 1794, Mr. Hunter, Inspector General of the Hospitals of the British army, indisputably the first surgeon of the age in which he lived, and whose great talents would have left nothing to be written on gun-shot wounds, if he had had the same opportunities of acquiring knowledge on this subject, as he had on others; and who has erred on a point which could only be decided by personal experience, says,* page 561, "Amputation of an extremity is almost the only operation that can, and is performed, immediately on receiving the injury.

"As these injuries in the soldier are generally received at a distance from all care, excepting what may be called surgical, it is proper we should consider how far the one should be practised without the other. In general, surgeons have not endeavoured to delay it till the patient has been housed, and put in the way of a cure; and therefore it has been a common practice to amputate on the field of battle; nothing can be more improper than this practice, for the following reasons. In such a

* Hunter on the Blood, Inflammation, and Gun-shot wounds.

situation it is almost impossible for a surgeon, in many instances, to make himself sufficiently master of the case, so as to perform so capital an operation with propriety ; and it admits of dispute, whether at any time, and in any place, amputation should be performed before the first inflammation is over: when a case is so violent as not to admit of a cure in any situation, it is a chance if the patient will be able to bear the consequent inflammation, therefore, in such a case, it might appear at first sight, that the best practice would be to amputate at the very first ; but if the patient is not able to support the inflammation arising from the accident, it is more than probable he would not be able to support the amputation and its consequences. On the other hand, if the case is such as will admit of being brought through the first inflammation, although not curable, we should certainly allow of it ; for we may be assured that the patient will be better able to bear the second.

“ If the chances are so even, where common circumstances in life favour the amputation, how must it be where they do not ? how must it be with a man whose mind is in the height of agitation, arising from fatigue, fear, distress, &c. ? These circumstances must add greatly to the consequent mischief, and cast the balance much in favor of forbearance.

“ If it should be said, that agreeable to my argument, the same circumstances of agitation will ren-

der the accident itself more dangerous; I answer, that the amputation is a violence superadded to the injury, therefore heightens the danger, and when the injury alone proves fatal, it is by slower means.

“In the first case, it is only inflammation; in the second, it is inflammation, loss of substance, and most probably loss of more blood, as it is to be supposed that a good deal has been lost from the accident, not to mention the awkward manner in which it must be done.

“The only thing that can be said in favour of amputation on the field of battle is, that the patient may be moved with more ease without a limb than with a shattered one: however experience is the best guide; and I believe it is universally allowed by those whom we are to esteem the best judges, those who have had opportunity of making comparative observations, with men who have been wounded in the same battle, some where amputation had been performed immediately, and others where it had been left till all circumstances favoured the operation; it has been found that few did well who had their limbs cut off on the field of battle; while a much greater proportion have done well, in similar cases, who were allowed to go on till the first inflammation was over, and underwent amputation afterwards.

“There will be exceptions to the above observations, which must be in a great measure left to the discretion of the surgeon; but a few of these objec-

tions may be mentioned, so as to give a general idea of what is meant.

“First;—it is of less consequence, whichever way it is treated, if the part to be amputated is an upper extremity; but it may be observed, that there will be little occasion in general to amputate an upper extremity upon the field, because there will be less danger in moving such a patient, than if the injury had happened to the lower.

“Secondly;—if the parts are very much torn, so that the limb only hangs by a small connexion, then the circumstance of the loss of so much substance to the constitution cannot be an objection, as it takes place from the accident; and indeed every thing that can possibly attend an amputation; therefore, in many cases, it may be more convenient to remove the whole. In many cases it may be necessary, to perform the operation, to get at blood vessels, which may be bleeding too freely; for the searching after them may do more mischief than the operation.”

M. Lombard, Professor in the Military Academy at Strasbourg, in his “*Clinique chirurgicale des plaies faites par armes à feu*,” published in 1804, and written professedly from experience, has endeavoured to support the arguments of the older French authors in favour of delayed amputation, by advancing a number of reasons, why immediate amputation ought and must be improper, according to the rules of surgery; but he brings few facts to support his opinion, and it is easy to collect from his work,

that he had not given amputation within the first twenty-four hours a fair trial in his own practice, but has drawn his conclusions from the operations performed at, or sent into, the sedentary hospitals of Mayence, Landau, and Strasbourg; and not from those performed by himself in the hospitals accompanying the army. The cases of ill success following immediate amputation that he instances, were not under his own care from the first, or performed by himself, but came to the hospitals in the rear, under a variety of circumstances that would militate against them. He allows, there are many cases which must be operated upon in the field of battle, but declares that when an operation, although indispensable, can be delayed until the secondary period for amputating, it ought to be delayed, to allow of the necessary preparation of the body. He illustrates the necessity of this preparation by declaring, that to perform a common bleeding with success (*saignée de precaution*) the patient should be fasting, that he should have been perfectly quiet for some hours, and that the body should be of a regular and equal temperature; to ensure all of which requisites he should be bled in bed in the morning, in summer, and between eleven and twelve o'clock in the day, in winter.

Mr. John Bell, in his work on Wounds in general, published in the year 1798, has recommended the performance of amputation, in some cases, as soon after the receipt of the injury as possible; but Mr.

Bell's advice was not generally received, although it had some good effect, because every one knew, as far as regarded himself, that it did not proceed from experience ; and in deprecating the practice of Bili-guer, he omitted to support his own opinion by the rules and repeated counsels of the older military surgeons on the subject : which would have impressed the fact upon the minds of his readers, instead of leaving it a matter of mere opinion.

In France, M. Larrey, now one of the Inspectors-General of the hospitals of the French army, in his "*Campagnes et Memoires de Chirurgie Militaire*," a work which particularly deserves the attention of the military surgeon, has endeavoured in various parts to prove the great advantages of immediate amputation, and to establish its superiority over that usually practised at a subsequent period ; and he has, I believe, after much opposition, successfully established this, in most instances, in the French army. The authorities of the older writers, the vacillatory, not to say decided, opinion of Mr. Percy against it, and the strenuous support of M. Lombard, &c. in favour of the delayed operation, have yet however retained it some advocates.

In Great Britain, military surgeons have not given due publicity to their practice, and it is only through the medium of those authors who have taken the trouble to inquire into it, that the necessity, or propriety, of immediate amputation in gunshot wounds that require such an operation, have

been made known. It is not therefore surprising, that some teachers of surgery should continue to teach the necessity of delaying amputation in military surgery, although the practice is totally exploded by military surgeons.

The writings of Mr. Hunter in England, and Messrs. Percy and Lombard in France, have not only guided the opinions of most succeeding teachers on this subject, but they have influenced the practice even of military surgeons, who rely more upon authorities than experience; and if the practice of great cities, in regard to accidents, should warrant the conclusions drawn by Mr. Hunter, still the theory exemplified by him, with reference to amputation after gun-shot wounds, is certainly not supported by actual experiment; and although there are yet a few surgeons in the French army, who prefer operating after the first inflammatory symptoms are over, in cases where amputation is clearly necessary from the first; there is probably not one in the British army who will wait for this period, if he can avail himself of the proper opportunity of performing it sooner.

During the course of the Peninsular war, the success of amputations performed on the field of battle, became so notorious, even among the soldiery, that the anxiety expressed by them, to have these operations executed with as little delay as possible, has frequently been prejudicial; for as much attention must be paid to avoid operating too soon, as too

late, and perhaps for a reason quite contrary to that usually received as legitimate for not operating, viz. that the sufferer may have time to recover from the shock of the injury, and approach as near as possible to a state of health ; and the farther he is from this state of health, the greater the chance of a fatal termination.

If a soldier at the end of two, four, or six, hours after the injury, has recovered from the general constitutional alarm occasioned by the blow, his pulse becomes regular and good, his stomach easy, he is less agitated, his countenance revives, and he begins to feel pain, stiffness, and uneasiness in the part : he will now undergo the operation with the greatest advantage, and if he bears it well, of which there will be but little doubt, he will recover in the proportion of nine cases out of ten in any operation on the upper extremity, or below the middle of the thigh, without any of the bad consequences usually mentioned by authors, as following such amputations.

If, on the contrary, the operation be performed before the constitution has recovered itself, to a certain degree, from the alarm it has sustained, the additional injury will most probably be more than he can bear, and he will gradually sink under it and die. At the storming of Ciudad Rodrigo I amputated a thigh in a convent close to the breach, within an hour after the accident, at the anxious desire of the patient, the leg having been destroyed by the explosion of a shell. There was not more than

the usual loss of blood, or of delay in the performance of it ; my patient did not however recover the shock of the operation, and at day-light I found him dead, without the bandage being stained with blood. At the battle of Salamanca, I had two men brought to me during the action, labouring under great anxiety : one had his arm carried away close to the shoulder, and his breast considerably grazed by a cannon shot ; the other had the greatest part of the leg torn away close to the knee ; this was about four in the evening. These men, amongst many others in the like situation, were particularly low, and the constitution seemed to sympathize more with the injury. They were laid in a ditch, without any covering over them, and a very small quantity of rum and water given them during the night. At day-light, five in the morning, they were much recovered, the countenance was less ghastly, the pulse regular and good, the stomach not irritable, and what is of essential importance, the wound was becoming stiff and painful. The disposition for inflammation was forming, and would of course have been very great, from the laceration and incurable state of parts, if I had not prevented it, by removing the whole of the seat of the injury, leaving a clean incised wound, the greater part of which healed by the first intention, with little comparative fever, or constitutional derangement. Instead then of inflicting an additional injury on the original one, and increasing the general symptoms of irritation in

those persons, I relieved them completely. They became calm, tranquil in mind as well as body, gradually recovered something more of their natural appearance, took some light nourishment and slept. If these men had suffered amputation when first they came to me, I think their recovery would have been less certain; and I have under such circumstances, seen more than one case die on the table.

The inflammation succeeding after amputations of this kind, is not in general more than is requisite for the necessary actions of adhesion and suppuration, and the attendant fever is mild and easily retained within due bounds. It is frequently indeed, under these circumstances, so mild, as not to affect materially the appetite of the patient, who is only restrained from eating by the strict injunctions of the surgeon. The recovery is perfect in most cases in a month, when the operation has been well performed; and innumerable evidences may be seen in England of these cases having been followed by no ill consequences.

All the operations of amputation of the upper extremity, and those below the middle of the thigh, generally follow this course. There are, however, in particular constitutions exceptions, in which there is much nervous irritation; but these deviations are more frequently to be met with when the operation is delayed to a later period.

When a thigh is destroyed by cannon shot

above or at its middle, the injury is very great and the danger proportionate. The shock is frequently more than the constitution can bear, and the patient dies in a few minutes without much hæmorrhage. The loss of blood is sometimes great; and whenever this has occurred, it very much destroys the chance of success of the operation. The influence, however, of the injury on the nervous system is most to be dreaded; and this is so great, that many, indeed the greater part of these kind of injuries are generally fatal, without coming under the observation of the surgeon. An operation, under these circumstances would only hasten the dissolution of the patient.

A cannon shot struck an officer in the middle of the upper half of the right thigh at the battle of Toulouse, went through the left thigh of a soldier at its middle, and through the thigh of the man behind him a little lower down. The officer was carried into a house a short distance from the place of the accident, and I saw him a few minutes afterwards; the soft parts were torn to the groin, the femur shattered to the trochanters, the femoral artery, vein, and anterior crural nerve fairly divided. He had lost more blood than is usual after a limb being torn away, but not any great quantity, and the hæmorrhage had ceased. He was pale, ghastly, little able to move, shewed great anxiety of countenance, the pulse small and quick, the skin clammy, his face bedewed with a

cold sweat, he could articulate, but with difficulty, and did not appear to suffer much pain. Here any operation would have been instant death. As the fire of the enemy was very smart around the house, I remained in it with him and some other wounded, with the hope of being able to rouse him sufficiently by cordials and stimulants to bear an operation. He at first swallowed a little wine, but the constitution could not recover itself, and in about two hours he died. I found the two soldiers, after some search the next morning, in a barn, where they had been carried, and remained undiscovered during the night. Amputation was performed on these men about twenty-four hours after the injury by staff-surgeon Lindsay. Both were as high up as an amputation of the thigh can well be performed by the circular incision, and both died; one shortly afterwards, the other the next day, whilst incautiously carried by mistake on a car into town. Another, under similar circumstances, operated upon by the same gentleman, recovered remarkably well; and a fourth, whose femur I amputated at the little trochanter by the flap operation, at the end of the fifth week, in a case of compound fracture, when suppuration and hectic fever were well established, died in about three hours, apparently from the shock of the operation, although it was performed in a very short space of time, and with little loss of blood; indeed hardly any but what came from the veins. This

accident as frequently occurs in operations at the secondary period, as on the field of battle, so that it appears to depend on a peculiarity of constitution not discoverable *a priori*; and if the patient surmount this trial, both in the primary or immediate operation, and the delayed or secondary operation, the chance of ultimate success bears no proportion in favour of the former.

Inflammation in the seat of injury comes on at an indeterminate period, varying in different people. When the injury is high in the thigh it commences sooner than in the leg or arm; and the symptomatic fever accompanying it is proportionably severe. If, then, after an injury where the alarm has been very great, and the powers of life considerably diminished, so as to have prevented an operation shortly after the accident, some little re-action should take place, the patient should become restless, the pulse quickened, the parts injured painful; the operation should be no longer delayed; for the removal of the diseased parts can alone moderate this nervous commotion, and prevent delirium and death. From the peculiarity above noticed the operation may destroy the patient, but the injury would of itself be no less fatal, and the chance of success is therefore in favour of the operation; for I never saw a person in this state live long enough for suppuration to be established, much less to survive all the first accidents attending a wound of this nature.

If the operation be delayed beyond the first twenty-four hours in some persons, and in others thirty-six hours, pain, heat, tumefaction, and the other constituents of inflammation come on rapidly; attended by increased arterial action, severe nervous twitchings, thirst, heat of skin, general restlessness, delirium, and the patient is soon carried off, if the injury has been extensive. Many very severe wounds do not terminate so quickly, the symptoms exist in a less degree, and may be moderated by the antiphlogistic treatment until suppuration is established, and the primary high excitement reduced within the limits of hectic fever, depending upon the irritation of incurable parts.

In any period from the time inflammation has commenced in the seat of injury, and symptomatic fever is established, amputation is performed under very different circumstances than when it has been done prior to their supervening; the parts to be divided are no longer in a healthy state; they have taken on inflammatory action tending to suppuration, and will not unite by adhesive inflammation, as they would have done if they had been divided forty-eight hours sooner. The operation, instead of relieving the symptomatic fever, greatly increases it. It is now really a violence superadded to the injury; and the patient dies, without very active means are employed for his relief, and even under the most vigorous and at-

tentive treatment it frequently proves fatal, although his life may be prolonged for some days.

All these operations have been unjustly called amputations on the field of battle; and when so much danger attends them now, under the present improved mode of treatment of modern surgeons, it is not surprising they were generally fatal among the older ones, and were of course discredited. Military surgeons therefore, endeavour to have all their operations performed within the first twenty-four, or at most forty-eight hours after the injury; and where due attention can be paid to medical aid, attendance, diet, &c. as is generally the case with officers, the result is surprising; and, even with soldiers, labouring under all the disadvantages of a military life and temporary hospital accommodation, it is very satisfactory, when compared with the result of operations performed in the same hospitals, at a later period, when the accommodation is much better.

It is argued, by the advocates for delayed amputation, that soldiers are not in a state of rude health during a campaign; that they have been ill fed, badly clothed, have suffered much from fatigue, and that they are not in the same state as persons in civil life meeting with the same accident. This is far, however, from being the fact with reference to the British army in the Peninsula, which was composed of men in the prime of life, the greater part under thirty-five years of

age, very many under twenty-five; they were always well fed, with an occasional exception; their appearance indicated high health, their diseases were frequently highly inflammatory, and the use of the lancet, and the antiphlogistic regimen were carried farther and successfully, than could be ventured upon in England. It can never be argued, that the principal part of the officers of the British army, are not young men in the flower of their age; and from operations performed on them, I would from choice take my examples. The result is within the reach of any surgeon in England. Let them ask any of the mutilated officers, to be seen in the streets, when they lost their limbs, in what state of health they were when they suffered amputation, and what inconvenience, in regard to their general health they have since experienced? Let them inquire of the friends of those who died after amputation, at what period it was performed? and they will hardly find one instance in ten, of an unfortunate termination after operations performed on the field of battle.

The adversaries of immediate amputation, founding their opinions upon the soldier being in a state of rude health at the time of injury, and supposing that state inimical to disease, have not, it appears to me, sufficiently considered the very great alarm and shock given to the constitution, on the receipt of the injury; they have not sufficiently considered the loss of blood that takes place the moment a

limb is destroyed by cannon shot, or the loss of blood during the operation; they have not duly considered, that the re-action of the constitution, producing high inflammatory fever, can be more readily suppressed, and with more safety in a healthy, than in an irritable constitution.

Others* have chosen to consider the soldier as frequently in a state of inebriety, or, as having his stomach full of food of various kinds at the moment of injury, and have considered this state to preclude amputation; and it certainly is not a state that would be selected for it; but they have overlooked this circumstance, that if a soldier was drunk at the moment of the injury, the shock of the blow, the loss of blood, and a few hours delay, would remove all the effects of the liquor, except debility; and, as to the stomach, it will generally be emptied on the receipt of the injury; and if it be not, the cathartic usually given after the operation, and a strict abstinence from solid food, will obviate any mischief it might produce, although I declare I have never seen any; and it is to be supposed that officers, whose cases are almost always successful, would be very liable to these inconveniencies if they did occur. Upon the whole, I consider these objections to have arisen from theory, not practice, and therefore not to be regarded.

* See Lombard, p. 85, Clinique chirurgicale des plaies faites par armes à feu.

All these authors are obliged to allow, that there are some cases which cannot be removed, and must be amputated on the spot; but if these unfortunate people survive the operation, they are called phenomena, accidental effects of nature, &c. What is more extraordinary, they have even gone so far, as to consider the removal of a patient after amputation, as a reason for delaying the operation; but, if he cannot bear removal with a clean incised wound, I should be glad to be informed from practical experience, how he will bear it, and what state he will be in with shattered bones? The objection was invented in theory, the reply is found in practice. “That the removal, where the means of conveyance is good, is in general attended with little or no detriment, provided it be not of longer continuance than one or two days; whilst, if there be a shattered limb, the pain is horrible, the inflammation and symptomatic fever excessive, gangrene is apt to supervene, and the patient frequently never lives to the proper time for secondary operation.”*

The numbers of officers and soldiers that have been removed after amputation by all the surgeons of the British army, with little or no disadvantage, entirely refute this objection; and the knowledge they have acquired of the danger attendant on the

* See Lombard.

removal of shattered bones, renders them extremely cautious of doing it, even where amputation is to be the result. I have removed officers and soldiers, at all times, before and after amputation. I removed an officer, during the first siege of Badajos, four hours after amputation at the shoulder joint, a distance of thirteen miles, on a bearer carried by six men. During the last siege of Badajos, and that of Ciudad Rodrigo, all the capital operations were performed on the field, and afterwards sent to the different hospitals, three and five leagues distant. I had officers and soldiers, after the affair at Elboden, for forty-eight hours together travelling almost constantly in waggons, immediately after amputation, without any bad consequence; but I have seen the most dreadful ones ensue after the removal of persons with shattered bones, and more especially where the injury had existed some hours. And this was illustrated particularly after the siege of Burgos, in the removal of the wounded in almost a direct march to Ciudad Rodrigo through Valladolid and Salamanca; the amputations having recovered in a very fair proportion, whilst a very severe loss followed the attempt at saving such doubtful cases of injury, as were not considered proper for amputation. The great point overlooked by all these authors, is the time lost in which only the operation can be expected to be successful, but of which they were not aware.

Others, state with Mr. Hunter, "that if the pa-

tient is not able to support the inflammation arising from the accident, it is more than probable he would not be able to support the amputation and its consequences." Now, this "more than probable" on which the argument rests, is disproved by the experience of the peninsular war; and the fact is found to be precisely the reverse, viz. "that a patient, who it is presumed will not be able to bear the inflammation resulting from his wound, if his limb be retained; will bear the amputation of it extremely well in most cases, and recover in a very short time, without subsequent detriment to his general health. The fact is perhaps better stated thus:—Suppose sixteen men have each a knee shattered by a cannon or grape-shot, without destroying either the circulation or the connexion of the limb, but in such a manner as to render amputation necessary: of these, eight shall be amputated on the field of battle, and eight delayed for amputation, when the first inflammation has subsided, and suppuration be duly established. Of the first eight amputated on the spot, or within the twenty-four hours after the injury, I assert, from my general experience, that on the average of three trials, six would recover; and from the same source I affirm, that of the eight delayed cases, not one-half would live to the proper period of performing the operation; and of the four remaining, not more than two would ultimately recover after amputation. Instead, therefore, of agreeing with the supposition of Mr Hunter above stated, I consider myself warranted in declaring (and I am sup-

ported in it by all the surgeons of the British army of experience) that it is erroneous ; and that in any equal number of severe cases, occurring on the same day, the chance of success would be as three to one in favour of amputation on the field of battle ; and the more severe the wounds, the more would this proportion be increased. If the thigh, in the above sixteen cases was broken at its middle, instead of near the knee, I am positive that two of the number would not live to the proper period for secondary amputation ; in other words, would not outlive the inflammation arising from the accident : when one-third of the number would recover, if amputation were performed immediately.

I allow amputation to be a violence superadded to the injury, a violence that occasionally destroys the patient ; but it as frequently does so after secondary, as primary operations, the cases being equally dangerous ; but, it is a violence intended to prevent a greater, which greater, the consequent inflammation and its attendant dreadful consequences. It does, in almost all proper cases, most effectually lessen, to the great advantage of the patient.

The inconvenience or danger, arising from loss of substance, as far as regards the sanguiferous system, is not of much consequence after such an injury ; and so far from the loss of blood, being at the same time injurious, if it were only inflammation, and the evils resulting from sudden loss of substance that were to be dreaded, I apprehend it would, when not

in excess, be the most likely means of preventing them.

The support Mr. Hunter gave to his opinion, by stating, that the experience of the military surgeons of his time, who were esteemed the best judges, coincided with it, was fallacious ; as I conceive these gentlemen did not give immediate amputation a fair trial, according to the rules of Wiseman or Ranby ; or, if they did, the operation itself, or the constitution of their patients must have been different, from what we have practised, or have met with lately ; or they must have had precisely the same results, as we have had during the course of the peninsular war.

I trust it will not be called presumption, thus to doubt the opinions of the military surgeons of Mr. Hunter's time ; to avoid, however, the shadow of it, I will leave the argument thus ;—that as those gentlemen supported one side of the question, and the military surgeons of the present day the opposite, one party must certainly be in error ; and my readers will determine for themselves.

It is said to be “ of less consequence whichever way it is treated, if the part to be amputated is an upper extremity.” This acknowledgment of the safety of immediate amputation on the upper extremity, is conceded, not in consequence of the arguments not applying ; but, because it was known to be a fact by the military surgeons of that time which they could not deny, that the arm was

frequently amputated with safety : the theory was therefore accommodated accordingly, for I believe there are few of these gentlemen, if there be any now living, who will deny the amputation at the shoulder joint to be as severe an operation, in every point of view, as amputation below the knee.

But I cannot consent to receive this concession, with the incumbrance of the delayed amputation being equally successful ; for I know that the amputation of the arm is as safe as any operation can be, in fair cases of injury, in nineteen cases out of twenty ; and that if the same kind of cases, as far as it is possible to discriminate them, were delayed, it would not be successful in more than fifteen cases, at the utmost, out of twenty ; which is a very important difference.

It is not sufficient to perform twenty amputations on the field of battle, and contrast them with as many cases of amputation, done at a later period. The twenty cases for delayed operation must be selected on the field of battle, and their result compared at the end of three months with that of the others ; when the value of the two modes will be duly estimated. I have never done this exactly, because I had ascertained the safety of immediate amputation in all cases that required it, after the first battles of Roliça and Vimiera in 1808 ; and when circumstances would have enabled me to have done so, I did not feel myself authorized to commit murder for the sake of experiment : but I have had

at various times a great number of unhappy objects under my care, who ought to have suffered amputation on the field of battle, but which circumstances did not permit, and most of these died ; whereas, those men who were wounded on the same day, and who suffered amputation shortly afterwards, for the most part recovered. Of a number of doubtful cases, in whom I tried to avoid amputation, and not extending the trial beyond what the situation of the patient would allow, I lost a much greater proportion, than I did of those who were amputated on the field. It is true, these men had a chance of saving their limbs, and in taking this chance they lost their lives : but they would not the less have done so, if they had from the first been considered as incurable cases, waiting only the proper period for amputation.

Officers, who may be considered as persons in the highest health, very seldom die after amputation of the upper extremity ; or below the middle of the thigh, when done within the twenty-four hours after the injury ; indeed I hardly know an instance of it in the upper extremity, without there being reason to expect it prior to the operation ; and on the lower extremity, the success as far as I can judge, has been in a greater proportion than that of primary amputations of troops in general : proving the great advantage of immediate operation, when undertaken with proper care, even in the most healthy subjects.

The following statements of operations, perform-

ed on the field of battle, and at a subsequent period in general hospitals, in the army in the Peninsula, which were collected by Sir James M'Grigor for the purpose, fully bear out the opinions above related.

RETURN of the capital operations performed at the hospital stations, between the 21st of June and the 24th December, 1813, of the army under the command of his Excellency Field Marshal the Duke of Wellington; being a period of six months, from the advance of the British army from Portugal, until its establishment in winter quarters in front of Bayonne.

	Number operations upon.	Of which died.	Discharged, cured.	Under cure.
Amputation of the upper extremities. }	296	116	105	75
Lower extremities. }	255	149	65	41
Total number of operations. }	551	265	170	116

The operations at the shoulder joint not included.

RETURN of the capital operations performed in the same period on the field of battle, and for the most part kept in regimental and divisional hospitals.

	Number ope- rated upon.	Of which died.	Discharged, cured.	Under cure.
Amputation of the } upper extremities. }	163	5	64	94
Lower extremities.	128	19	43	66
Total number of } operations. }	291	24	107	160

The cases marked "under cure," in both statements, having passed the period of danger, are considered as recovered; and from this it will appear that the comparative loss, in secondary or delayed operations, and primary or immediate operations, is as follows.

	Secondary.	Primary.
Upper extremities	12 to	1
Lower extremities	3 to	1

This difference is certainly very remarkable, and it is so well known to all the surgeons of the British army, as a constant occurrence, that there is no longer among them any doubt on the subject; and

the following statement of operations performed on officers and soldiers, in consequence of the battle of Toulouse, will probably be even more satisfactory ; as the medical duties both in the field on the day of action, and in the hospitals afterwards, until the final evacuation of Toulouse, were more immediately under my observation and controul.

Primary Operations on the Field of Battle.

	Number operated upon.	Of which died.	cured.
Upper extremities . . .	7	1	6
Lower extremities . . .	40	8	32
Total of primary amputations. }	47	9	38

Of the eight that died of amputation of the lower extremity, three were shortly after the operation; which was performed as high as possible in the thigh by the circular incision, and one officer.

Secondary or delayed operations in General Hospital.

	Number operated upon.	Of which died.	Discharged cured, or considered out of danger when transferred from Toulouse.
Upper extremities .	15	3	12
Lower ditto. .	36	18	18
Total of delayed, or secondary amputations. }	51	21	30

The secondary amputations of the lower extremities as well as of the primary, were mostly of the thigh; in consequence of compound fractures, or of wounds of, or close to the knee-joint. Seven of the eighteen deceased, were from compound fractures of the thigh, broken at its middle; three were operations at the trochanter minor, and three more with the view of relieving tetanus.

The wounds in general, were extremely severe in consequence of the exposure of the troops to a constant heavy fire of artillery. The number of officers and soldiers of the British army received into hospital, or treated in quarters, was 1407; the number of amputations 98; average of success in primary operations, one-fifth; in secondary am-

putations, one in two and a half; general average one in three and one third; deaths of the total number wounded 147, being nearly one tenth.

This return is made out for the three months succeeding the battle, whilst the wounded remained at Toulouse; but a number more must have been lost before the whole arrived in England, or were dismissed from surgical care. After the battle of Salamanca, the proportion of loss in the same period of time, was one-tenth. After the battle of Albuhera, considerably greater.

In a report made by Mr. Gunning, the surgeon-in-chief, to Sir James M'Grigor, on the wounded after the battle of Orthez; he states, that on the 24th of March, one month after the affair, the loss from amputation had been one in twenty of the upper extremities, and one in nine of the lower extremities; and that of eight hundred wounded on that occasion, fifty-one only had died.

When a soldier must die, retaining his shattered limb in a few hours or days, and there is a chance, however small, of saving his life by removing it; this chance and the prospect of success is to be explained to him, when the man will generally decide for amputation. In this manner, several limbs are amputated, although the prospect of success is but small, and the number of fatal cases are increased; whereas, if those only were calculated, which might be considered good cases for amputation, as is generally done in domestic surgery, the

average of success would be infinitely greater. Many operations, both in the field and in hospital, are forced upon the military surgeon, that he would willingly avoid, but he has not conscientiously the means. A soldier, in addition to a bad compound fracture of the thigh, above its middle, has a considerable hæmorrhage, from a deep seated artery or vein, and this may happen in the field of battle, or in hospital; is he to die unaided, because amputation near or at the hip joint is generally unsuccessful? or, is he to have that chance of life if he is anxious to undergo the operation? A military surgeon, in these cases, has no alternative, for a soldier ought never to die without surgical aid, where there is a chance of its being successful. These kind of cases will very much decrease his average of success, but he will have done his duty.

Considerable stress has been laid upon the inconvenience of situation for performing operations, the irregularity or disorder of camps, of besieged towns, of the want of comfort, or proper accommodation for operating, and other reasons of the same description, why amputation should not be performed in the field of action; but all this is fanciful, they may be insuperable difficulties to a surgeon accustomed to the conveniences of civil life, but are by no means necessary: indeed, in the education of a military surgeon, he should never be taught to expect any convenience; his field pannier for a seat for the patient, and a dry piece of ground to spread

his dressings and instruments upon, are all that are required. It is needless to discuss this point further, as a reason why any operation should be postponed.

A due consideration of all these circumstances, induces military surgeons to divide the operations of amputation into Primary and Secondary.

Primary, when performed within forty-eight hours after the receipt of the injury; or before the constitution has become affected in consequence of the accident, or inflammatory action in the part, constituting symptomatic fever.

Secondary, when performed after this symptomatic fever has continued some time and subsided; suppuration being fully established, the strength of the patient considerably reduced, and the powers of nature found incapable of effecting a cure, or of supporting longer the disease without material disadvantage; which in general is a period of from three, to six weeks.

Of Primary Amputation.

When the surgeon is satisfied there is no chance of saving the limb by prudent delay, the operation is to be performed as soon after the receipt of the injury as the state of the patient will permit; the only point to be considered, is, if the patient have so far recovered the shock of the injury, as to be able to bear the additional one of the operation.

This depends on the different powers of constitution in individuals, as two men shall have the leg below the knee torn off by the same shot, or at the same time, under precisely similar circumstances; one, shall recover from the alarm given to the constitution, and undergo the operation within the hour with advantage, whilst the other shall not be in a state to bear it for twelve hours: and if this man be operated upon immediately after the accident, without due attention being paid to the state of the constitution; under the idea that the removal of the injured parts will remove the nervous affection, the consequences in many instances will be fatal.

When, after an accident of this kind, the general alarm has a little subsided, and the patient is made acquainted with the extent of the injury, he knows he has at most only lost a leg, and with this knowledge he is unconsciously tranquillized, the pulse becomes more regular, the confused sense of the blow remains, but the pain is seldom great, and is in general more a painful sense of numbness, than absolute pain. In this state, he is brought to the surgeon, requiring to be relieved from danger; and that of bleeding to death, &c. presses on his mind, until his wound be examined. The anxiety is now momentarily increased, and with it a false feeling of strength and courage, that renders him desirous of undergoing any operation that may be necessary. He may now bear the operation very well, but it is not the best time of doing it, the surgeon should

endeavour still further to tranquillize the mind of his patient, by explaining to him the nature of his wound, and assuring him that he shall receive the necessary assistance in due time. The confidence in obtaining surgical aid, and the knowledge of being in safety will gradually reassure him, his pulse will become fuller, the agitation both of mind and body will decrease, the countenance become more natural, the voice more equable and clear. He now anxiously desires the operation, to relieve him from the increasing uneasiness in the part affected; and it will be borne, with every chance of success.

Soldiers in general are anxious to undergo an operation when they find it inevitable, and frequently press it before the proper time, that is, before they have sufficiently recovered the shock of the injury; and if attention be not paid to support them afterwards, they sink and die, as in the case related page 24, and which is better seen in the following.

A soldier, during the action of Toulouse, had his leg carried away close to the knee by a cannon shot, so as to render amputation above necessary; he suffered less than is usual, from the constitutional alarm on the receipt of such an injury; or rather, as soon as he was aware of his precise situation, and found himself within reach of surgical assistance, he endeavoured to command his feelings, and pressed to have the operation performed. His thigh was cut off, a little above the knee, in



about an hour after the accident, which he bore very well, and was placed on his bed like other wounded men, in a house at hand in charge of an assistant surgeon; this occurred in the evening. I rode up to the house next morning to inquire about him, and found he had not slept during the night, that towards morning he had been more restless, and was sixteen hours after the operation in a very alarming state; the pulse very quick and weak, the skin clammy and wet, the stomach rejecting all the light drink offered, and he was suffering considerable anxiety from the idea he entertained of his situation. I ordered him a wine glass full of two thirds French brandy and one of water, which remained upon his stomach. His confidence in the gentlemen who shortly afterwards visited him helped to relieve his mind, and a repetition of the warm brandy and water from time to time during the morning banished the bad symptoms; a little broth staid on his stomach in the evening, and the cure went on without further inconvenience from debility or symptomatic fever. The muscles retracted, however, considerably after the operation, the bone protruded, and the cure was not completed for some months. The principal error committed here, was in performing the operation before the patient had sufficiently recovered from the shock of the injury.

I think I saved this man's life, for if he had been neglected an hour longer, his fate would have been decided. It is necessary, therefore, to watch all

primary amputations carefully, and guard against accidents of this kind, by supporting them with some light cordial as their strength appears to fail. It must also be remembered, that it is more likely to occur after amputation of the thigh, than of the arm.

When a limb has been torn off by cannon shot, the state of the patient will be such as has been described in the generality of cases; sometimes, and especially when it is the thigh that is injured, the nervous commotion will be much greater, the pain considerable, and gradually increasing; so as to cause the patient to claim relief, not from the calm courage of a man who is desirous of undergoing an operation he cannot avoid, but from the suffering being so intolerable, that it cannot be borne. The operation is then to be performed immediately; for although the patient may appear unable to bear it, the shock of the operation will not be equal to the continuance of the suffering he is undergoing, which would soon prove fatal. The operation may do so likewise, but it is the only chance of safety, and will in general bring immediate relief, even if the patient sink under it afterwards. These cases are not of frequent occurrence, there is in general a certain period differing in different persons as to time, before these symptoms come on, and they are then severe in a greater or less degree. Severe twitchings of the limb, violent pain and convulsive motions of the body, indicate great danger; as do in a greater degree, a total absence of these symp-

toms, with great prostration of strength, irritability of stomach, clamminess of the skin, and aberration of mind.—A moderate sense of pain, and apparent recovery from the first alarm and nervous commotion, give the most favourable prospect of recovery after amputation.

I believe it to be a stretch of fancy in those surgeons who conceive, that if the knife followed the shot in all cases, the patient would have the best chance of success. No one will deny, that if the shot performed a regular amputation, it would not be better than to have to do it afterwards; but if they mean to say the operation should in general be performed a few minutes after the injury, I can only oppose to them the facts above stated, and the general result of my experience, which is decidedly in favour of allowing the first moments of agitation to pass over before any thing be done; a period of from one, to six or eight hours, according to the different constitutions of different people. But from one to three hours will in most cases, be found sufficient.

When the due period of operating is observed, the bad consequences which are supposed by authors to ensue, do not occur; the symptomatic fever seldom runs high, it is in general moderate, after an amputation of the upper extremity frequently trifling; and this is to be accounted for from the parts only taking on such actions as are necessary for the cure of the stump: and the powers of the

constitution having been weakened by the shock of the accident and of the subsequent operation. Suppurative inflammation is in a great measure avoided, the bone is in general well covered, and the cure is completed in the space of from three to five weeks. Venesection is seldom necessary. Spoon diet or a total abstinence from solid food, with occasional cathartics, should be the general plan of treatment. —Opiates where there are spasmodic affections of the limb, and a more generous diet if there be much debility. If the symptomatic fever runs high in a robust man, blood is to be taken freely and with effect from the arm, cold applications are to be applied to the stump, and the antiphlogistic mode of treatment rigidly enforced; and especially the bloodletting, which is to be repeated on the first two or three days, until the increased arterial action be reduced. The antimonium tartarizatum will be found very useful in divided doses, so as to nauseate the stomach and affect the bowels, which must be strictly attended to from the first.

Secondary hæmorrhage seldom occurs after primary operations. Retraction of the muscles and exfoliations of bone are not frequent, without some untoward accidents happen after the operation, in moving the patient; or, there have been errors in the performance of it, inattention in bandaging the limb at the subsequent dressings; or accidents from fever, or other causes in hospital, which are foreign to the operation.

The greater proportion of those who die after primary amputation, die within the first twenty-four hours.—Of the eight fatal cases from forty-one operations, on the lower extremity, at the battle of Toulouse, two died within an hour, and two more within twelve hours; and of these, there was little expectation from the first. It would be but just then to exclude them from the list of cases performed with the prospect of success, and the average instead of being one-fifth, would be a ninth.

Inflammation occurring in other parts of the body, and particularly in the viscera of the thorax and abdomen, during the cure of a primary amputation, is very rare. After the first few days the patient feels much debilitated, and continues so in successful cases for some time after the stump is healed. It is, indeed, generally from three to six months, before the patient is as strong, or as fat as he was prior to the operation; and I do not believe, that in young men, any evil consequences result to the system after the period of cure, from the loss of a limb.

I have met since the peace, many men whose limbs I amputated after the battles of Vimiera, Talavera, &c. at the beginning of the Peninsular war; and I do not find they have suffered any inconvenience in their general health.

The nature of war on a large scale, often renders it impossible to perform all the amputations required, before inflammation shall have com-

menced in the seat of injury, and considerable fever has ensued ; which is generally the case when the enemy leave their wounded on the field of battle without surgical aid, as the French invariably did when opposed to us in the Peninsula. These unfortunate people could seldom be collected in hospitals before the third or fourth day, and between that and the twelfth or fourteenth, many operations were indispensable to give the patient a chance of life. Of these cases, were limbs torn off, bad wounds of joints, compound fractures by cannon shot, wounded arteries causing mortification of the extremities, or other severe injuries from which the soldier claims relief by operation to save him from inevitable death, before the suppurative inflammation shall have come on, and duly subsided ; then the most advantageous period for amputation, and which is to be waited for, if the patient's strength will permit, in all cases, except that of wounded arteries inducing gangrene.

Sooner or later, after the receipt of an injury rendering amputation necessary, if it be not performed, pain, heat, redness, tumefaction of the neighbouring parts constituting inflammation come on, which speedily runs into suppuration or gangrene ; depending considerably upon the nature of the injury, the parts injured, the constitution, habits, age, and disposition of the patient, independent of the adventitious and frequently unfortunate circumstances of situation, surgical attendance

and aid, which decide in a great measure the fate of the patient. The constitution sympathizes with the local injury—as the inflammation increases in the limb, the symptomatic fever becomes more violent, and if relief is not obtained, frequently ends in death in the course of a few days. The local inflammation appears to be augmented in turn by the fever, and extends far from the seat of injury; the temperature of the limb is increased, the tumefaction and redness is considerable, the pain generally intolerable, the limb will hardly bear to be touched, and far above the injury will be much firmer on pressure, and larger than usual. If the integuments of the thigh be cut into in this state, when the wound is in the leg, they will be found full of fluid partly coagulated, and especially upon the under part; they will not retract from the muscles on being divided, which are fuller of blood in consequence of the increased size of the smaller arteries; and the stump thus made will not unite by adhesive inflammation. The symptomatic fever is much increased after the operation, and frequently proves fatal; and in the autumn in Spain, and Portugal, would occasionally take on the form of the bilious remittent endemic in the country, which very much increased the danger. In fact, when the injury has been severe, amputation at this period is attended by all the bad consequences enumerated by authors; and it is from their having been performed at this period, and confounded with

operations performed prior to the constitutional derangement, that the prejudice against immediate amputation has arisen.

When the local inflammation and symptomatic fever run high, both are to be moderated by a total abstinence from solid food, blood-letting, purgatives, and diaphoretics; cold water is to be constantly kept to the limb, and the heat reduced by constant evaporation. If the symptomatic fever is not reduced by these means, venesection is to be resorted to every six or eight hours; leeches to the part affected will at the same time be of infinite service, and in combination with the general means, will probably prevent gangrene. These being continued for the first five or seven days, in different constitutions and habits, the ulcerative process for the separation of the dead from the living parts will be very observable, although the discharge shall be small; the skin will be stiff and uneasy, a sense of tightness, throbbing, and uneasiness, will be felt by the patient in the limb near the injury, which the cold applications appear to increase. Warm fomentations and poultices are to be applied for a few days, when suppuration will readily be brought on, and the general uneasiness diminished. During this period, the greatest attention must be paid to the state of the bowels. Opiates may be given to relieve pain and procure sleep, and good light nourishment is to be allowed.

Under this treatment, the patient will sink and

die, or he will arrive at that state usually described as advantageous for operating; when the suppuration will be good, the separation of the dead parts accomplished, the tumefaction of the limb diminished from the absorption of the effused fluid, the strength and health of the patient much reduced, the fever abated; and only a general irritation remaining from the powers of nature being unequal to the cure of the injury, constituting hectic fever, under which the patient would soon sink, unless the seat of disease is removed by secondary amputation; and this period will arrive in severe wounds from the third, to the sixth week. It ought to be clearly understood, that a limb is to be amputated at this period, only, because the health and strength are sinking under the disease, the powers of nature being unequal to its removal or support.

Many bad wounds will never reach this secondary stage, especially in the summer season; and if they do outlive the first symptoms, they will not outlive the operation. I had satisfactory proof of this after the battle of Salamanca, in the French wounded brought into our hospitals on the third and fourth day after they had been wounded; they were compound fractures, requiring conveyance, and could not be removed sooner. Of these I had 150 in the most deplorable state; from the constant exposure to a burning sun, their sufferings had been horrible, and they earnestly prayed to be shot, or to have their limbs removed. There was

little hope of saving either the lives or the limbs of the greater part of them, and few had any prospect of living to the proper period for secondary amputation. Forty-six of the worst of these wounds were amputated in the course of the next fourteen days, nearly all at the thigh; of this number I saved but six, and these six may truly be said to have been saved, for of their comrades who were not so severely wounded, and who were not operated upon, as few in proportion survived.—If I argued upon these cases as of primary operations, I should draw false conclusions, as the advocates for delayed operations have done in many instances. I allow that most of them were not cases of secondary amputation, and I do not adduce them as such, but to exemplify the fatality of not operating on the field of battle without delay; for if these men had had their limbs removed on the first or second day, and still remained as they did on the field of battle, with a little cold water to wet their stumps; I have no doubt the result would have been very different, even under equally unfavourable circumstances during the remainder of the cure.

It is not my intention here to enter into the treatment of inflammation or gangrene; one species of the latter, however, demands our attention, as a point of some importance in military surgery: when it results in consequence of a wound of the large blood-vessels of the limb, which, at page 55,

I have mentioned as demanding immediate amputation.

A soldier shall receive a flesh wound from a musket-ball in the middle of the thigh, which passed through the limb apparently on a superficial inspection, without injuring the main artery; or, it shall pass close behind the femur where the artery turns to the back part of the bone; or it may go through the middle of the bone from behind forwards between the condyles of the femur into the knee-joint, and the patient shall walk to the surgeon with little assistance, be superficially dressed, and, in many cases, considered slightly wounded; yet the femoral artery and vein in the whole of these cases, and, indeed, in many others, shall be wounded, or cut across, and the local inflammation be so slight, as to obtain little attention. On the third or fourth day, the patient shews his toes discoloured, and complains of pain and coldness in the limb below the wound, the constitution begins to sympathize with the injury, and the surgeon probably thinks the case extraordinary. Perhaps he suspects the real state of the injury, but is surprised that a wound of the femoral or popliteal artery, with so little attendant injury, could cause mortification. The more he considers, the more he recollects that the anastomosing branches are declared to be sufficient to nourish the limb; and their not doing so, he thinks still more extraordinary. He is anxious to do something, but

mortification, or, at least, gangrene, having commenced, he must, according to general rule, await the formation of the line of separation. The temperature of the leg, a little above the gangrene, is good, perhaps higher than natural; he hopes it will not extend farther, and it probably does remain stationary for a little time; at last, the parts originally affected, the toes, become sphacelated, and gangrene quickly spreads up the leg as far as the wounded artery, by which time the patient dies. This accident occurs more frequently than is generally suspected, being placed to the account of gangrene from other causes, especially if there be a wound of any magnitude, and of course more attendant inflammation.

I believe two errors are committed here, one, in supposing that the anastomosing branches are sufficient to support the limb in the majority of cases, when the great blood-vessels are wounded by gunshot. The other, of waiting for the line of separation, or rather, the cessation of the gangrene; for if the wounded vessels be in the middle of the thigh, it will extend to the seat of the injury, and destroy the patient, before the action of separation can commence. To obviate this misfortune, amputation is to be performed where the artery, or artery and vein, has been divided, as soon as the gangrene is perceived to extend beyond the toes; and the swelling and slight attendant inflammation, which is marked more by the tumefaction than the

redness of the part, has passed up higher than the ankle.

The constitution at this period will have sympathized but little with the injury, and gangrene will not occur after amputation, in the stump, as most frequently happens in sphacelus from other causes. I may here add, that the stump is to be tenderly treated, not bound firmly down by adhesive plasters if it will not unite kindly; and such constitutional symptoms as arise, are to be moderated as in other amputations.

I by no means intend to assert, that the anastomosing branches of arteries are not equal to carry on the circulation in the extremities in every instance, where the main artery has been wounded: for I know the contrary; indeed, in the upper extremity it will almost invariably be effected; but in the lower, where there has been no previous disease, and the femoral or popliteal artery be divided by a musket-ball, the anastomosing branches cannot always carry on the circulation, and sphacelus will affect the toes. I think I have seen it cease with a part of the ball of the great toe, in an unsuccessful case of femoral artery tied after a gun-shot wound; and I have seen it in other cases destroy the patient. If the vein accompanying the artery be injured, I believe mortification of the extremity to be inevitable; and in gun-shot wounds there is frequently more or less injury of the vein, as well as of the artery.

In cases of wounds from cannon or grape shot, the effects of the injury cannot be so well observed, from the practice of immediate amputation. In doubtful cases, or wounds from shells or grape shot, where there is a hope of saving the limb, gangrene is more frequent; but then it is attributed to the effect of the general injury, rather than to the division of the vessels, and the defective state of the circulation. The nature of the gangrene to which I particularly allude, is always pointed out by its commencing below the wound; for example, if with a wound near the elbow, the hand first becomes gangrenous, or even at the same time as the wound, with little inflammation in the vicinity, the trunk of the brachial, or the radial and ulnar arteries have been divided. If the foot and leg become gangrenous, where the wound has been in the leg by a grape shot passing through the tibia; or, with a wound of the ham or thigh, the principal artery or arteries have been wounded, and in all probability the great vein has been injured. A wound of the *tibialis antica*, or *postica*, singly, will not cause it, as either vessel is sufficient to support the limb, even if the fibular artery be also injured.

M. Larrey, in his memoirs of military surgery, endeavours to prove a marked difference between gangrene arising from external violence, and internal causes; of which there can be no doubt in many instances; and on this he founds a practice of amputating in all cases of gangrene or *sphacelus*

from gun-shot wounds, as soon as the gangrene shall have proceeded so far, that the limb must be lost even if it were likely to stop spontaneously.

As a general rule, placed in opposition to that of never amputating in cases of gun-shot wounds, until a line of separation between the dead and living parts is distinctly marked, I think it the best, although admitting of exceptions; and principally, where the gangrene does not come on quickly, from want of power in the parts arising from deficient nourishment; but, where the inflammatory action has been high, has included the neighbouring parts to some distance, has continued some days, and gangrene appears to have occurred in consequence of this excess of action; or, when it occurs in a constitution debilitated and injured by hard drinking; or long residence in a tropical climate; and in these cases, where there is much constitutional affection, amputation would not be so advantageous as awaiting the line of separation. The operation must be performed on parts partaking of the inflammatory disposition; it is done whilst the constitution is in a state of great irritability, and the operation would act as an additional stimulus to increase it. Where gangrene, however, is rapidly extending towards the trunk of the body, without any hope of its cessation, the operation is to be tried; for it has certainly succeeded where death would, in a few hours, have ensued. Under these circumstances, the nature of the operation,

and the reason for operating, should be clearly understood by the friends of the patient before it is performed. I may add, that where the constitution was bad, I have always failed either in amputating on the approach of gangrene, in the hope of avoiding it, or when it had apparently ceased.

If a cannon or grape shot were, in hot climates, to destroy so effectually as to cause the death of the parts injured to some depth, and gangrene appeared to spread with little preceding inflammation on the third or fourth day ; and especially if this injury were near the trunk of the body, amputation would be advisable ; for I do believe it would rapidly extend, and the line of separation would never be formed, as I have seen in several cases of this kind, which terminated fatally in forty-eight hours after gangrene had commenced.

Military surgeons, in general, appear to me to have overlooked this difference of cause of gangrene, and therefore to have confounded the treatment. This kind arises from no previous defect of constitution in which the whole system must participate, it does not follow a long continued, or excessive action which the vitality of the part cannot sustain, and to the support of which contest the whole system has been, and is still contributing ; but, from the sudden abstraction of the blood of a part, on which it depends for its life, and in consequence of which, it dies nearly in the same manner, as the whole animal would do on the cessation of

the function of the heart. The part is cold, insensible, of a deadly white colour, and with no surrounding inflammation; but the patient soon complains of numbness, afterwards attended with pain, the skin becomes streaked and discoloured, and the living parts in the immediate vicinity are a little tumid. The general state of the patient at this period is but little affected, the pulse hardly accelerated, little heat of skin, thirst, want of appetite, or derangement of the sensorial functions. There is not that appearance of the countenance which attends mortification of a part of the body from constitutional causes. This state continues for three, four, or more days; there is a struggle to support the limb: if the wound be in the middle of the thigh, the calf of the leg is as warm, probably a little warmer to the touch than the other, a little more swelling and redness bounds the gangrenous part, the patient becomes restless, the whole system is in fact affected, there is fever. In the course of a few hours, the limb swells to the calf, is very painful, tumid, yellowish, and streaked with bluish lines, the swelling almost visibly extends, it passes the knee, the patient expresses much anxiety, becomes delirious, and dies in a few hours. During the first few days, when there is no very evident sympathy of the constitution, I consider amputation will be successful, if performed where the vessels are wounded; and I recommend it to be done, as soon as the death of the toes and part of the foot

indicates the defect of the circulation. If this stage should have passed by, and the gangrene has suddenly began to extend, I would refer to the original wound; if it is above the knee, I would amputate instantly; for, although it may at this period be unsuccessful, the patient has a chance of living, which he will not have if it be neglected. If the gangrene should have already extended, as far as the wound in the leg or ham, without much constitutional affection, it will probably stop there, and the line of separation will be formed, which should be awaited; but the patient will have little chance of escaping.

Having lost all the cases of gangrene succeeding to wounds of arteries, and other cases of greater injury, in which it supervened on the third or fourth day without much previous inflammation; I began to think it an error to wait for the line of separation, when there appeared but little prospect of its formation. In two cases after the battle of Salamanca, in which I had reason to think the gangrene was of this kind, I amputated with success; a third died after amputation, but not of gangrene affecting the stump; and a fourth and fifth, which I left for the appearance of the line of separation, or the cessation of the gangrene, very soon died. This practice, in cases of severe injury, after gun-shot wounds, has succeeded in the hands of others, even in England.

My principal object here has been, to draw the

attention of military surgeons to the practice necessary when gangrene occurs after wounds of the large blood-vessels of a limb, and to the impropriety of delaying amputation in all such cases.

On Secondary Amputation.

Secondary amputations, or those performed from the third week, to any later period of the continuance of an injury, are by no means performed by military surgeons with such confidence of success, as those done on the field of battle; or, with such comparative success as the writings and opinions of surgeons in civil life, and the advocates for delayed operations seem to indicate. On the contrary, they are found to be attended with considerable danger, arising from a variety of causes, and to be followed frequently by greater evils than those performed on the field of battle.

This difference of success between the surgeons in domestic and military surgery, may perhaps arise in some degree from the nature of military service, which does not at all times admit of the same comforts and attendance as in private life; but the difference is still very remarkable, even amongst officers, who, with few exceptions, have every thing they require. In domestic surgery, amputation is very seldom performed, except in sound parts; in military surgery it is the reverse, and is seldom

done, except in parts that have suffered in some degree from inflammation ; and this is one of the many peculiarities attendant on gun-shot wounds, that renders the practice of military and domestic surgeons dissimilar.

When secondary amputation is performed in parts nearly in a healthy state, where the extent of injury has not been great, and the discharge moderate, although the irritation of the disease would destroy the patient if it were not removed ; when the constitution of the patient is naturally good, and every convenience is attainable during the cure ; it would, I believe, be accomplished nearly as successfully as when performed shortly after the injury ; but nothing would be gained in safety to compensate for the misery, the anxiety, and the danger attendant on delay.

Military surgeons meet with few cases of this kind ; for independent of those persons who die without operation, before they reach the proper secondary period of amputation, and those whose limbs are removed from necessity before this period ; a great part of the operations are performed in parts that have been lately affected by inflammation, or are even in a state of inflammation and disease. In these cases the cellular membrane is firmer and more compact than usual, the muscles are not perfectly healthy, the blood-vessels of the soft parts are considerably larger and more numerous, they sometimes take on actions unusual in a state of

health, and where the bone has been diseased much additional bony matter is often deposited in the muscles ; and in some cases, from the time of the operation until the death of the patient, a period of a very few days, I have found several of the ligatures completely surrounded and immovably fastened in bone. After a few hours remission, the constitutional irritation returns, and the increased size of the smaller blood-vessels renders secondary hæmorrhage much more frequent. The ligatures are a source of irritation, and prevent union, even if it were likely to take place ; and in the best of these cases, a conical stump is in general the result after much pain and anxiety.

After a great battle the wounded are usually collected in large hospitals. If these hospitals are not greatly thinned at the end of three or four weeks, no wounds do well, and the health of most of the men is affected by the air of the hospital ; a fact that is constantly demonstrated by the amendment of those who are able to travel to a new station or establishment. Amputations performed in an hospital of this kind seldom do well ; the febrile irritation remains after the operation, the wound suppurates, does not unite, the strength gradually decays, and the patient dies exhausted. The whole of this statement was exemplified in a very striking manner, in our hospitals, after the battle of Vittoria, properly so named ; and a second time after the battle of the Pyrenees, near Pam-

peluna, when the same hospitals were necessarily a second time filled with wounded, many of whom required the greater operations of amputation.

At other times, the wounds slough and hæmorrhages take place, demanding other operations; or, in many cases, destroying the patients where assistance could not be given in time, or surgical aid could not be of avail; as where the axillary artery has been tied repeatedly after the operation at the shoulder-joint. From such causes most of the unfortunate cases in the statement of operations at the shoulder-joint, from June to December 1813, terminated fatally.

If there be any disease endemic in the country at the season of the year, or time, a soldier undergoes a secondary operation; and he is so unfortunate as to acquire it; as in the Peninsula, where intermittents, bilious remittents, and dysenteries were endemic in autumn, the season for military movements; or, when contagious typhus fever is prevalent, as in the greater part of our hospitals after the retreat from Burgos; he will frequently sink under the united pressure of the disease, and the operation; whereas, the soldier who has had his limb taken off at the time of injury, has much greater powers of resistance in him, than the other who has been labouring three or four weeks under an incurable injury; and what is of more consequence, his stump is nearly healed before he becomes subject to disease, or is affected by the bad air of the hospital.

When an amputation is delayed from any cause, to the secondary period, a joint is most frequently lost ; for instance, if a leg be shattered four inches below the knee, it can frequently be taken off on the field of battle, and the joint saved. Three or four weeks afterwards, the joint will in all probability be so much concerned in the disease, that the operation must be performed in the thigh ; the same in regard to the fore-arm and hand, and the upper part of the arm with the shoulder-joint. The greater mischief resulting from this delay, is where the injury is about the middle of the thigh ; for amputation on the field, near to the seat of injury, is performed with a fair prospect of success ; but, at a later period, it must be done at the little trochanter, or at the hip joint, and the chance of success will be much diminished. This is a very important point for the consideration of military surgeons, in recommending delay in doubtful cases ; as well as the knowledge, that amputations in unsound parts are frequently fatal, and are always attended with danger.

In gun-shot wounds of the thigh, with fracture, there is little possibility of cutting into sound parts if it be high up, and yet hæmorrhage shall frequently require it to be done. Whilst waiting the proper period for amputation, in a case of fracture, I have seen both the femoral artery and vein opened into by ulceration, or by a projecting point of bone, inject the limb with blood, and render immediate amputation necessary ; which then will not in ge-

neral be successful. It must not also be overlooked, that these evils occur while the patient is waiting the proper time for amputation ; and that they would have been avoided, if it had been done in the first instance.

I have said, page 69, that secondary amputation in favourable cases, is nearly as successful as primary ; that is, the wound would heal as soon, but the difference of success in favour of the primary operation arises, from there being less danger of any local affection after it, than there is after a secondary operation.

After secondary amputations, where there has been a great discharge, amounting perhaps to near a pint of pus at each dressing, as in cases of compound fractures, wounds of the knee joint, &c. the constitutional affection a few hours after the operation, or perhaps in two or three days afterwards becomes severe ; there is considerable fever, and occasionally a sudden determination to particular parts, which very soon ends in death. As I have not seen this, after primary operations, I believe it to arise, from the system being unable to accommodate itself to the sudden change so well, as when the person was in a state of health : for although the continuance of the discharge would very soon have destroyed the patient, still he is not able to bear the sudden change on the removal of the limb ; because, the quantity of blood sent to it for the formation of pus and the natural supply of the limb,

was much greater in proportion to the quantity in circulation, than in a state of health.

In adopting this opinion of the adversaries of operations performed on the field of battle, I apply it in opposition to the manner in which they intended it; and it is probable they will think, that if it was not valid in the one case, it is not in the other; and this may be true, but I leave them to account for it, while I relate a fact well known to every military surgeon of experience. That forty-eight hours after amputation above the knee in two cases, one performed on the field of battle, the other at the end of three or four weeks, in which there had been great discharge, and both dressed in the same way with the view of procuring union; he would have much more anxiety for the secondary, than the primary operation, and it would require a much more attentive general treatment.

In the particular cases to which I allude, the febrile irritation returns some time after the operation, instead of gradually abating; and after a continuance of a few days, or in some hours, cuts off the patient by an affection of some particular part. If it be the lungs, and they are most usually affected, the breathing becomes uneasy, there is little pain when the disease is compared with Pneumonia or Pleuritis, the cough is dry and not very troublesome, the pulse having previously been frequent there is but little alteration, the attention of the surgeon is not sufficiently drawn by the symptoms to the state

of this organ, and in a very short time all the symptoms are deteriorated ; blisters are employed, perhaps bloodletting, but generally in vain ; and the patient dies in a few hours as in the last stage of inflammation of the lungs, in which effusion or suppuration has taken place.

The first cases I saw of this kind, I believed to arise from the action of external causes after the operation ; but I now believe it to depend upon a determination to, or irritation in, a particular part, in consequence of the operation, and I conceive the viscera in each person most predisposed to disease, will be the most likely to be affected.

When the inflammation attacks the lungs, the approaches of it are more insidious, the soldier does not suffer sufficient to make him apply for particular assistance, as he labours under fever ; and when the disease has advanced to that point that the attention is especially drawn to it, the time for assistance is past, and the disease shortly proves fatal ; in some instances apparently by suffocation. The lungs on dissection are found full of blood, and firmer than usual, occasionally pus is formed in them, or there is effusion into the air cells, and into the cavity of the chest.

This sudden and insidious attack of disease, has been observed by several officers during the Peninsular war ; and I am certain that many cases are lost without much particular observation ; for in those that have been noticed, the disease appeared

to have existed for so short a time, as almost to have excluded the suspicion of its being the cause of death, and yet there has been pus found in the lungs, and in the cavity of the chest. My own attention was drawn to it after losing several cases in this way as a circumstance of more than common accident, from its having happened in a young man to whom I was paying considerable attention; since that, I have had one well marked case at Santander, of a sudden and fatal affection of the lungs after amputation of the thigh, under the immediate care of Dr. Irwin, Physician to the Forces; and Sir James Mc Grigor, did me the favour to transmit me the account of a case of the same kind, that occurred to Mr. Rose, of the Guards, after amputation of the arm.

My friend, Mr. Boutflower, Surgeon to the Forces, whose experience, during the Peninsular war, was very great, has informed me, that in consequence of losing several amputations, without any satisfactory assignable cause, he was induced to attend particularly to the examination of their bodies after death: and in two cases of this kind, which terminated fatally at Fuenterabia, after amputation of the upper extremity, he found a considerable quantity of pus in the cavity of the thorax, and other general marks of inflammation. In these two cases, so insidious was the approach of this disease, that except a difficulty of breathing, which supervened a few hours before death, there were no symptoms indicating the existence of such morbid affection.

In both, there was much febrile irritation with occasional and severe rigors, but the entire absence of pain led to the belief, that these were referable to the formation of matter in, or about the stump. In consequence of this unexpected occurrence, Mr. Boutflower made it a practice to bleed in every subsequent case, where there was any undue febrile irritation, and with the happiest effect.

When the viscus affected, is not so immediately concerned in supporting life as the lungs, I do not believe the termination is so rapid; it runs into suppuration, and abscesses are formed, which are generally supposed to arise from the commotion and shock given to the different organs, at the moment of injury. I have not seen the heart affected with inflammation in the same manner, but I suspect it is likely to occur in soldiers who have been hard drinkers; for in them I have frequently seen it after an attack of inflammatory fever destroy the patient, when there was no suspicion of its being the organ originally affected.

I know that inflammation taking place in one part of the body, when the injury has been received in another, has been often noticed; and that this also happens in gun-shot wounds, there can be no doubt, but it is by no means a common occurrence. M. Larrey, in his first volume, page 306, gives a case after primary amputation, in a general officer, who was wounded at the siege of Acre by a musket ball, which passed through the elbow joint, destroying

the articulating surfaces, and doing so much mischief as to render amputation necessary, which was immediately performed. The shock of the blow and the fall of this officer, which were simultaneous, causing considerable disorder in the limb, and in the viscera of the thorax and abdomen. He appeared to be doing extremely well, until the thirteenth day, when he was attacked by all the symptoms of a nervous fever, with exacerbations, which were most likely caused by the chilliness and dampness of the nights, the unhealthiness of the camp, and other causes foreign to the operation. The stump was in a good state, and had nearly healed, but there was no discharge from it. The febrile symptoms, however, rapidly increased, and on the nineteenth day he died. On opening the body, an abscess was found in the liver, and another in the lungs, with effusion in the chest. In this case M. Larrey thinks the predisposition for the internal disease was caused by the commotion which took place at the time of the injury, and from the bilious idiosyncrasy of the patient.

I conceive the following case to be an instance of it in the thyroid gland. A soldier had his thigh amputated five weeks after the injury, a compound fracture of the thigh, when, in a very reduced state, the discharge having been profuse, the pain great, and the hectic fever severe. He sunk a good deal after the operation, the stomach became very irritable, and small doses of brandy and water could

alone be retained, the pulse being small and frequent, the countenance pallid and contracted. Nearly in this state, the third day after the operation, the stomach being more quiet, and the stump easy, he complained of difficulty in swallowing, and a little pain in the situation of the thyroid gland, which the next morning was found to be swelled and inflamed. The linimentum ammoniæ was used to the sides of the throat, and subsequently blisters, gentle diaphoretics were given internally, his bowels kept open by the oleum ricini, and his throat cleared with the common acid gargle, although little or no inflammation was apparent; his diet was of milk and beef tea, the prostration of strength being very great. On the third day after the affection of the throat, the difficulty in deglutition increased, accompanied by some obstruction in respiration, and on the morning of the fourth he died, seven days after the operation, and in a state of great emaciation. On dissection, the whole substance of the thyroid gland was destroyed, and good pus deposited in its place, which descended by the sides of the trachea and œsophagus to the sternum, and had all but found its way into the larynx, between the cricoid and thyroid cartilages on the right side. The surrounding parts were but slightly injured, and could be readily dissected.

The following instance will shew a deposition of pus with little or no attendant inflammation, and is

a good case, as fairly illustrating the manner in which one half of the fatal cases of secondary amputation die, when there is any particular irritation in the stump.

Daniel Lynch, 36th Regiment, was admitted into the Calvete General Hospital, April 12th, 1814, in consequence of a gun-shot wound penetrating the knee joint, received on the 10th of April, in the action before Toulouse.

Notwithstanding frequent general and local bleeding, and the strictest antiphlogistic regimen, with the application of cold to the part, high inflammation of the joint ensued. On the 8th of May the limb was removed; his health before the operation was not good, being constantly under the influence of irritative fever, and his strength very much reduced by it, and the profuse discharge. The night succeeding the operation he passed comfortably; on the 9th, his febrile symptoms increased; his bowels being in a state of torpor, small doses of the sulphate of magnesia, with infusion of senna, were administered, which succeeded in procuring several bilious evacuations; a saline anodyne draught was given him at night. On the morning of the 10th, he was considerably worse; pulse 150, skin hot, tongue parched, with excessive thirst, stomach irritable; he was ordered a saline draught in a state of effervescence every three hours, and was also directed to be frequently sponged with vinegar and water; this treatment was steadily

pursued during the day and succeeding night. On the 11th, he was evidently better, and continued gradually to amend; on the 16th he was considered in a state of convalescence, and remained apparently going on well until the 22d, when he was again seized with symptoms of fever, which, however, continued mild until the 26th. On that day his stomach again became irritable; the irritability was overcome by the repetition of the effervescent draughts; at this time the stump was nearly healed throughout its whole extent, but only two of the ligatures had as yet come away; the discharge small in quantity, but of a good quality. On the 30th he had had no return of the vomiting, but his pulse had arisen from 100 to 110, and his tongue had assumed a brownish hue; a saline draught was ordered, and he was directed to be sponged with tepid vinegar and water. On the 31st appears to sink, has been dozing all night, and unless spoken to, does not ask for drink as usual; at this day's dressing all the ligatures but one came away. *Applicetur vesicatorium nuchæ statim. Capiat cochleare magnum misturæ sequentis tertiâ quâque horâ. R. Misturæ Camphoræ ʒviij. Ætheris Sulph. ʒss. Misce.* June 1st, continues to get worse, tongue dark, low muttering delirium. *Vinum rubrum ad libitum. Decoct. Cinchon. cum Acido Sulph. tertiâ quâque horâ.* Died at midnight.

This man, as well as the former, was in charge of Mr. Boutflower, from whom I had the preceding

account; the body I examined. The stump appeared externally to have united, except where the ligature came out; on cutting through the line of adherence, which consisted only of the common integuments, the face of the muscles was discovered of an unhealthy sloughy appearance; the bone for about three inches was surrounded by a case of osseous matter, diffused widely among the contiguous muscles, and including the remaining ligature, which could not be removed by any force not breaking it; the femur, for the space in which it was enclosed, was bare, and shewed marked signs of absorption.

Having dissected the left extremity for other purposes, which appeared perfectly sound, and of which he had never complained, for considerable attention was paid to him, I found, on raising the soleus muscle, a membranous bag, containing a fluid in the course of the tibialis posterior muscle, and close to the interosseous ligament. I punctured this shining semi-transparent bag, which appeared to be the fascia running across, and let out between three and four ounces of good, thick, yellow, inoffensive pus. The blood in the peroneal vein, which was close to the outside of the sac, was coagulated, or rather, a coagulum had formed in it prior to death: there was no perceptible cause of injury, and little or no marks of inflammation; it would indeed give the idea of having been deposited without any. The inner side of the soleus seemed sim-

ply discoloured where it covered the bag; the outside, and the integuments were quite in a natural state.

I am disposed to think this matter was secreted, or deposited after the amputation, which was performed high up in the thigh, yet the bone was affected by necrosis, and three inches of it, at least, must have come away if the man had lived.

I am not aware that this sudden and insidious attack of disease has been noticed hitherto as a disadvantage attending in particular, secondary operations, and in thus mentioning it, I am desirous of drawing the attention of military surgeons to it, and of gaining further information on the subject; for, as I have already stated, I have reason to believe many cases are lost in this way, without the cause of death being ascertained by dissection.

On the Operation of Amputation.

There is a great difference in the manner of performing primary and secondary operations in military surgery, arising from the parts divided being in the one case sound, in the other frequently the reverse. There is no less difference in the method of cure; the one is to be expected in great part by adhesion, the other where the parts are not sound, seldom but by suppuration and granulation; and the attempt to alter this course of nature by

the interference of surgical art, is always very painful, is often the cause of much mischief, and frequently of death.

In primary amputations, or in the natural state of parts, the loose attachment of the cellular membrane to the fascia, and to the muscles beneath, permits of much retractile power in the integuments; and when the first incision is made through the fascia, they retract considerably; and this is powerfully assisted by an assistant grasping the limb with both hands previous to the incision being made, and pulling the integuments as much upwards as possible, which puts the skin to be divided on the stretch, and renders its division more easy to the surgeon, and less painful to the patient, especially if the limb be again firmly grasped below, and the integuments made tense downwards. So much of the integuments will be saved in consequence of this retraction, that it will not be necessary to dissect them back with the fingers and scalpel, as recommended in many surgical works; it will be sufficient to touch the thread of membrane or fascia adhering below with the point of the same knife, to give ample covering for an excellent stump, without putting the patient to the torture of having his skin pinched, and dissected back for the space of a couple of inches, for four or five minutes; which I have often seen occur in the first operations of gentlemen entering into the service. Bromfield and Allanson inveigh against

this practice, and military surgeons during the last war, proved it to be so unnecessary, that it is now acknowledged in general to be so, by those who formerly recommended it; but in the adoption of it, they do not all seem to be aware, that the fascia and integuments should be divided by the same incision, when the whole will retract much further than the skin and cellular membrane could do, if the fascia remained to be divided by the second incision.

In operations performed from the third to the twelfth day, in parts at a little distance from the injury, this retraction will not take place sufficiently, either naturally, or by the force of an assistant, from the quantity of coagulable lymph thrown out; it will in these cases be necessary to turn a little of it back, and to separate it to a greater distance from the parts beneath, without however turning it back, as usually recommended like the top of a glove. It will also be frequently necessary to dissect away with the point of the knife some of the jelly-like substance that fills the cellular membrane underneath, if union be desired.

In secondary amputations, (with the exception of those in which the operation is required in parts actually unsound) the integuments will retract sufficiently by the means proposed; the lymph thrown out during the active inflammation having been absorbed, and the integuments being more in their natural state.

It is usually allowed by military surgeons, that the appearance of the stump, when the bone is sawed through, should be that of a broad cone inverted, the bone forming the apex, and a little depressed. To effect this, the muscles must be cut through at unequal lengths, to allow of the greater retraction of those not attached to the bone. I consider this may be duly accomplished, in general, by two circular incisions even in the thigh; one dividing the loose muscles running to be inserted in the bones below, with such part of those attached to the bone as cannot be avoided: the other, those having their attachment at the place of division. If the first incision leave any of the long muscles undivided, they may be completely cut through by a touch of the knife, and those that cannot retract are to be divided close to the edges of those that are retracted, by the next circular incision, which should be if possible, down to the bone. In cutting the muscles by these incisions, the edge of the knife should be inclined upwards, so that it may make an incision slanting inwards, instead of directly down to the bone. If the bone were to be now sawed off, it would not be well covered by the muscles; neither would it form a cone with the apex depressed or elongated: it is necessary therefore to dissect back the muscles adhering to it for the space of two or three inches, as the size of the limb or other circumstances may require; and in doing this a large scalpel will be the most useful.

In secondary operations, it is necessary to leave more muscle than in primary ones, or in other words, to cut the bone shorter; for the muscles on the under-part, if in the thigh, will retract and diminish much more than is frequently supposed, so much indeed, as to induce some surgeons to cut through them first by a semicircular incision, and allow for their retraction on dividing the others afterwards; but this I do not consider necessary.

In secondary amputations, where there has been much suppuration in the limb, a sinus may run up, and a stream of matter follow the knife. In these cases, if the sinus extend only a short way between the muscles, the membrane lining it may be dissected out: but if the matter has lain upon the bone, it will have become diseased; necrosis, and a train of constitutional symptoms will be the consequence, frequently terminating in death.

In such cases, the amputation should be immediately begun higher up, at such distance as will include the diseased portion of bone; and in the arm removing it even at the joint of the shoulder, will be better than suffering necrosis of the stump above the insertion of the deltoid muscle.

The muscles, in either state of operation, having been divided and separated from the bone or bones as far as may be deemed necessary, so that they may cover them with the greatest ease, and adhere to them, forming a cushion for their defence when subsequently brought forwards, are to be kept back

at the proper place for the division of the bones, by a retractor of linen or leather, or any instrument that will allow the free motion of the saw without injuring the muscles. Where there has been much inflammation, or the limb is very large, there is some little difficulty in effecting this, and instruments have been invented to close on the bone, and push the integuments back. In the numerous amputations I have performed, I never found any difficulty not easily surmounted by the linen retractor in common use, aided by the hands of an assistant; and as it admits of pressure or retraction being made on any part desired, without much pain to the patient, or injury to the muscles, I prefer it to any thing I have yet seen for the purpose.

Before the bones are sawed, the periosteum should be cut through, without scraping it either upwards or downwards, as this practice is not only unnecessary but detrimental; for when a portion of the bone is scraped, the saw is frequently placed in the middle, and the bone above thus denuded of its natural covering exfoliates, causing at best a tedious cure, and a bad stump.

If the saw be applied to the edge of the periosteum above, there is no necessity to scrape it below, as it is going to be removed; indeed I have often sawed through the bone without previously touching the periosteum, and the stumps have been as soon healed, and with as little inconvenience as any others.

In sawing bones, a saw is to be selected of a

large size, that cuts with both edges, backwards and forwards, which expedites the operation, and what is of more consequence, helps to prevent splintering when the bone is nearly divided; as the forward motion is more forcible than the backward, with which the operation generally terminates when the saw will cut in both directions. The saw should be as thick, or thicker, at its edge than in the blade, or it will be confined in its own track. The limb, above and below, should be held steady, and perfectly horizontal. The saw should be used, not with short strokes backwards and forwards, but with a long and steady motion nearly its whole length, placing the heel first on the bone, and drawing it towards you. The point should incline downwards, and when the bone is two-thirds divided, the saw should gradually be used more lightly, so as to cut the last portion without splintering; which will also in a great measure be prevented, by the assistants holding the limb steadily, and rather a little raised, so as to take its weight off the bone, and yet not impede the motion of the saw, which should now be inclined downwards nearly to a perpendicular; whereby the under part of the bone is cut through, and the side next the operator reserved to the last.

The arteries of a limb are next to be tied with round ligatures made of waxed silk, two threads being sufficient for the large arteries, and one for the smaller ones, or three threads for the femoral

artery at the groin ; not that the action of the vessel would burst the ligature, but the force generally employed in drawing it on so large a vessel, will weaken it very much, if it be not sufficiently strong. The great object of the ligature is to retain the sides of the artery as nearly as possible in apposition ; it should therefore be pulled out by a tenaculum that will readily pierce its coats ; on the tenaculum the ligature is to be carried noosed, and when the artery is separated from its accompanying vein, nerve, and cellular membrane, the noose is to be put over it and firmly tied ; a second knot being made for security on the principal arteries, and a double noose or surgeon's knot, made by putting the thread round the first knot a second time, for the smaller arteries. The nerve is always to be separated from the artery by the scalpel, if it cannot be done by easier means.

In primary amputations there are in general but few arteries that require the ligature ; in secondary amputations there will be twice or thrice as many, making a difference in the period of time required for the operation, that is occasionally distressing ; and I have seen it fatal.

The principal artery of a limb can in most cases be readily distinguished and secured, without slackening the tourniquet, or raising the compress, where there is no tourniquet applied ; it will be known by its round open mouth, containing florid blood ; if the artery should have retracted within its sheath

of cellular membrane, so that this open mouth and the firm white coats of the vessel cannot be distinctly seen, as it is transfixed by the tenaculum, the sheath must be separated, or slit up, so as fairly to expose the artery before it is tied. The face of the stump is to be cleansed with a warm dry sponge, and the compression raised, provided no more vessels can be seen. Other arteries now shew themselves; one is selected, compression is again made, and so on, until the whole is secured. When only three or four small ones remain, it is better to remove or entirely loosen the tourniquet; for, as Bromfield has observed, the repeated tightening and loosening of the tourniquet will cause a number of small vessels to bleed, which, if it were removed, would contract, and not require the ligature. Any bleeding that ensues can be stopped by the points of the fingers on the vessels, until it be convenient to tie them.

Sometimes, after the principal artery of a limb has been secured, hæmorrhage shall continue from its sides above the ligature, arising in general from small branches which have been cut shorter, or have retracted more unequally than the principal trunk. Instead of puzzling at this for ten minutes, screwing and unscrewing the tourniquet, and at last diving with a needle, and laying the foundation for a secondary hæmorrhage by pricking the artery; let it be transfixed and pulled out by the tenaculum, and separated a little with the scalpel from its

connexions as high as these troublesome openings; when a ligature is to be put upon it, and the end of the artery cut off with the scissars: and I never saw this ligature pushed off a large artery when properly tied. This inconvenience is in general avoided by the division of the muscles; the operator taking care to divide the principal artery at one stroke of the knife, and with it half an inch at least of surrounding substance on each side, when these small vessels will give little trouble.

When the tourniquet is applied close to the place of amputation, the muscles and blood-vessels contract within the limits of the action of the band of the instrument, and while it remains tight the principal artery cannot be discovered; occasionally, not even when it is loosened; here, it is necessary to take it off altogether, for it presses upon the mouth of the vessel, or rather it presses the ends of the muscles against it, and very little compression upon the orifice of a large artery, such as the axillary, is sufficient to prevent its bleeding. It is in this way that the principal artery has not been found after amputation, of which I have seen several instances, and which have given rise to very serious hæmorrhages.

When there is bleeding from any particular part, both venous and arterial, in larger quantity than can with propriety be overlooked, the part ought to be pressed upon by the points of the fingers one on each side; or rather separated, and a small piece of dry sponge used to absorb the blood, when the

vessel will be found retracted within the muscular fibres surrounding it, which prevent the flowing of the blood per saltum; if this fail, a slight touch with the scalpel will shew the vessel, and save much unnecessary delay. I have seen the arteries of a stump occupy a person a quarter of an hour, and were not even then properly secured.

As each ligature is tied, one end should be cut away close to the knot, by which means they are prevented from acting in so great a degree as setons. The stump should lastly be sponged with cold water, which will generally restrain any oozing that may occur. The only two cases of hæmorrhage after amputation, that I recollect ever to have happened to myself, were in consequence of neglecting this precaution; one in a Frenchman after the battle of Albuera, the other after the battle of Toulouse. In the latter there was no oozing or bleeding whatever from the stump when it was closed, but two arteries soon shewed themselves, and bled so profusely as to require the ligature shortly afterwards. In neither instance did it affect the goodness of the stump, and I am disinclined to believe, where the operation has been otherwise well performed, that it will be a sufficient cause for the protrusion of the bone.

Some military surgeons, both French and British, have lately adopted the practice of cutting off both ends of the ligatures, close to the knot on the artery;

uniting the parts, if possible, over them, and allowing the knots to find their way out as they can. The edges of the wound, in some instances, have united thoroughly in a few days, and when the knots have come off the ends of the arteries, they have caused small abscesses to be formed, which point at the nearest external surface, and are discharged with little uneasiness. I know that many cases, treated in this manner, in the campaign of 1813, ended successfully, and healed in as short a time as the most favourable ones by the usual method; and at Montpellier, in June 1814, Mons. Delpech, Professor of Surgery in that University, shewed me at least twenty cases, in which he had, and was still practising this method with success. I have seen, however, in two or three instances, some ill-looking abscesses formed by them, and I suspect some disagreeable consequences will occasionally ensue, if this practice be continued.

I consider this improvement as very valuable, in all cases that will not unite by the first intention. The ligatures, if there be many, form into ropes, are the cause of much irritation, and are frequently pulled away with the dressings; by cutting them off these evils are avoided, and the knots will come away with the discharge. It is adopting the practice, in a view diametrically opposite to that of its advocates, but it will be found very advantageous in all cases of operations performed in un-

sound parts, or in irritable, or bad constitutions, where union will not take place, or only in a slight degree.

After the opinion of the propriety of closing a stump by adhesive plasters, with the view of obtaining union by the first intention, has been so long received in England as to become almost a law in surgery, it may appear presumption to doubt its correctness; there are cases, however, and many cases in military surgery, in which I am confident it does harm; and this circumstance forms another important point in the consideration of primary and secondary amputations.

In the hospitals in England, amputation is seldom attempted but in sound parts; in military hospitals it is often absolutely necessary to perform it in unsound parts. Surgeons in civil life always therefore endeavour, and successfully, to promote union by the first intention; and in this practice they have been followed by military surgeons in general, without due regard being paid to the difference of circumstances. M. Larrey and a number of the French military surgeons, having found the operation fail when they closed their stumps, and much mischief or even death ensue, when the compression of the adhesive straps was considerable, have run into the other extreme, and direct that in no case, should this adhesion or union by the first intention be attempted. M. Larrey says, page 379, Vol. III. "I do not unite the wound by the first intention. I

have shewn the inconvenience of this method in several parts of this work. I shall, therefore, refrain from repeating them again. I confine myself to bringing forwards the edges, so as to make them approach each other with a piece of linen which surrounds the whole of the wound, having small holes cut in it for the easier passage of the discharge, and supporting them by compresses applied round the stump." At page 481, of Vol. II., after giving directions how to perform the operation, he says, "All that is required to keep the edges forwards, and near each other, is a circular bandage moderately tight, and a piece of linen having a number of eyelet holes cut into it, which covers the wound; a little charpie is to be laid above this, and retained in its place by the compresses in the form of a cross. The dressing is completed by a roller of sufficient length to regulate the action of the muscles, and prevent their retraction, without passing over the face of the stump."

This differs but little from Mr. O'Halloran's method of dressing his flaps until suppuration is established, and then uniting them. In primary cases, it is certainly an unnecessary delay to the cure, as well as exposing the patient in many instances where great attention cannot be paid, to retraction of the muscles, exfoliations of the bone, and all the evils that formerly attended this operation. It is unnecessary, however, to dwell upon this point in cases of primary operation in sound parts;

the advantages of procuring union of the stump in them are too well known to require discussion; and with all the respect I entertain for M. Larrey's opinions and experience, I cannot help thinking he has fallen into error, from not sufficiently discriminating between primary and secondary operations; or rather, between those performed in sound and unsound parts. No man can possess more facility in operative surgery than M. Larrey, and I conceive he must have met with the same successful results as the British military surgeons, if he could have been induced to employ the same means of cure.

In unsound parts, union by the first intention will not take place, their vital powers are frequently weak, and unequal to carry on any high action, or support themselves under it. When parts thus situated are brought down in close contact by adhesive plasters, the patient is for the first twenty-four or forty-eight hours easier, he then becomes restless, irritable, the stump swells, the constriction of the plasters brings on inflammation, more evident however by the tumefaction than the redness of the parts. There is constant fever; a gradual prostration of strength, and the patient at the end of two or three weeks dies exhausted.

In other cases of secondary amputation, where the operation has been performed in parts apparently sound, and the wound has been brought into close contact, the symptomatic fever shall soon return



with violence, and continue ; the integuments shall unite, there shall be little or no external swelling or inflammation, and all will appear to do well in the wound, yet the constitutional irritation shall increase rather than diminish, the skin become permanently hot, the pulse very quick, with a gradual deterioration of all the symptoms usually attendant on irritative fever, under which the patient at the end of ten or fourteen days is carried off. On examining stumps of this kind after death, I have invariably found, that although the integuments had united, and the line of incision had nearly cicatrized, or had in great part completely done so, that the muscles beneath were far from being in that situation ; and that in many instances, they were in a sloughing or diseased state, which affected two or three different parts where the continuance of disease had not caused the ulcerations to communicate. The ends of the great vessels have not always been included in the diseased parts, and have appeared perfectly healthy ; at other times, sinuses have run up between the muscles and by the sides of the vessels, and I have seen them engaged in the disease, and containing pus. I have in three cases, and I know of a fourth, found the femoral artery, lying quite open on the face of a stump of this kind, without any apparent obstacle to the free passage of blood through it, and yet no hæmorrhage took place ; which I cannot satisfactorily account for, having never seen the femoral artery lying open in

any other wounds in which life had been preserved, without hæmorrhage occurring.*

In the most favourable state of the stump the diseased parts do not extend very deep, yet the thickening of the cellular membrane composing the sheaths of the vessels, is often considerable, and the disease is frequently communicated along the vein, which is found to contain pus even as far as the vena cava; inducing some gentlemen to suppose that the whole complaint arises from inflammation and suppuration of the great vein; and the knowledge of the same mischief occurring when the vena saphena has been tied, on account of varicose veins of the leg, has not a little contributed to support the opinion. When I have met with this appearance, I have always considered the vessels as participating in the disease, which had existed some days, and thereby more quickly destroying the patient. I did not, therefore, attend to this point of pathology, with all the correctness it deserved, and cannot give a decided opinion on the subject, although I have examined very many stumps that had terminated fatally; but having found in all of those that died, that there was ulceration or even sloughing in several places, or for a great part of the muscular surface of the stump under the united integuments; and having found on the other hand in those that recovered, that the

* See Dr. Thompson's Lectures on Inflammation, page 556.

stump always opened out, and shewed a diseased surface, which afterwards granulated and healed from the bottom, I was induced to believe, and I confess I still think, the complaint commences on the face of the stump, and is the cause of irritation, which sooner or later may be communicated to the vessels, when the fate of the patient is more quickly decided.

Whatever may be the original seat of the complaint, I never saw a fatal case in which there was not ulceration or sloughing of the internal part of the stump; and I am not conscious, I have ever seen one that appeared to suffer in this way and recover, in which the adhesion of the integuments did not in part, or totally separate, and in which the antiphlogistic regimen was not strictly enforced. In cases of this kind, bloodletting from the arm to considerable extent, not taking away a few ounces every other day, but sixteen, or twenty, or even thirty ounces, three or four times in the course of the first three days of the complaint, spoon diet, and opening medicines, will be of essential service in reducing the fever; but what I think is of equal service with any thing else, is the removal of the straps of adhesive plaster, and of all compression on the stump, the end of which should be laid in a warm poultice, and suppuration, and separation of the adhesion of the integuments, if any have taken place, promoted. Diaphoretics determining to the bowels and skin, as the antimonium tartarizatum in divided doses are very useful. Under

this treatment I have seen several recover who under less decided measures would most probably have died. I believe the advantages of bloodletting to a greater extent than was formerly practised, in many cases of secondary amputation, are admitted by all military surgeons who have had much experience, and whether the disease begins in the vein, or the stump, I believe the means recommended will be found highly useful.

Whenever there is irritative fever with a stump partially closed, and discharging a little matter on pressure, I consider it in general indicative of disease going on beneath; and that if the state of the patient should not immediately demand venesection, it still requires the separation of the union of the integuments, and the dressing of the wound from the bottom, which may prevent further mischief.

A soldier submitted to amputation of the thigh, on account of a wound of the knee-joint, at the end of five weeks suffering, on the condition that I would perform the operation myself; to this I consented; the man bore it very well, and appeared to improve for two or three days, when his fever returned, his appetite gradually failed, and he became weaker; the stump in the mean time looked well, covered completely, and, by the fourteenth day, the integuments had united over the bone and the surface of the stump, except in one small space, from whence a little matter could be squeezed on pressure. He died at this period, completely ex-

hausted by the constant state of febrile irritation. I found the stump underneath the integuments unsound, and from the experience I have since had, I think the man would have had a better chance of recovering, if the integuments had been separated, the stump laid in a poultice for a day or two, and then dressed from the bottom. This state of stump is another of the disadvantages more particularly attending secondary operations, as it does not follow those performed on the field of battle in an equal proportion.

Frequently, however, the disease in unsound parts does not go on so slowly; the stump becomes so swelled and painful that it cannot be brought together after the first dressing; and if it be attempted, as is frequently done, by force, the most serious uneasiness ensues, the stump sloughs, the ligatures come away on the fifth or sixth day, the discharge is enormous; and as the powers of the part are weak, and unable to support the action caused in them by the operation, and by the subsequent pressure attending the attempted union, gangrene rapidly approaches, and destroys the patient. In several cases of the thigh under these circumstances, it has appeared to have proceeded no further than coagulating the blood in the vessels of the stump, when the patient has died.

In all these cases, and many must have occurred to every military surgeon, the adhesive plasters are at last removed, and fomentations and poultices ap-

plied to the stump; but the mischief has proceeded so far in general, that it cannot be arrested, and the patient dies. The stump, when the poultice is applied, or when the straps of plaster are removed, is in a state further from healing, even if the mischief be stopped, than it would have been at first after the amputation was performed, if union had not been attempted. The process of cure in both must be alike, and equally subject to the evils resulting from the suppuration of the stump; it is certainly then better to adopt that practice at first, which must often, of necessity be followed, when the parts are in a much worse state, the constitution more irritable, and the prospect of success less encouraging. It was in this way, that all the amputations after gangrene, that I have seen prove fatal, have terminated; death taking place before the stump was in the complete state of sphacelus.

Another and very serious evil frequently resulting from the improper attempt at procuring union, is necrosis of the bone to some extent; for, whenever the soft parts of the stump become diseased in the manner I have represented, the bone very soon participates in it, and a very tedious cure is the consequence.

From the consideration of all these circumstances, I am induced, in amputations performed from necessity in parts not in a healthy state, or rather, in a diseased state, as in most secondary amputations after compound fracture of the thigh,

where the parts are unsound, not to insist upon the edges of the wound being brought into close contact by sticking plaster, compress, and bandage. The bone is to be sawed an inch shorter than usual, or than would be necessary in amputation under other circumstances, in order to prevent its protrusion; the ligatures should also be cut off close to the knot, by which much irritation will be avoided; the integuments and muscles are to be brought forward in the usual manner, and retained by the roller put on moderately tight, but not laid down in contact over the bone; some fine lint smeared with cerate or oil is to be put between the edges of the wound; a piece of linen and a Malta cross over it, and a few light turns of the roller finishes the dressing. In some cases I have put one, and even two straps of plaster over the stump, to keep the edges approximated without being in contact; and where the parts are but little diseased, this may be attempted; but, if the stump becomes uneasy, they should be cut, and a poultice applied. When only a part of the stump has appeared to slough, I have found the spiritus camphoræ alone, or diluted with a watery solution of opium applied with the lint, very useful.

In the irritable and sloughing state of stump that has been noticed, hæmorrhages frequently take place from the small branches, or from the main trunks of the arteries, in consequence of ulceration; and it is not always easy to discover the

bleeding vessel, or, when discovered, to secure it on the face of the stump; for as the ulcerative process has not ceased, and the end of the artery which is to be secured is not sound, no healthy action takes place; the ligature very soon cuts its way through, or is thrown off, and the hæmorrhage returns in as great a quantity as before; or some other branch is opened into, and another ligature is required, which is equally uncertain; and under this succession of ligatures and hæmorrhages, the patient dies. Surgeons have for some time, in such cases, preferred cutting down upon the principal artery of the limb, in preference to performing another amputation, even when it is practicable; and they have frequently succeeded in restraining the hæmorrhage for a sufficient length of time, to allow the stump to resume a more healthy action. This operation, although successful in many cases, will, under certain circumstances, fail, and amputation become ultimately necessary; but the same objection of want of success may be made to amputation; and, on a due comparison of the whole of the attending circumstances, I recommend the operation of tying the artery, in most cases, in the first instance; and if that prove unsuccessful, of resorting to amputation; but this practice is by no means to be followed indiscriminately. The artery is to be secured with reference to the mode of operating, as in aneurism; but the doctrines of this disease are not to be applied to it, because it is still a wounded

vessel with an external opening, which truth I have more than once seen proved to the discomfiture of the surgeon who relied upon them.

In the thigh, the operation is less certain than in the arm, and especially if it is not the main artery that bleeds; for the branch from which the hæmorrhage proceeds may come from the profunda, and tying the artery in the groin on such opinion, would be doing a serious operation, and one which would probably not succeed; for the anastomosing branches would restore the circulation in the stump in a short time, and again establish the bleeding. If it is the femoral artery that bleeds, and the ligature is applied high, it is very liable to a return of the hæmorrhage. To obviate these difficulties, the part from which the bleeding comes should be well studied, and the shortest distance from the stump carefully noted, at which, compression on the artery commands the bleeding; and at this spot the ligature should be applied, provided it is not within the sphere of the inflammation of the stump. In case the hæmorrhage should only be restrained by pressure above the origin of the profunda, and repeated attempts to secure the vessel on the surface of the stump had failed, I would prefer amputation, where the strength of the patient would bear it, to tying the artery in the groin, which I do not think would be successful; and the patient would be then in a less favorable state for amputation.

In a bad state of stump below the knee, attended with hæmorrhage, the artery, whether the anterior or posterior tibial, should be secured if possible, below the knee; and if this should not succeed, amputation should be performed above, in preference to tying the artery in the thigh, which most assuredly would fail. The popliteal artery may be taken up in these cases with much more ease and advantage than in aneurism, and may be tried when the stump is likely to do well, if the bleeding had ceased, but not otherwise. I am informed by my friend, Mr. Robb, Deputy Inspector of Hospitals, that staff-surgeon Berry, in a case of this kind, tied the popliteal artery with success.

In a bad stump below the elbow with hæmorrhage, amputation above the joint is to be preferred to tying the brachical artery; for as this would not be a certain operation, and the stump if it healed a bad one, always exposed to injury, the amputation would be most advantageous for the patient.

When hæmorrhage takes place after amputation at the shoulder joint, it is a most dangerous occurrence. The space between the end of the artery and the clavicle, below which only, the vessel has hitherto been tied with success is so small, and the operation of tying the artery at this point so difficult, that few have attempted it; and the patients have sunk under the hæmorrhages, when reiterated efforts to secure the vessel on the face of the stump

had failed. When the artery gives way on the face of the stump by ulceration, it ought not to be repeatedly noosed with the needle in the same place, but tied by a clean operation immediately below the clavicle.

If the state of the stump in any of these cases depends upon the bad air of the hospital, I would expose the patient to the inclemency of the weather rather than allow him to remain in it; for I know that the effects of any exposure must be less certainly fatal to a patient of this kind, than a continuance in the same atmosphere.

A protrusion of bone is another unpleasant occurrence after amputation, when ill performed. It will sometimes however happen, after sloughing of the stump, or other accidental circumstances, without any fault on the part of the operator. That part of the bone which is exposed, dies, and after some time exfoliates, leaving a very conical stump; and upon this subject some good remarks may be read in the *Memoires de l'Academie de Chirurgie*. It will almost always be prevented by attention to the following circumstances. 1. To leave the integuments attached to the muscles, instead of turning them back. 2. When the muscles are cut through in a slanting direction, upwards and inwards, or even directly downwards, to separate them from the bone, so that it may appear at the bottom of the cone, as a depressed point; the muscle in contact

with the side of the bone meeting its fellow on the opposite side immediately on the face of it, and having over it another layer of muscle; and, lastly, the integuments. 3. To cut the bone short, and to keep the thigh constantly bandaged from the trunk during the cure, so as to prevent the retraction of the muscles.

If a surgeon, after having completed his amputation, finds, on bringing the parts together, that the bone cannot be well covered, and that it will in all probability protrude in the course of a few days, he ought not to leave it in this state, but immediately saw off as much more bone as will reduce it to its proper length. The error may be remedied at this moment with very little comparative inconvenience to what it will occasion hereafter: and no false shame should prevent its being done at the moment, if the state of the patient will permit.

When the bone has protruded, it has been disputed whether it should be sawed off, or allowed to exfoliate.

Where there is only a very little protrusion, or rather, the point of the bone appears in the middle of the stump, the muscular part of which has been well kept forward, it will be the best practice to allow the exposed bone to exfoliate; for it must not be overlooked, that if the protruded part be sawed off, which is done with pain and difficulty, an ex-

posed surface will still remain, which must also exfoliate before the stump can heal.

If the bone should protrude for one or two inches, which I have frequently seen in the first operations of gentlemen entering into the service, the stump will be very conical and bad; granulations will grow up around the bone, the exfoliation of this piece will be long delayed, and, when accomplished, the stump will still be very conical, tender, and always obnoxious to injury. In these cases, it should be removed by an operation, and the saw should be applied on the sound bone, immediately above the part originally exposed; for, if it be sawed below, little will be gained by the operation. It should be done before the granulations surrounding the bone have begun to skin over, or it will be more difficult and painful. The tourniquet is to be put on for fear of accident; the exposed bone must be held firmly with a pair of pincers, or introduced into any hollow tube which cannot move round it; the granulations are to be cut through to make room for the saw, the muscular part of the stump is to be retracted as much as propriety will permit, and defended from the action of the saw, while the bone is removing. The stump is to be afterwards kept wet with cold water, the thigh well bandaged, and the exfoliation of the bone touched by the saw, awaited, which will still occupy some time. The advantage gained by this operation

is in the end a better stump, and, during the cure, a greater tranquillity of mind; for while the bone is protruding there is always much anxiety.

When amputations performed on the field of battle, and those delayed until suppuration is established, or the first symptoms of inflammation are over, are carefully compared with each other, according to the different views I have given of them, it will be perceived that the dangers attendant on secondary operations in military surgery, are infinitely greater than those on primary operations; and the result of the practice of the whole of the surgeons of the British army, and of a great part of the French army, as given by M. Larrey, ought to be decisive on this point, and establish it as a law in military surgery, "that when amputation, in any case, is indispensable, it ought to be performed as soon after the injury as the state of the patient will permit; and ought not to be delayed beyond twenty-four hours, with the view of obtaining a more favourable opportunity for its performance."

ON PARTICULAR OPERATIONS.

BEFORE entering upon the subject of particular amputations, it may save some repetition, to state the practice to be followed in all cases where a limb is torn away by a cannon ball. The opinions of authors have been, and are still in opposition on this subject; Bilguer and his followers declaring, that when the bone is broken short off, it is only necessary to cut away the ragged edges of the wound, and await, with a smooth surface, the processes of suppuration and granulation for a cure, which may then be effected in five or six months; and this opinion is still maintained by Lombard* and other French modern surgeons, although it is strenuously disputed by M. Larrey, vol. ii. p. 263, and in other parts, in consequence of the bad success he had seen attend the practice.

Most other surgeons consider amputation in sound parts above the injury as absolutely necessary, and this has been the invariable practice of the British surgeons during the peninsular war, without a single exception; and it is to be hoped that there are but few who entertain the contrary opinion. The only thing they propose to themselves

* Clinique chirurgicale, a Lyon 1804.

is, to avoid the pain of the operation of amputation, which may be considered momentary, when compared with the tedious misery of a five months cure. The pain of amputation is indeed but trifling in comparison with the dreadful torture of a shattered limb, of suppuration, ulceration, exfoliation, &c. as detailed even by its advocates; and an unfortunate termination will more frequently occur in this state than after amputation.

It is unnecessary to enter more fully into this subject. No unprejudiced surgeon can entertain the opinion; neither has it been entertained by British military surgeons for many years.

On Amputation at the Hip Joint.

This operation has been seldom performed. Surgeons have agreed in calling it a dreadful and a horrible operation, and of expressing their dislike to it by intimating that the advocates or the proposers of it were guilty of little less than murder. Both the British and French military surgeons of the greatest talents, with a few exceptions, have considered it as a hopeless operation, and the performance of it an unnecessary cruelty, unworthy the character of a surgeon; and from this conviction they have had no hesitation in saying, that they could not be persuaded to perform it themselves; but they have suffered it to be understood, that the attempt

at performing it was the foolish or barbarous cruelty of men who were desirous of gaining notoriety by any means, without considering the lives of the persons entrusted to their care, or that humanity, which tempered with firmness and judgment, is the brightest ornament of the surgeon. Prejudiced against the operation without having tried it, surgeons have not only suffered their own patients to die unassisted when this operation alone could bring relief, if any was to be obtained ; but, by the respectability of their opinions on these subjects, they have influenced the minds of others, who had conceived the idea of executing it with success, and thus have prevented its being tried.

The evil in surgery does not however stop here : if any one or two men are unsuccessful in their first attempts, they are obliged to desist from a repetition of the operation, or hazard the loss of their character for humanity and judgment ; and it is only by being in a high situation, or of great authority in the profession, that they can silence the clamour or insinuations of idle people. It behoves all military surgeons, therefore, to avoid giving their negative opinion too strongly upon subjects of which they have not had actual experience ; for they not only refrain from doing good themselves, but they prevent others from attempting it, and thereby enable many unqualified persons to object to an operation as impracticable and improper, because they feel that they are unequal to the performance of it.

I consider this prejudice common to both British and French military surgeons against amputation at the hip joint, as the cause that so few cases of its performance, or of its success, are on record. Now, however, that successful cases are known to have occurred; and the necessity of doing it under certain circumstances has become more evident, the opinions of its adversaries have lost part of their weight; and if the war had lasted another year on the Peninsula, I am satisfied, cases demanding it would have been found sufficiently numerous; and the operation would have been comparatively as much practised, as the sister operation at the shoulder joint, which was but a very few years ago considered almost equally dangerous.

The more modern surgeons in civil life have not been less decided in the opinion of the impropriety of performing it, and they have carefully refrained from noticing it in their surgical works; or when they have hinted at such an operation, it has only been to express their disapprobation. Teachers of surgery have all, by their omission of it in their lectures, tacitly declared that it ought not to be attempted, and fear has so much pervaded the minds of all, that it is generally regarded in domestic surgery with as much horror, as the attempt at putting a ligature on the external iliac artery would have been a century ago, if such an operation had been proposed.

The opinions of military surgeons supported by

their practice, is however likely to overcome this prejudice, and I am informed that Mr. Brodie very lately performed this operation at St. George's Hospital, in a case of gun-shot wound from accident; and although the result was unsuccessful, the man living but a few hours, still it will tend to diminish the dread entertained of the operation by surgeons in civil life.

It was certainly once before, at least, performed in London, for M. Pott, who saw an operation of the kind, expresses his opinion of it in the following terms: "That amputation in the joint of the hip is not an impracticable operation (although it be a dreadful one) I very well know: I cannot say that I have ever done it, but I have seen it done, and am now very sure I shall never do it, unless it be on a dead body."

Amputation at the hip-joint is certainly a formidable operation to the patient. The removal of nearly one-fourth of the body must always be attended with the greatest danger, and must in general be unsuccessful. It does not, however, follow from this cause that it should never be performed; on the contrary, when there is no chance of life without relief be obtained by the removal of the injured part, the operation should be resorted to, in compliance with the precept of Celsus,* "*Nihil interest an satis tutum sit præsidium, quod unicum*

* Lib. vii. cap. xxxiii.

est," which, on this occasion, is peculiarly applicable. The patient should be apprised of his situation, of the impending danger, and the chance he has of escaping death; and although this chance be small, still the love of life makes us grasp at any thing that holds out a hope of preserving it, and very many, under these circumstances, will submit to the operation.

Authorities on this subject are but slender; little of value is to be obtained from books until very lately, which can assist the surgeon, either in his mode of performing the operation, the time of doing it, or in pointing out the kind of injury that requires it to be done; and the practice of no individual has been hitherto sufficiently extensive, to allow him to give from his own experience, general rules that can be considered on all these points as legitimate. No operation, therefore, in military surgery, deserves more the attention of surgeons. The cases in which it is requisite, are not all known, or if known, are not sufficiently described: the more obvious ones seldom present themselves to the surgeon, as they are generally fatal, and the less urgent ones are frequently neglected until it is too late to execute it. The mode of performing it is not thoroughly understood, and the difficulties and dangers attending it are so magnified, as to appal most military surgeons who have not made the operation an object of their particular attention.

The Royal Academy of Surgery, in France, made this operation the subject of their prize ques-

tion for the year 1757 ; but, not considering any of the twelve memoirs they received, sufficiently satisfactory, they proposed it again for the year 1759, when forty-four were transmitted for the double prize. In the various discussions which took place, during the consideration of these memoirs, reference was made to the registers of the academy, which stated that, on the 3d of March, 1739, the reading of a memoir was begun on this operation by M. Volher, Surgeon Major to the Horse Guards of the King of Denmark, and finished on the 17th ; and that on the 24th the reading of another memoir, on the same subject, by M. Puthod, Surgeon at Nyon, in the canton of Berne, in Switzerland, took place, was continued on the 2d of April, and finished on the 7th of the same month. Messrs. Le Dran and Guerin, Junr., were appointed to examine these memoirs, and their decision was not precipitately formed, as they did not report upon them until the 26th of July, 1740, fifteen months afterwards, and their opinion was favourable to the authors. The experiments made by these gentlemen, in the course of their examination, are detailed in a thesis, maintained in the school of medicine, at Paris, on the 7th of March, 1748, by M. L'Alouette, which is printed in Haller's "*Disputationes Chirurgicæ selectæ*," Vol. V., page 265, and entitled, "*An femur in cavitate cotyloidea aliquando amputandum.*" The memoirs of Messrs. Volher and Puthod are to be found in the "*Opuscles de Chirurgie*," de Morand.

The academy decided on the propriety and necessity of the operation, in awarding the double prize to M. Barbet, whose memoir is printed in the ninth volume of the *Memoirs of the Academy*, duodecimo edition; Paris, 1778. He therein relates the following case as the first on record of the kind. "In the winter of 1748, a boy about thirteen or fourteen years of age, was brought to the *Hotel Dieu* of Orleans, suffering from gangrene, in consequence of having eaten unsound rye; the disease being endemic among the inhabitants of Sologne, in rainy seasons, which corrupt the grain of that province. The gangrene had affected both legs and a part of the thighs, and M. la Croix, the principal Surgeon of the Hospital, endeavoured in vain, to arrest its progress by the means usually employed in such cases. The disease extended on the right side to the articulation of the thigh with the hip, and on the left side to the great trochanter. Sphacelus having soon supervened, the death of the child was considered inevitable in a very short time; but it did not immediately follow, the line of separation between the dead and living parts soon formed on the right side around the joint, and the separation of the thigh at the articulation with the hip was nearly effected by the efforts of nature alone. The head of the femur slipped out of the acetabulum, and was attached to the os innominatum only by the round ligament; and the soft parts of the thigh to the body, by the great sciatic nerve.

Under these circumstances, M. La Croix, in the presence of M. le Blanc, completed with the scissors, in dividing these parts, what nature alone had almost entirely accomplished. The patient was so well on the fourth day, that M. La Croix proposed to amputate the other leg, the separation of the dead from the living parts having left a space sufficient to allow of his sawing the bone close to the sound parts; and in this manner these two amputations were done without pain, or loss of blood. The boy passed the first two days very well, the wound looked healthy, and some granulations were already perceivable in the cavity of the joint. The second amputation was also in a tolerably good state, and some hopes were entertained of the patient's recovery, when he was unfortunately attacked with fever, of which he died fifteen days after the first operation."

M. Percy, in his work on Military Surgery, has not noticed the operation. M. Larrey, has performed it seven times, three cases are related in the 2d volume of his Memoirs, page 180.

In the first case, the operation was performed without accident, and the soldier was so easy for some hours after, that a favourable result might have been expected, if he had not been obliged to undergo a hurried journey of twenty-four hours in the winter season; which, with the fatigue and inconvenience of the conveyance most probably caused his death.

“The second was an officer, Mons. Bonhomme, of the 18th demi-brigade, wounded by a splinter of a shell at St. Jean d’Acre, and brought to me with an enormous wound of the right thigh.”

“The muscles were either torn or carried away from a great part of the circumference of the thigh, the femoral artery was torn about five or six finger’s breadth below the crural arch, and the femur was broken as high as the great trochanter. He had lost a great deal of blood, and was considerably weakened. I even thought he would die in a few minutes, if the removal of the thigh was not immediately accomplished. He passed the day and night after the operation in as quiet a state as could be desired. I gave him some antispasmodic draughts, some cooling drinks, and weak broth with a little wine. The next morning the dressings were wet with a reddish coloured serous discharge, without swelling, pain, or tension in the stump. He was easy during the night, and slept well for three hours. The third day the dressings were removed, and he passed the day very well, the bowels were regular, and he had a desire to eat. I gave him some rice gruel (potage) night and morning. On the night of the third to the fourth day, he had some slight febrile symptoms accompanied by throbbing in the stump, and general heat of the body, which was succeeded by a plentiful perspiration, ease and sleep. In the morning I found the dressings soaked with a purulent discharge.

The flaps had already united the half of their extent, leaving at their upper and under extremities an opening about two inches long, where I had brought out the ligatures. On the fifth day every thing appeared to be going on as well as possible. The matter discharged from the upper and lower openings was of good quality and quantity. On the sixth day his situation was still very favourable, and I had every reason to expect a cure; but the crowded state of our hospital, and the impossibility of separating even the most severe cases of wounded from the other sick, were the cause of an unfortunate occurrence the next night, which the particular nature of our situation did not enable me to guard against. A soldier, affected with the plague for some days, which he had concealed, was wounded in the leg by a cannon shot whilst on his way from the camp to the hospital. Although very ill with the plague, he was in consequence of this accident, placed without my knowledge, amongst the wounded, by the side and on the same straw as this officer, to whom he communicated the plague, which appeared on the night of the sixth and seventh day. In the morning the stump was in a gangrenous state, and its progress was so rapid, that death in a short time destroyed all the hopes I had entertained from the favourable state of my patient the day before."

"The subject of the third case was a drummer of the second demi-brigade of light infantry, twenty

years of age. He had his right thigh carried away at its middle by a splinter of a shell at the last assault of Acre. The fracture of the femur extended as far as the joint, and the soft parts were bruised and disorganized. This man, although very much weakened by the loss of blood at the moment of injury, felt excessive pain, which he expressed by the most frightful screams. I immediately amputated the thigh, after my usual method. This young man being stouter than the other, I thought it necessary to retain the flaps in their places by some sutures placed at proper distances. Some long compresses, in the form of a Malta cross, were laid on the stump, and the whole retained by an appropriate bandage. The operation was very quickly done, and without loss of blood. In a few minutes he became easy, and slept quietly for some hours. The return of the army to Egypt, which took place immediately afterwards, obliged me to move this young man, with the other wounded; and I subsequently learned that he died on the road."

In the 3d volume, page 349, the two following cases are related. Speaking of the battle of Wagram, he says—"Before night, near five hundred wounded collected at my station, for the greater part wounded by cannon-shot, or having very severe wounds that required some capital operations. This afforded me another opportunity of convincing myself of the necessity of immediate amputation, in all cases where it is declared indispensable; and I

have no hesitation in asserting that if it had not been done, the greater part of these men would have died within the first twenty-four hours; as was exemplified in the cases of two of the Imperial guard, whose wounds rendered amputation at the hip joint necessary, and who lost their lives in consequence of the operation being too long delayed."

"I must confess, that the little encouragement given me by professional men, to expect success in this operation, made me for a time give up the idea I had entertained of performing it upon these men, although I had met with considerable success in other instances nearly analogous. I had not an idea of saving them, and merely laid some simple dressings on their wounds, which were of great extent, with fracture of the bone to the great trochanter, and then proceeded to perform such other operations as could be done with more chance of success. These two men in the meantime underwent the most horrible sufferings, they begged for relief by the operation, and even endeavoured to destroy themselves. The repeated solicitations of my colleagues, and the dreadful situation of these poor men at last determined me to perform the operation, although I did it with regret, foreseeing but little hope of success. They had now been wounded seven hours, and in performing the operation, I had no other prospect than to be able to remove the cause of their dreadful sufferings, and

to take from the sight of their comrades so horrible a spectacle."

"I first, after my method, tied the femoral artery, and the limb was then removed in about fourteen or fifteen seconds. The vessels were very quickly secured, there was no hæmorrhage, and they both became so much more easy, that one man shortly fell asleep. The pulse of the first was scarcely perceptible, his strength was exhausted, and he died three hours afterwards. The other passed the night tolerably well, but continued in a very exhausted state. I saw him at four o'clock in the morning, when I left the hospital to obtain a little repose; and on my return at six, I found him dead."

At page 351, he says in continuation, "I believe, that if an expert surgeon had the boldness to perform this operation, in such cases as require it immediately after the accident, as in the two cases above related, it would succeed in proportion in the same manner as the amputation at the shoulder-joint. Before the present war, two or three cases only of this operation could be adduced that were attended with complete success; and this arose, without doubt, from the delay in executing them; for when the operation is indispensably necessary, and is delayed only for a few hours, the wounded are generally lost before they can be removed from the field of battle."

M. Larrey has done me the favour to inform me,

that he performed the operation twice during the campaign in Russia. In the first instance, on a Russian at Witterp, who lived to the thirty-fifth day, when the wound was nearly healed: he died in consequence of an attack of fever and dysentery, caused by the scarcity and bad quality of his food. The second, a Frenchman, operated upon after the battle of Mozaïks, was seen perfectly cured at Witterp three months afterwards, by M. Bachelet, principal surgeon of the hospital of that town. This man had borne the extreme rigor of the climate, and the privations of the retreat of the French army, thus far on his way home, when he was obliged to be left behind; but M. Larrey still hopes to see him in Paris.

In the 3d vol. of the *Bulletin de la Faculté de Medecine*, published at Paris in 1812, there is the following case of amputation at the hip joint, performed by M. Baffos, surgeon (adjoint) to the hospital of the *Enfans Malades*, and to that of *Madame Necker*.

“Bartholomew Taillandier, an orphan, seven years of age, of a phlegmatic temperament (d'une constitution lymphatique), was admitted into the hospital for sick children, on the 24th of September, 1811.

“This child had a cicatrix on the joint of the great toe with the first metatarsal bone, the result of a well cured scrophulous affection.

“There was on the superior, anterior, and external

part of the thigh, a smooth hard tumour, without fluctuation or discoloration of the skin; but it could not be ascertained from himself or others, whether or not it had arisen from any external cause; and I readily perceived that it depended on a disease of the bone, which had made considerable progress. It was in an indolent state on his admission into the hospital, but soon became painful, and particularly at night; he lost his appetite, became feverish, restless, grew thin, &c.

“ The tumour increasing in size, and being convinced that nothing could arrest its progress, I proposed to perform a formidable operation, of the dangers of which I was well aware; but which still left me some hope of saving the life of the child, when no other method could preserve him from the horrible sufferings which a lingering death would but too slowly terminate. The disease occupied more than the upper half of the femur, including the neck of the bone, for the great trochanter was lost in the tumour; and the ease with which I could bend and straighten the thigh, induced me to think that the joint had not participated in the disease.

“ Before I determined on performing the operation, I was desirous of having the opinion and assent of the professor to whom I am so much indebted, and for whom I feel a veneration, equalled only by the particular friendship with which he has honored me for the last fifteen years. I had the

patient conveyed to the Hôpital de la Faculté, and Mr. Antoine Dubois after having carefully examined him, encouraged me to operate, founding his opinion for the operation, ^{on its} offering some chance of success from the thinness of the subject, from the ease with which the flow of blood could be suppressed, and from the certainty of taking away the whole of the disease, by removing the thigh at the hip joint; whilst, on the other hand, if the disease was left to itself, it must necessarily end in death. The patient was brought back to the Hôpital des Enfants.

“ Two or three days afterwards I requested M. Le Baron Larrey to give me his opinion; and after an attentive examination of the little sufferer, he did not hesitate in advising the operation.

“ I made several trials on the dead body, of the different methods recommended of performing this operation; and on considering the advantages and inconveniences of each, I selected that of M. Larrey, which he had three or four times executed himself. I made in it, however, one important alteration, that of compressing the artery against the ^{os pubis} ~~brim of the pelvis~~, so as not to be obliged to apply the ligature until I had finished the amputation; whilst M. Larrey, according to the advice of Volher and Puthod, begins by laying bare and tying the artery.

I performed the operation the 3d of January last (1812), before a great number of students, being particularly assisted by my friends Messieurs Dan-

yau and Abraham, whose presence gave me more courage from the confidence I placed both in their judgment and friendship.

“ The patient was placed horizontally on a bed a little raised, with the pelvis brought forwards, the left leg hanging supported by an assistant, the right leg stretched out, and sustained by another.

“ M. Danyau, standing on the left side of the patient, compressed the artery with the thumb of the right hand. Holding the thigh with my left hand, I moved it gently backwards and forwards to enable me to observe the spot nearest to the joint where the knife ought to enter; which, having ascertained, I plunged a sharp pointed straight knife, eight inches long, and six or seven lines broad, into the anterior and superior part of the thigh, external to the artery, and brought it out directly opposite behind. I then cut along the bone for the breadth of four fingers, when, turning my knife, I made a horizontal cut, by which I completed the internal flap. M. Danyau grasped this in his hand, and completely commanded the flow of blood. I now exchanged my knife for a straight bistoury, with which, at one stroke, I cut into the capsular ligament, and divided the round ligament, luxating at the same time, the head of the femur by a strong abduction of the thigh. Resuming my first knife, I carried it behind the head of the bone, and made a horizontal incision outwards, on a level with the top of the trochanter, which completed the external

flap. I pulled out the artery with the forceps, and tied it with a double thread, and then secured the lesser arteries that bled in succession; but there were not more than seven or eight requiring the ligature.

“The operation was performed in thirty or forty seconds, not including the time required for securing the vessels; and the quantity of blood lost was supposed to be something less than a porringer full (palette).

“The dressing consisted in the application of a piece of agaric of oak to the bottom of the wound, in front of the cavity of the joint. The internal flap was laid down upon this agaric, and retained in apposition with the external flap by adhesive plasters, some charpie, and long compresses, with a simple retaining bandage, which completed the dressing, and the patient was put to bed.

We wished to examine the amputated limb on the spot, but thinking it would be more useful to the students to make a cast of the diseased bone, M. Pinson had the goodness to undertake its performance. I am going to deposit these two preparations in the museum of the faculty, and it will be seen that the disease occupies more than half of the femur, and that the swelling is formed of a homogeneous matter, something resembling cartilage; in the middle of which, the bone is seen with its outside rough, and studded with bony points. The femur sawed in two in its length, shewed nothing

particular, with the exception of a diminution in thickness of its external compact bony substance. The head of the bone, the round ligament, and the cotyloid cavity, were perfectly healthy.

"I shall not enter further into the description of this disease; a more correct idea will be obtained of it by examining the two preparations, which shall be placed in the museum of the society.

"To judge from the cries of the little patient, he appeared to suffer a good deal during the operation; I ordered him an anti-spasmodic draught, with some laudanum, of which he took twenty-four drops in the space of fifteen hours. He was in some pain during the first three days, but had little fever.

"On the third day I removed the dressings, and found that the two flaps had remained in apposition. I separated them a little at their lower angle, to enable me to draw out the piece of agaric, which I did with the forceps, without pain or difficulty. I again dressed it with dry lint, and two or three straps of adhesive plaster; suppuration soon formed, and continued throughout of a good quality. Some ligatures came away about the eighth or ninth day, and on the twelfth I found that of the femoral artery in the dressings.

"Perhaps it would be proper to add here some reflections on the nature of the disease, the different methods of operating proposed, and upon the circumstances which were more or less favorable to the success of this operation; but I refrain from

doing this, because I only had it in contemplation to lay before the society the first case of success of amputation of the thigh at the hip joint, performed where the limb was entire.

At page 112 there is the following note from M. Baffos, in continuation of the case: "The wound was healed, the health of the child was good, and every thing promised a most satisfactory result; it was even intended to discharge him from the hospital, when about the sixty-third day, pain came on with tension of the belly, loss of appetite, fever, diarrhœa, &c. A short time after the cicatrix ulcerated, and opened out, and Tallandier died at the end of the third month after the operation."

On dissection, nothing worthy of observation was found in the head, thorax, or abdomen. The acetabulum was filled with a reddish cellular membrane, and some soft fleshy granulations, which were very readily and completely removed by the fingers. It had lost nothing of its depth or form, and the cartilage covering it had suffered no evident alteration, except in colour, which was less bright than natural. The bottom of the cavity was irregular, and an opening was perceived in it through which a round pointed probe penetrated into the substance of the ilium; the whole internal surface of which was carious."

I have not much to offer from actual experience of the operation, having performed it but once un-

successfully. I have however seen many cases in which it ought to have been attempted, and which died. I have seen many in which the operation would have been necessary, if the constitution of the patients could ever have recovered the shock it had received at the moment of injury. I know that many cases have died after long continued disease of the thigh bone from gun-shot wounds, that would have had a chance of recovery, if the operation had been performed; and I have several times amputated so close to the trochanters, that I could with ease have removed the head of the bone without any increase of the external incisions.

This amputation is of course either primary or secondary; but the nature of the injury or disease differs very much in these two stages; for very few, or none of the cases that render its performance necessary on the field of battle, ever live to the period when secondary amputation is usually recommended.

Wounds demanding amputation of the hip joint on the field of battle, arise from cannon or grape shot, or the explosion of shells. Few surgeons would think of performing it for a wound by a musket ball, although cases may occur that require it, and the principal one that will render it necessary, will be a fracture of the head or neck of the bone, with a wound of the great vessels, or some other arterial trunk causing hæmorrhage, and stuffing the thigh with blood. A grape or small

cannon shot, may strike the fore part of the thigh, and without wounding the inguinal artery itself, may, in its passage to the neck of the femur, wound some large arterial branches, causing considerable hæmorrhage: the wound shall not be large, and yet the chance of saving the life of the patient will be but very small indeed. I recollect two cases of this kind in particular; one after the battle of Vimiera, by a cannon shot, which proved fatal on the second day after the injury, no one at that time thinking of the amputation at the hip joint. The other occurred at Salamanca, by a large ball, which shattered the neck of the femur and the body of the bone below. I did not see this person for near forty-eight hours after the injury, but was informed that on his first presentation for assistance, an artery, supposed to be a large branch of the femoral, had thrown out its blood *per saltum*, and was stopped by pressing some lint on the wound. The limb soon swelled to nearly twice its natural size, with much external inflammation. The patient himself thought his case desperate, as did every one about him, and declared his willingness to submit to any operation that might be proposed; but the time for operating was past, even if any operation could have been agreed upon.

After two months of severe suffering, in which there were even some prospects of life being preserved, this man died. The latter period of the time was passed, however, without any hope of re-

covery, and surgical aid was given merely with the view of rendering his last moments as easy as possible. The great strength of constitution shewed by this man during the whole course of his illness, and his great endurance of suffering, have always inclined me to think the operation at the hip joint would have succeeded, if it had been performed shortly after the receipt of the injury.

A shell bursting near a soldier may drive a large piece of an inch in thickness, and a pound or two in weight, into the inner part of the thigh, without wounding the femoral artery, yet fracturing the head of the bone: here several large vessels, and perhaps the great sciatic nerve would be divided, and the only chance of life, in my mind, would be in the immediate removal of the whole. I saw a fatal case of this kind during the siege of Ciudad Rodrigo, where the patient lived long enough to shew the necessity of performing this operation.

A piece of a shell may strike between the trochanter and the ilium, go through the neck of the bone, and tear its way out below the tuberosity of the ischium, destroying all the parts in its course, without either killing the soldier by hæmorrhage, or by the shock of the blow to the constitution. This accident happened to a man of the 40th Regiment, at the battle of Salamanca, about four o'clock in the afternoon. He was in a good state to undergo the operation when I saw him next morning, but none of the surgeons present with me would

agree to it ; all allowed nothing could save the man ; but the opinion entertained of the cruelty of the operation, and of its certain failure prevented its being done. I took this man into Salamanca with me, and his appearance for six successive days before he died, made me reproach myself for my want of courage, in not contemning any remarks that might be made, on my having undertaken it in opposition to the opinion of my colleagues ; and I declined it, not because the general opinion was against it, but in consequence of the bad success of one, and of the good success of the other, of the two next cases to be related.

When a cannon-shot carries away the thigh above its middle, so as to exclude the more common flap operation close to the trochanter, it is almost always fatal. These accidents generally destroy at once. On the field of battle, I have seen many, having searched particularly for them, but have found them dead, or, beyond the reach of surgical aid.

I have seen a case of a cannon-shot striking the outside of the thigh, tearing away the trochanter and surrounding parts, without wounding the femoral artery or any great vessel that would cause any serious hæmorrhage, or, so great a shock to the constitution as to render the operation impracticable ; yet this man died without any attempt being made for his relief, which was neither good surgery or humanity.

When the femoral artery has been torn through

by a cannon-shot there is, at the moment, a great loss of blood, but the patient does not bleed to death, neither does he appear to die ultimately from the effects of the hæmorrhage; for I have seen several men lose a greater quantity from the same vessel without any such effect, but from the shock to the constitution; and this is observable in many cases of amputation of the thigh, where there has been little loss of blood; and yet the patient dies, during, or, immediately after the operation. A considerable hæmorrhage, on the other hand, renders a patient less able to bear an operation than he otherwise would do, and where there has been much and sudden bleeding, the powers of life are so exhausted as not to be able to bear any further disturbance. This effect is most frequently caused by wounds of the femoral artery, and where it has occurred, the chance of success from the operation, will be very small; and the combination of injury arising from the loss of blood, and the shock of the blow, will have so much diminished the powers of life, that the operation in addition, will destroy the remainder.

If (as I have seen in many instances) the bones of the pelvis are injured, in any of the preceding kinds of accident, the result will be fatal, and the operation should not be performed; but some little destruction of the soft parts, should not prevent it, if the patient be otherwise in a favourable state.

A very extensive injury of the soft parts of the

thigh, if the bone be not broken, and the femoral artery not divided, does not authorize the operation, although the artery be laid bare for three or four inches of its course.

An officer of the 88th Regiment, was wounded in the trenches, at the siege of Ciudad Rodrigo, by a twenty-four pound shot, which struck the outside of the anterior part of the left thigh, and carried away the fore part of it from the groin to within a hand's breadth of the knee; the femoral artery lay bare at the bottom of the upper part of the wound, and was seen pulsating for near three inches; the sartorius and rectus muscles were carried away, and all the muscles on the outer and inner side of the thigh more or less mangled by the shot, or torn by the laceration; it was altogether the most frightful looking wound I had seen, not even excepting where the limb has been completely torn off. Having the superintendence of the 3d and 4th divisions of infantry, the greater part of the medical officers of both were with me at the time, and on this officer's being brought to our field hospital in the rear of the trenches, they all, without an exception, declared he must shortly die, if the limb was not removed. In compliance with this opinion, I proposed to tie the artery below Poupart's ligament, and to endeavour to save flaps to cover the great trochanter, the bone being sawed off below, as I have since done in several instances; and if this was not practicable, the head of the femur was to

be removed. On placing him on the panniers for the purpose of operating, he was so exceedingly faint, the pulse at the wrist being scarcely perceptible, that I conceived the operation would be useless, as he would certainly die under our hands. He was removed to a corner of the hospital, and placed on a hay mat amongst other cases of wounded supposed in a dying state, a little lint being laid over this enormous surface. By the next morning he had much recovered, and as his thigh became very painful, he was desired by the surgeon of the division arriving in succession, to wet it with warm water; this was done, but his countenance was so ghastly that he was considered by every one as dying; indeed his regiment actually returned him dead, and his commission was filled up in England. In this state he remained till the day after the storming of Ciudad Rodrigo, when, from the advance of Marshal Marmont, the wounded were sent across the Agueda. Desirous of knowing whether any stragglers of the corps I belonged to might still be at the field hospital, I rode to it on leaving the town, and found every one gone except this poor gentleman, who requested my assistance; having conveyance in the town, I offered to take him to my divisional hospital, five leagues distant, where all the other wounded had been conveyed, which offer he gladly accepted, and reached the village of Aldea del Obispo, with less inconvenience than I expected, I daily feared the femoral artery would

give way, but nothing of the kind occurred, the slough from the whole surface of the wound soon separated, and there was much less of it than is usual on such occasions, but this may be attributed in some measure to the attention paid him, and to the extreme coldness of the weather in a room without a fire-place. The discharge of pus was very great, and the artery lay in a channel completely covered by it ;—I hourly expected it would ulcerate, but granulations soon began to shoot out, and by the end of three weeks the artery was covered in, although its pulsations were still visible at a distance ; the sore gradually contracted in a surprising degree, and in two months it was diminished to half its original size, very little new skin having been formed. At this period he left me on his way to the rear, on the army moving down to the siege of Badajos. The attention paid to this officer in regard to diet, attendance, and surgical aid, was very great ; more, indeed, than he could have received under any other circumstances. His recovery was considered so unlikely, that no one looked at his wound after the first day ; all supposed him past relief, as was really the case with an officer of Engineers, lying beside him, whose arm was shattered to pieces by a shell, and the os ilium bared on the outside of the glutæi muscles, and on the inside of the iliacus internus, as if it had been for some time in maceration. The insertions of the external and internal oblique, and the trans-

versalis muscles were torn out without the peritoneum being opened, which alone prevented the intestines from coming out at the wound.

Although this gentleman's life was saved, still, I am of opinion, that very few would have recovered under the same injury.

The secondary operation has seldom, I believe, been performed during the high suppurative stage succeeding to injury from gun-shot wounds; and as I do not believe it can be successful, if done at this period, I would not perform it after the second day, until the third or fourth week. There are not many cases that will demand it at this period, as the femur, in most compound fractures of the thigh, can in general be sawed off, at, or immediately below the little trochanter.

The following case will best explain another state of disease in which the operation may be necessary.

Private Mason, of the 23d regiment of infantry, or Welch fusileers, had his thigh amputated about its middle during the siege of Ciudad Rodrigo, and was sent to the divisional hospital at Aldea del Obispo, with the other wounded of the fourth division, those of the other part of the army being in general hospital. For some time he appeared to be doing well, when the wound became irritable, opened out, and sloughed on the under and inner part with some hæmorrhage. Attention was paid to this both in dressing and searching for the vessel which could

not be found, for the stump ceased to bleed when opened and cleansed, and yet soon filled after the dressings were applied. Finding my endeavours to suppress the hæmorrhage fruitless, I determined on tying the femoral artery above where the profunda is usually given off, as it appeared to be a branch of that vessel that bled. This was effected as I supposed, about two inches and a half below Poupart's ligament, with little disturbance to the contiguous parts. The hæmorrhage ceased from the stump, and I hoped all would do well. The next morning the bleeding suddenly returned, and about a pound of blood was removed from the stump in coagulum. Pressure on the artery at the pubes hardly commanded it, and the poor man earnestly begged something might be done to save him. The appearance of the stump had deteriorated very much in the last twenty-four hours, the ulceration was extending deeper between the muscles, and the prospect of the healing of the stump without much exfoliation of bone, even if the hæmorrhage could be suppressed, was but trifling. The man willingly agreed to have the stump removed a little below the ligature on the artery, although he was aware his chance of surviving it was doubtful: but, finding himself much weakened from the loss of blood, he said to me, "I must die, Sir, to-night if I keep it, and I will take my chance."

The artery being compressed against the os pubis, I made my incisions down to the bone, taking the

ligature on the artery as the centre; and in doing this I observed a vessel equal in size to the one I had tied, running down a little distance behind and on the outside of it, which I immediately secured. The head of the bone was now removed from the acetabulum without difficulty. Fourteen vessels were tied; yet little blood was lost, as my two assistants, Mr. Cartan, now surgeon of the 15th Hussars, and Mr. Loane, surgeon of the 94th, the only professional men present, aided me in pressing on the mouths of the vessels with their fingers, until I could take them up in succession. The parts were brought together, and the integuments retained in contact by two sutures with the needle above and below, assisted by adhesive straps. The operation from first to last was completed in less than a quarter of an hour, and the man bore it heroically. I had even strong hopes of him for the first hour, but he gradually sunk, and died seven hours after the operation.

On examining the original stump I found the femoral artery perfectly open where the ligature came off, but from this part it never bled. It was from underneath the blood came, and from some small branches of the profunda. This vessel was given off from the external iliac, or rather the external iliac divided into two equal branches, immediately after giving off the epigastric and circumflex arteries. There was the same peculiarity in the other limb, and the vessel acting as the pro-

funda sunk into the thigh at the usual place. I have always thought this man would have lived if the amputation had been performed when the femoral artery was tied, which operation of course could not succeed, from the peculiarity in the origin of the profunda.

After common amputation at the middle of the thigh, it may be necessary at some distance of time, in consequence of the injury to the bone having extended above the place at which it was sawed off, or from the death of the bone, in consequence of matter forming on its surface; ulceration then takes place at or about the trochanter, the soft parts all become diseased, the irritation is great, and the patient dies exhausted; and of this I have seen several instances.

The most common cause requiring its performance at a late period, will be compound fractures above the middle of the thigh, which have been badly or unsuccessfully treated. In these cases the bone, as well as the soft parts, become a mass of disease, or cause such continued pain and irritation to the patient, with a useless limb, and rapidly declining health, that the operation offers the only chance of relief.

The two cases that have occurred in England, and which may be considered most favourable to the operation, were of this nature; one having proved completely successful, the other having lived to the 30th day; and of this case my friend Mr.

Emery, Surgeon to the Forces, has favoured me with the following account.

In a skirmish with the enemy, in the mountains near St. Sebastian, August 1813, Sebastian de L'Amour, a corporal in the Chasseurs Britanniques, received a wound in the left lower extremity; the ball entered the upper and outer part of the thigh, passed obliquely downwards and inwards, fractured the os femoris, went through it, and was extracted about the centre of the sartorius muscle, at an opening made with a scalpel. Soon after receiving the wound he was conveyed to the general hospital at Passages, and from thence, in February following, removed to England, arriving in an extremely low irritable state, copious discharge issuing from the wounds, and the limb much indurated, but giving, by its firm feel, every reason to believe that it had united.

After some time the deposition of ossific matter was so great, both above and below the fracture, that the thigh became considerably enlarged, the old or original bone had grown carious to a great extent, attended with sinuses in the soft parts running up to the trochanter major, and downwards to the condyles.

July 18. His body being much emaciated and reduced by hectic fever, night sweats, and diarrhoea, the extremities cold and œdematous, appetite gone, and the constitution evidently giving way, a consultation was called of the senior medical officers of the



establishment, for the purpose of forming a decisive opinion on the case; when, after mature deliberation, it was determined that the only chance of saving his life was by amputating the limb at the hip-joint (the disease of the femur running up to its very head). However, on the patient being questioned as to submission, an answer was given in the negative, and the idea accordingly, though reluctantly, abandoned.

July 19. Having passed a tolerably easy night, spirits rather improved, the diarrhoea a little abated, but the wound painful, the operation was again mentioned, when he seemed to waver, and said it should be considered during the day. He took some nourishing diet at intervals, producing a good effect on his system.

20. His spirits being good, from sleeping well nearly all night, he voluntarily consented to submit to our determination, provided it was not carried into effect till next day, which of course was agreed to; and instantaneously he became more tranquil and happy than he had been for months before.

21. Every thing being arranged, and the different departments assigned to the respective assistants, the patient was placed diagonally on a narrow table, supported by a strong man behind; the operation then commenced by making an incision with a large broad scalpel through the integuments, beginning four fingers breadth below the anterior superior spinous process of the ilium, carried with a convexity downwards on each side

of the thigh, and meeting close to the tuberosity of the ischium, the adipose membrane was then separated from the fascia and drawn upwards; the femoral artery was next laid bare by dissection, and secured beneath the giving off of the profunda (in consequence of the division taking place very high up), by passing an eyed probe under it with a double ligature, which, being separated, were tied in two knots half an inch asunder, and the vessel divided between them; the vein was also tied to prevent an effusion of blood from the limb. The scalpels were now laid aside, and an amputating knife applied close to the retracted edge of the skin, cutting obliquely down through the muscles of the thigh on the fore and inside, by inclining the instrument upwards. In doing this the patient lost a few ounces of blood, though chiefly from the veins, which, with the arteries then cut, were immediately secured by ligatures. After this the incision round the thigh was finished, by dividing, on the back and outer side, the remaining uncut muscles; which being accomplished, the femur was laid completely bare by dissecting them up with a curved scalpel, first on the outside, entirely above the trochanter major, and then on the inside, till the notch of the acetabulum was rendered perceptible, through which a double edged bent bistoury was introduced into the capsular ligament, dividing with it also the round ligament, which was made to present itself by turning the limb outwards. The head of the

bone was next extracted, the vessels taken up, and the operation finished by removing, with the same bent instrument, as much of the cartilage that lines the cotyloid cavity as could be got at, scarifying what could not be taken easily away, and detaching some ligamentous filaments and synovial apparatus. The wound was then cleansed, its parts brought together in a straight line, and secured by four sutures passed through the cellular substance at equal distances, nearly close to the edges of the skin, supported by strips of sticking plaster, covered with pledgets of lint, common dressings, &c. and the whole made fast by a broad calico bandage, to which a cushion was attached, being fixed so as to press on the parts opposite, with a view of making them fill the cavity caused by the removal of the trochanter major, and act as a prop to the external and inferior side of the stump. He was immediately after put to bed, and a draught given him, containing opium and spirits of nitre, of each forty drops.

July 22. Slept soundly after the operation, and again during the night; pulse 120, rather full; skin rather dry, with increased heat; bowels confined.

R. Mist. salinæ ʒ iss. quartis horis.

23. Having had no stools at eleven last night, an injection was administered, producing several motions, has slept well at intervals, and the febrile

symptoms are much abated ; pulse 120, but not so full, tongue clean and moist, stump feels a little heated, and in consequence ordered to be kept wet with cold water.

July 24. Has had a good night, and towards morning a lax motion, pulse 119, skin soft and pleasant to the feel, heat of stump diminished ; removed the dressing, and examined the wound, of which a third of the upper and some of the lower part had united by the first intention, the centre being a little open, and a small quantity of sanious fluid issuing from it. The inferior suture has cut its way out ; the application of cold water to be continued.

25. Did not sleep well, and feels much heat about the stump, attributing it to the orderly neglecting to keep the parts wet as directed ; had one motion since bed time, pulse 119, skin soft, tongue clean and moist, fever trifling ; dressed the wound, discharge from the centre improved, and a small quantity of genuine pus came away by pressure from an orifice at the lower part of the line.

26. Was very uneasy the early part of the night, but slept well towards morning, has had four evacuations during the last sixteen hours, unattended by griping or pain ; pulse 102, and moderately full. He does not look quite so well, and is rather irritable : the discharge from the wound is less on pressure, but more has issued out from under the dressing, since yesterday, than in the same space of time before ; the quality of it seems improved,

granulations springing up, but the inferior part of the line, which appeared united by the first intention, now gapes a little; three ligatures came away with great ease, and two sutures were taken out; continued the cold application to the stump, and allowed him some chicken broth.

R. Misturæ cretæ ʒ viij.

Tincturæ kino ʒj misce.

Sumat uncias duas tertiâ quâque horâ.

July 27. Has had an excellent night, and only one motion; countenance rather brightened, tongue clean and moist, pulse 102 and soft, discharge considerable since yesterday, but good; two ligatures came away.

Vespere. Bowels again relaxed, has taken some soup and wine during the day.

R. Tinct. opii m. xxx.

Pulv. rhæi. gr. xx.

Aq. menthæ sativæ ʒj. misce et fiat haustus statim sumendus.

28. Vomited the draught half an hour after taking it, but was quiet in the night, although without much sleep, and had two loose stools, pulse 105 and weak; lips parched with thirst, tongue dryish, skin natural, the wound looks pale and languid, discharging greenish coloured matter of tolerably good consistence.

Two o'clock, P. M. Has just had a copious

loose evacuation, the colour of barley meal gruel, and fetid.

R Pulv. rhæi. gr. viij.

Hydrargyri submuriatis, gr. ij.

Conf. aromat. q. s. ut fiat bolus, statim sumendus.

Vespere. Has had three stools with tenesmus and griping since taking the bolus, the last being more scanty and fetid, and of darker hue, pulse 102, slept well before the action of the medicine but not since, ordered him an ounce of mulled wine with five drops of opium every hour when awake.

July 29. Passed a quiet night, having two motions more copious but less offensive, pulse the same in number as yesterday and fuller; appears better, though very irritable, tongue clean and moist, lips not so much parched, wound improved, granulations more florid and healthy, two more ligatures (one of them from the femoral artery) and the remaining suture are come away, discharge rather lessened.

Capiat infusi gentianæ comp. ʒi Pulv. rhæi gr. iij. secundâ vel tertiâ quâque horâ.

Vespere. Has had three evacuations since morning of a pale colour, having the appearance of indigested food.

30. Slept tolerably well and comfortable, had three stools during the night, the last being nearly

natural, pulse 90, improved and firmer, wound looking well, discharge copious.

Vespere. The discharge having increased to such a degree as to issue out from under the pledgets, the wound has been opened and fresh dressed in the usual manner; bowels still much relaxed.

R. Extracti opii gr. iss. fiat pilula statim sumenda.

31. Rested remarkably well, sleeping soundly all night, and only one evacuation, pulse 96 and stronger, wound looking more healthy, and not discharging quite so much.

Infusi gentianæ comp. 3j tertiis horis.

August 1. Eat a good dinner yesterday, and drank some old port wine, passed a very favourable night, wound appears well, but a considerable quantity of discharge comes away by pressure from the vicinity of the acetabulum, where it collects in spite of our endeavours to prevent it by compress bandages &c. the last ligature came off, though not so easily as the others, having embedded itself in granulations, no motion since the evening, pulse 108.

Vespere. Feverish and low spirited, pulse quickened to 116, has had three stools since the morning visit, complains of tension of the abdomen, with flatulency and a burning heat running up towards the sternum.

Omitte infusum gentianæ.

Habeat statim misturæ salinæ. $\frac{3}{4}$ iss.

Aug. 2. Slept well, had two motions during the night, abdomen tense, right extremity cold and œdematous, wound pale and languid, discharge moderate, and but little of it issuing from the cavity of the acetabulum.

Capiat Olei ricini $\frac{3}{4}$ ss statim.

Liniment : anodynum cum camphorâ.

3. Rested well during the night, had three motions after taking the castor oil, wound improved in appearance, but discharges considerably; a small quantity of good pus issued out when dressing from an orifice formed at the superior part of the line, œdema of the right leg and foot abated.

Repetatur infus. gentianæ ut antea.

Extr. opii gr. ij. hora somni.

4. In the afternoon he was very sick, and vomited some green bilious fluid, but kept down some beef tea in the evening, and took the opium at ten o'clock, had a motion of tolerable consistence at midnight, slept extremely well, but has no inclination to eat; pulse 100 and pretty good, wound florid and healthy, discharge not so great, granulations springing up rather luxuriantly.

Vespere. Did not relish his dinner, feels a kind of stupor, and complains of pain with darting sensations in the stump, which seem to diminish on ap-

plying cold water and spirits, pulse 108 and weaker, has had two loose evacuations since morning.

Extr. Opii gr. ij. hora somni.

5. Slept tolerably well, has been a little purged in the night, complains of tenesmus and tension of the abdomen, pulse 120 and weak, could eat no breakfast, is extremely irritable, obstinate and cross, wound looks well, discharge small but not very good.

R Olei ricini ℥i Tinct. opii. m. xxx. Aq. Pimentæ ℥i fiat haustus statim sumendus.

Vespere. Medicine operated, bringing off two fetid stools, tension of abdomen much decreased, pulse 128 and feeble, has taken hardly any nourishment to day, ordered a little mulled wine to be given him often during the night.

R Vini antim. tartar.
Tinct. opii āā. m. xx.

Aq. menth sativæ . . ℥iss.

Fiat haustus statim sumendus.

6. Passed an easy night, though with little sleep, had two stools towards morning, pulse 112 and stronger, wound looking healthy but discharged on dressing a considerable quantity of thin fluid; eat some chocolate for breakfast, and is improved, directed some Tincture of Kino to be given in his wine, as he refuses to take medicines.

Vespere. Has had four evacuations since morning, the last being more natural, feels quite easy, but dislikes the kino in his wine, and can only with difficulty be prevailed on to take it.

Extr. opii gr. ij. hora somni.

7. Slept tolerably well till six o'clock, when he was disturbed by spasms and darting pains in the inferior part of the wound, and soon after the bandage became tinged with blood to a considerable extent; compresses of linen wetted with vinegar and spirits were immediately applied, and continued over the whole right till ten o'clock, when the dressings were removed, but the bleeding had ceased, and the source could not be discovered, or the quantity of blood lost be ascertained; but I think it did not exceed four or five ounces, the wound did not look bad, though the stump appeared and felt swoln, the granulations pale and languid without much discharge; fresh dressings were now applied with only a wet pad over them, the bandage being dispensed with, pulse 112 and pretty good.

R Infus; rosæ lb j. Acid sulph. 3 ss. misce.

Fiat mistura cujus capiat æger. cohlearia iij.
ampla quartis horis.

Vespere. Has been quiet and easy all day, no sign of hæmorrhage or heat of stump, but the tension continues; had one motion since morning.

Extr. opii gr. ij. hora somni.

8. Has had an excellent night, with three evacuations; pulse 112, and weak; wound looks languid and pale; discharge profuse, mixed with coagulated blood, issuing chiefly from the neighbourhood of the acetabulum; is not quite so irritable, and appears somewhat mended.

Pergat in usu pil. opii. hora somni.

9. Rested well, having only two stools, and those pretty natural, appears considerably mended, pulse 100 and improved, wound florid and healthy, with but little discharge.

10. Although he has slept well, and is free from pain, yet he is excessively irritable, cross, and obstinate, refusing nourishment, wine, and medicine, pulse 112 weak and fluctuating, countenance pale and thin, wound not looking so well, and discharging very considerably.

Vespere. Has had two evacuations the last twenty-four hours, and is quiet and easy, could not be prevailed on to take any medicine, but drank a little mulled wine, and eat a morsel of chicken.

11. Seems more lively, and is much improved, slept well, and had two motions, pulse 104 firmer and more regular, held the stump himself, and assisted us whilst dressing it, discharge decreased and the granulations brighter, has made a good breakfast of chocolate and an egg.

Vespere. Complains of not having enough to eat, and is improving hourly.

12. Bowels getting into good order, passed a comfortable night, and is in much better humour; says he shall get well; afforded considerable assistance in dressing the wound, which appears more florid and healthy, but discharges profusely.

Repetatur infus. rosæ, ut antea.

13. Having eat a little fish for dinner, he became sick in the evening, and vomited, but rested well all night; has taken some of his medicine, and positively refuses swallowing any more; discharge from the wound rather increased; granulations requiring caustic.

Vespere. The fish eaten yesterday has just been thrown off his stomach in a totally indigested state, pulse increased to 120, but weak; has had four fetid stools since morning.

Capiat Tinct: opii 3 ss in vini rubri ʒij horâ somni.

14. Much better, passed a good night, and only twice purged, pulse 106 and improved, edges of the wound healing fast, granulations rather exuberant, made a good breakfast with chocolate, and at his own request was placed in an erect position.

Vespere. Has sat up in bed for four hours, and feels stronger, &c.

15. Had three loose motions during the night, but nevertheless rested well, pulse 120 and inclined

to waver, countenance not quite so cheerful, wound healing, discharge diminished.

Four o'clock P. M. Has had five evacuations since the morning visit; complains of pain about the abdomen, which is tense, and cannot relish any thing.

R. Olei Ricini ℥ss.

Tincturæ opii m. xx.

Aq. pimentæ ℥j. statim sumendus.

Vespere. Vomited about an hour after taking the medicine, throwing off part of it with much bilious matter; some thin soup was then given him, after which he became easy, and went to sleep for some time.

R. pulv. rhæi. gr̄ xv.

Magnesiae carbonatis gr̄ x.

Tr. opii m. xv.

Aq. piment. ℥j. misce. Fiat haustus.

16. Retained the medicine on his stomach, and slept well till break of day, since which he has four evacuations, and is now easy and comfortable, abdomen softer, pulse 111, and rather more regular, wound healthy and discharging but little.

Vespere. Bowels still lax, but he appears to be doing well.

Extr. opii gr. ii. hora somni.

17. Had two loose stools since evening; eat some breakfast, but vomited it up again with a quantity of bile; spirits much depressed, and he is become more irritable, and looking pale, emaciated, &c. Pulse 100, soft and pleasant to the feel, wound florid, discharge profuse and excessively thin.

R. Extract. gentianæ gr ij.

Pulv. aromat. gr j.

Fiat pilula quartâ quâque horâ sumenda.

R. Pil. hydrargyri gr iij.

Pulv. aromat. gr ij.

Fiat pilula nocte sumenda.

Vespere. Very low and weak, though more tranquil; has had three motions since morning, but not so liquid as before; the dressings appear to be slightly tinged with blood, being first observed about an hour ago, when he was restless, and made an effort to vomit; seems to be changed for the worse, and declares he will take no more medicine or wine. Applied a clean bandage, and left him for the night.

18. Has had but little sleep, being extremely restless all night, and is now in an extremely low debilitated state; pulse 106, and very weak. At seven this morning the bandages, pads, &c. were perceived to be soaked in blood, and immediately wetted with vinegar, and compressed by the hand of one of the assistants for about two hours, when

the dressings were removed; but the hæmorrhage had ceased, and no trace or sign could be discovered to guide us to the vessel from whence it had taken place; the stump was found much tumefied and hard, though in other respects looking well; fresh lint, sticking-plaster, and a pad, were applied without a bandage, and an orderly directed never to quit the bed-side, but to keep the whole wet and cold, with a lotion composed of the superacetate of lead, spirits of wine and vinegar. His spirits have entirely forsaken him; he has given up all idea of living; feels disgusted with every body and every thing, and wishes to have a priest sent for; the quantity of arterial blood lost on this occasion is, I imagine, about three or four ounces.

One o'clock P. M. His face and extremities are getting cold.

Vespere. Is quiet and easy, no appearance of hæmorrhage; pulse 100 and very weak; drank a little brandy and wine during the day; has been attended by his pastor, made a distribution of his things, and believes he shall die at midnight!

19. Has been composed and comfortable all night, sleeping at intervals, and is certainly improved; pulse 90 and stronger, abdomen soft and flaccid; no motion the last 36 hours, wound discharges copiously a thin sanious fluid, mixed with coagulated blood; the tumefaction of the stump somewhat diminished: took some chocolate for breakfast.

Vespere. Is free from pain, and has had a loose

motion; pulse 90 and very weak; dressings slightly tinged with blood, eat a morsel of beef for dinner and drank some brandy and water; is quite resigned, and thinks a few hours will decide his fate.

20. Slept only three or four hours, but was tranquil till morning, when he became wandering and talked incoherently; has with much difficulty been prevailed on to sip a little brandy, and take a small cup of chocolate. Pulse very small and weak, and hardly to be counted; wound pale and languid, discharging but little; extremities cold and numb, and he is altogether so much worse as to leave no hope. At three P. M. he died.

Dissection.

“ On making an incision the whole length of the cicatrix, and down to the acetabulum, the parts exhibited a variegated appearance, having a white spot near the centre, the shape and size of an acorn, with the consistence of tendon; a sinus ran down to the edge of the sacrum, being, together with the acetabulum, filled with a sanious fetid fluid; another sinus also extended about an inch and a half in the course of the femoral artery towards the groin, on the superior side of the wound: the edges of the acetabulum had a rough feel, and were denuded of their cartilaginous covering; when making the in-

cision the knife conveyed the same sensation, as is experienced on cutting an apple, and indeed such was the case when performing the operation. On laying open the abdomen, the liver was found considerably enlarged, weighing nearly seven pounds; externally, of the colour of straw, and appearing internally as if parboiled, bearing also evident marks of having been injured by the immoderate use of spirits; the pressure of it against the ribs had been so great, from its enormous size, as to cause the formation of regular grooves. The cardiac orifice and extremity of the stomach, bore signs of inflammation, as did the jejunum, and part of the ileum. In the thorax were found such firm adhesions of the lungs to the pleura, that they could not be separated without lacerating and tearing them to pieces. The other viscera were in a healthy state. The orifice of the vessel from whence the hæmorrhage came could not be discovered."

I have been informed, that the whole of the gentlemen who were present at the performance of this operation were highly satisfied with the method of doing it, and declared their conviction, that if the patient's state of health had been good, and the soft parts of the stump less diseased, there would have been little doubt of a successful issue; and although the morbid state of the stump rendered the successful termination of the operation very doubtful, they still expressed their unanimous opinion, that Mr. Emery had conscientiously done his duty

in performing, and deserved much credit for undertaking, so difficult and serious an operation.

Mr. Brownrigg, Surgeon to the Forces, has performed the operation four or five times: on one occasion the patient lived eight days, and died from fever, supposed to arise from causes foreign to the operation.

In the last case he was completely successful. The man received a gun-shot wound in the thigh, which fractured the bone close to the trochanter, on the 29th Dec. 1811, near Merida, in Spain. On the 12th of December, 1812, the operation was performed, and the man is now living at Spalding, in Lincolnshire, in perfect health.

Mr. Brownrigg intends, I believe, to publish the particulars of this case. I have also been informed, that the operation has been performed in the West Indies.

These cases prove, that the operation is not only necessary, but practicable, and that it may be effected with success under certain circumstances. This being granted, it necessarily follows, that the operation ought to be recommended and performed in every case in which it can alone bring relief, or offer a prospect of success. No man should, therefore, be allowed to die without its being proposed to him; and if it be a case for primary operation, the sooner it is done on the field of battle, consistent with propriety, the greater will be the chance of success, for the patient cannot live

to the period for secondary amputation. It is in this, and other operations high in the thigh, that the question of time is most important, for haste is as injurious as delay, when improperly applied.

If the patient has suffered much loss of blood, or is in a state of syncope, or nearly approaching to it, unable to articulate, with a pulse scarcely perceptible, and the skin clammy and cold, an immediate operation would only hasten his death; but if excited by stimulants and cordials, he will have some chance of recovering himself in an hour or two, so as to undergo the operation with a better prospect of success, or he will in that period sink and die. If, on the contrary, he is brought to the surgeon, although much alarmed and reduced by the sudden shock and loss of blood, with strong sensations of pain, expressed by his cries for assistance, convulsive motions of the limb and body, and the powers of the sensorium not destroyed, the operation should be performed immediately; or, instead of becoming more calm and collected, he will gradually sink into the state of the first described, and be unable to bear the operation. On the other hand, the first mentioned, if he be excitable, will in time rather approach to the state of the latter, and from the pain, &c, he suffers, will call for the performance of the operation. This violent nervous commotion, however, is not common; it depends upon particular idiosyncrasies, and will never in the first be so excessive as in the last.

The operation being decided upon, it is, I confess, not like that at the shoulder-joint, to be done by every one of moderate ability. No surgeon should attempt it, unless he is conscious of possessing great coolness, a presence of mind equal to any emergency, and a correct knowledge of the parts to be divided.

The fear usually entertained by surgeons, is that of incontrollable hæmorrhage ; and Mr. John Bell (whose works have done so much good in the surgery of arteries) has here done much mischief, in persuading many young men, that hæmorrhage from large arteries is not to be restrained by any pressure ; which is, in my opinion, one of the principal errors of his work, in relation to military surgery, and is indeed almost as great an error as any he has laboured so effectually to overturn.

He says, p. 415 of his Principles of Surgery, “ I
 “ will repeat with confidence what I have frequently
 “ affirmed, that it is one thing to suppress the pulse
 “ in the lower part of the limb, and another thing to
 “ stop the pulse in the great artery. I have tried
 “ in great operations, near the trunk of the body, to
 “ stop the blood by pressure ; but though I could
 “ suppress the pulse of the femoral artery with my
 “ fore-finger, I could not command its blood with the
 “ whole strength of my body.” And in a note he
 says, “ the fact which I have here affirmed is of too
 “ much importance for me not to maintain it with
 “ more than common earnestness. I affirm then that

“ though the throbbing of an aneurism, or the pulse
 “ in the lower part of a limb, be quite suppressed,
 “ yet the circulation is not stopped ; and I entreat
 “ the young surgeon never to trust to any such mark
 “ of the compression being effectual.”

If he wish it to be understood, that the inguinal, or the subclavian artery, cannot be commanded by any pressure, so as to prevent hæmorrhage on their division, it is merely advancing an opinion, that hardly needs a comment ; for almost all the medical officers of the British army have, on many occasions, seen both vessels so effectually compressed by moderate pressure, that not one drop of blood has escaped from the orifice of the artery, after it has been divided. I am therefore willing to believe that this cannot be his meaning, but that he supposes a certain degree of pressure may stop the pulsation of the artery without suppressing the circulation : an opinion equally as dangerous, and erroneous, as the other ; for it tends to keep the mind of the young surgeon in alarm, and thereby obstructs the free exercise of his judgment, during the whole course of many serious operations, when he often requires the greatest firmness to enable him to surmount the difficulties that present themselves. This alarm is most unnecessarily raised, for I have no hesitation in declaring, and I am supported in the assertion by all the surgeons of extensive practice in the British army, that when the pulse is suppressed in a great artery, that the

flow of blood is completely restrained for every purpose in military surgery. I will even say, that the flow of blood shall be entirely suppressed, and yet the pressure upon the subclavian artery above the clavicle, shall be so moderate, that the instrument will not leave a mark upon the skin discoverable after twenty-four hours. I do not assert this without solid foundation, for I have seen the inguinal and subclavian arteries compressed and divided very many times, and I have had the femoral and axillary arteries as often between my fingers; but, I never saw blood projected one inch from the orifice of these vessels without the pulsation or motion of the artery taking place; and I never saw blood flow in a stream from the orifice of any large artery. I have seen, when the sides of these vessels have not been pressed exactly together, so that the inner coats have not been in contact, that a little blood has oozed to the mouth of the artery, and that it has even dropped from it; but the moment this drop became a stream, the pulsation of the artery was sensible to the fingers, and the blood thrown out, came per saltum. I have never found any difficulty in holding the divided end of the femoral, or axillary arteries, between my finger and thumb, whilst a ligature has been placed upon them; and I do not therefore believe, that the blood is propelled in these arteries, with a force that is not readily overcome by moderate pressure; or, that in a healthy man any circulation goes on

in an artery, when the pulse of that artery has ceased in consequence of pressure. It is not, indeed, consistent that it should, for if the circulation can go on so as to cause a dangerous hæmorrhage, without any pulsation of the artery, the continuance of it in the smaller arteries in a state of health would almost appear unnecessary. If it be said, that it is not circulation, but merely a little blood that passes between the sides of the vessel that are not exactly in contact; I would reply, that if such an occurrence did take place, the quantity must be so small, as to be unworthy the attention of the surgeon; for, if it were in greater quantity, it would be attended by pulsation of the artery.

I do not mean, in the slightest degree, to doubt the correctness of Mr. Bell's statements, of his inability to suppress the circulation in the cases of aneurism he has adduced. I mean to assert only, that the passage of the blood through a healthy artery, can be effectually prevented by moderate pressure; that when the pulse has ceased in a large artery in consequence of this pressure, the circulation is suppressed for every purpose in surgery; and that the surgeon may therefore divest himself of all fear of hæmorrhage. It is, indeed, a fact so notorious in the medical department of the army, that I need not have noticed it thus particularly, if I did not think the great authority of Mr. Bell's opinion, might prevail, when the practice of the peninsular war shall be forgotten.

The difficulty supposed to arise from this cause, was to be surmounted in the amputation at the hip-joint, by putting a ligature on the artery below Poupart's ligament; and all who have written on the subject, or attempted this amputation, have directed this operation, often considered serious in its performance, although in reality, extremely simple, as a preliminary step. Tourniquets were not invented for this operation, as for the shoulder, for little dependance was placed on compression; and they knew there were several other arteries to be divided, that could not be commanded by any external means. This consideration, combined with the great shock to the nervous system, and the supposed impossibility of a person surviving the operation, induced most surgeons to abandon it as a hopeless piece of barbarity.

The surgeon, after making himself acquainted with every part, but more especially with the course of the great vessels, and the insertion and attachment of the muscles in and near the trochanters, must endeavour to free himself from this dread of hæmorrhage, which shackles his hands and his judgment. If he cannot do this, he had better not attempt the operation, as its success must depend, in a great measure, on the celerity and ability with which it is performed, and on the due securing of the vessels with little loss of blood; two points that may be accomplished by a surgeon thus prepared, with little difficulty. The larger an artery the

more readily it is secured, and the femoral artery the most readily of all. The smaller vessels only require the ends of the fingers to be placed upon them to stop the flow of blood, and this support, which hardly amounts to compression, is sufficient for vessels of considerable size, such as the branches of the glutæal, sciatic, and obturator arteries, to be divided in the course of the operation. The femoral artery in the groin can always be held with ease between the finger and thumb, or pulled out by a tenaculum, until a ligature be put around it. In fact, military surgeons must entirely throw off this dread of arterial bleeding which they bring with them into the army, or they can never become good practical military surgeons.

I think this operation should be performed only by surgeons who have already attained a competent knowledge of the relative situation of parts, and some dexterity in operating; and not as at the shoulder-joint by the junior officers of the department. I shall mention, however, the most important points of anatomy to be attended to, which may much expedite, or delay, the operation.

Immediately under the skin and cellular membrane there is a strong fascia surrounding the thigh, and attached with the tendinous expansion of the glutæus maximus to the linea aspera, which attachment gives some little inconvenience, if not separated from the bone. Under this fascia there

are twenty muscles surrounding the hip-joint, the whole of which must of course be divided. 1. Tensor vaginæ femoris. 2. Sartorius. 3. Rectus cruris. 4. Iliacus internus. 5. Psoas magnus. 6. Pectinæus. 7. Gracilis. 8. Triceps, arising by three distinct heads, longus, brevis, magnus. 9. Semi tendinosus. 10. Biceps long head. 11. Semi membranous. 12. Quadratus femoris. 13. Obturator externus. 14. Obturator internus. 15 and 16. Gemini. 17. Piriformis. 18. Glutæus minimus. 19. Glutæus medius. 20. Glutæus maximus. Many of these are simply divided in the first incisions, without difficulty or interference, with the ulterior steps of the operation. The muscles immediately attached or inserted about the joint do, however, cause inconvenience if overlooked, or not known; and these are Nos. 4, 5, 6, 12, 13, 14, 15, 16, 17, 18, 19, and 20. The knowledge of the insertions of these muscles will enable the surgeon to understand and obviate any difficulty that may arise in dislocating the head of the femur.

The vessels are in four sets. The femoral, obturator, sciatic, and glutæal arteries. The femoral artery has the anterior crural nerve on the outside, and its corresponding vein on the inside, and may be compressed with certainty where it passes over the brim of the pelvis.

The obturator artery, whatever may be its origin, always comes out through the thyroid fora-

men; is not compressible, but is not of great size.

The sciatic artery is given off by the internal iliac, passes out of the pelvis below the pyriformis muscle, and divides into a number of branches running downwards towards the thigh, and anastomosing largely with vessels coming from the fore part: it is also not compressible, and several branches will bleed during the operation; but they are easily stopped by the points of the fingers, and often cease to bleed spontaneously.

The glutæal artery is given off before the sciatic in the pelvis, comes out above the pyriformis muscle, and principally supplies the outside of the haunch. One large branch descends between the glutæus maximus and medius towards the thigh, supplying these muscles, and a branch or two may bleed during the operation, but they are not of much importance.

There may also be some small branches of the external pudic artery divided, but they will not in general require to be tied.

The femoral vein is large, and will require a single thread to be placed over it.

The head of the bone is retained in the acetabulum by a very strong capsular ligament, and by an internal ligament, called the ligamentum teres, which, until it is divided, effectually prevents its dislocation.

The anterior crural nerve on the fore part, and the great sciatic on the back part, alone require observation, and they should be cut short.

This operation being considered necessary, it must, like all others, be done with reference to the parts remaining uninjured; but there is, in general, more choice in this instance than in many other operations; for the patient will seldom survive an injury, or the operation be recommended, in which there is not an opportunity of selecting the parts to be retained, for the formation of the flaps.

It has been recommended to commence the operation by amputating the thigh first, in the usual manner, and then, by cutting through the muscles which surround, or are attached to the bone, to remove it from the acetabulum. This I consider as two operations instead of one, by which much time is lost, and nothing gained. The vessels are not so readily secured, and the parts will not be in such just apposition, or so favorably disposed to unite.

It was proposed formerly in France, by Mess. Volher and Puthod,* to commence the operation by tying the artery on the fore part of the thigh; when the patient is to be placed on the opposite side, resting upon the ilium and the great trochanter. An incision is then to be made from about

* See *Opuscles de Chirurgie de Morand*, page 189. *Premiere partie*. Paris, 1768.

three fingers breadth below the tuberosity of the ischium, through the integuments forwards, so as to expose the tendon of the glutæus maximus inserted into the linea aspera, which is to be cut through to form the flap on the under part with the semi-membranosus, semi-tendinosus, and biceps; the glutæus medius and minimus are to be cut through, with the muscles inserted between the trochanters. The capsular ligament is then opened into, the ligamentum teres divided, and the head of the bone dislocated. The muscles and integuments on the inside remain to be cut through, when the operation is completed. It was allowed by its advocates to be a tedious, and it must be a very inconvenient operation; for the knife, in detaching the different muscles from their attachments, may cut much more than is intended, as its effects are not observable. The hæmorrhage is from a hollow space, and not so readily commanded; and every step of the operation, after the first incision, is difficult and tedious.

M. Larrey describes his method of performing the operation as follows. * “I place the patient nearly in a horizontal position on the foot of the bed, and stand on the inside of the thigh to be operated upon, an able and intelligent assistant compressing the artery where it passes over the

* See tome ii. p. 186.

brim of the pelvis. I make an incision in the groin in the course of the great vessels, which I carefully lay bare ; and having separated the anterior crural nerve, which is on the outside of the artery and vein, I pass a blunt curved needle under them, so as to include both together in the same ligature. I take care to make this ligature immediately below the crural arch, so as to tie the vessel above the origin of the profunda, the division of which, during the operation, without this precaution, might cause a fatal hæmorrhage. Having tied the femoral artery, and placed a ligature above it, to be tightened, if necessary (*ligature d'attente*), I plunge my straight, sharp-pointed knife perpendicularly into the thigh, between the tendons that are attached to the little trochanter, and the base of the neck of the femur, bringing out the point of the instrument diametrically opposite, on the posterior part of the thigh or buttock, and by then directing it obliquely downwards and inwards, it cuts itself out through all the parts which ought to form the inner flap, which should not be too large. This flap is to be raised up towards the scrotum by an assistant, and the articulation is immediately visible. The obturator, and some branches of the external pudic artery are divided, and these must be immediately secured. A single stroke of the bistoury is sufficient to divide the capsular ligament ; the head of the femur is almost dislocated by simply moving the bone outwards, and it will readily be conceived

how easily the ligamentum teres may be divided by the same instrument. I then form the outer flap by passing the cutting edge of a small straight knife between the brim of the acetabulum and the great trochanter, carrying it downwards and outwards, nearly on a level with this tuberosity, so as to give a rounded form to the flap. The assistant who holds the flap stops the mouths of the bleeding vessels with his fingers, until they can be tied, and the smallest arteries should be secured to prevent secondary hæmorrhage, and to allow of union of the flaps. If these flaps are not diseased, or inflamed, or irritable, or, in other words, are healthy, some stitches by the interrupted suture may be made in the integuments to keep the parts together, but the muscles must not be included. The flaps are to be kept in contact by compresses moistened in red wine, and by a retaining bandage.

“ I have always found it a quick and easy operation. I had planned the mode of doing it before I entered into the service, and the trials I made on animals, and on the dead body, led me to hope for a successful result on the living.

“ The surgeon must afterwards attend to the general state of the patient. Bleeding, if there be any indication of plethora, with refrigerants, antispasmodics, perfect quiet, and proper diet, are not to be neglected. By these means the inflammatory symptoms usually accompanying great operations, such as amputation, are obviated. The

adhesion of the flaps quickly takes place, and supuration is established only where some bruised or injured parts have remained in the wound."

This last remark of M. Larrey I consider a very valuable one, as it is a complete answer to all his own objections to union by the first intention after primary amputation in other parts, and especially at the shoulder and thigh; for every evil and every accident that can happen in these or other places, in consequence of the attempt to procure union, will, I conceive, occur in the hip; and if it be an object to avoid them in every other part, it must be equally so at the hip, for if union is not desirable after amputation at the shoulder or thigh, I do not see why it should be sought for at the hip alone.

To the method of operating I have some objections. I consider the preliminary step of tying the artery and vein as unnecessary, by prolonging the operation; the placing of a precautionary ligature above, to be drawn tight if necessary, (*ligature d'attente*) is now universally allowed in England to be extremely dangerous, inducing rather hæmorrhage by causing ulceration of the coats of the artery, against which it presses, than preventing it, being therefore itself the cause of the mischief it is intended to suppress. The artery and vein should be tied separately; the internal flap made in the manner recommended by M. Larrey, will require a knife being carried in our military cases of instruments for this purpose alone, as it must be long,

narrow, straight, pointed, and have two cutting edges. The flap made in this manner will, without care, contain too much muscle for the integuments; and as the knife is only used for this step of the operation, its place may be supplied by the common one, by cutting from without, inwards. I also consider the outer flap as better made, by cutting in the same manner, through the integuments from without.

I consider the operation to be best performed in the following manner: The patient should be laid on a low table, or two field panniers placed together, covered with a folded blanket to prevent the edges giving pain, and properly supported in a horizontal position. An assistant leaning over, and standing on the outside, should compress the artery against the brim of the pelvis, with a firm, hard compress of linen; such as is usually used before the tourniquet; he should also be able to do it with his thumb, behind the compress, if it be found insufficient. The surgeon standing on the inside, with a strong pointed amputating knife of a middle size, with the back curved, makes his first incision through the skin, cellular membrane, and fascia, so as to mark out the flaps on each side, commencing about four finger's breadth, and in a direct line below the anterior superior spinous process of the ilium in a well-sized man; and continuing it round in a slanting direction at an almost equal distance from the tuberosity of the ischium, nearly

opposite to the place where the incision commenced. Bringing the knife to the outside of the thigh, he connects the point of the incision where he left off with the place of commencement, by a gently curved line, by which means the outer incision is not in extent more than one third of the size of the internal one. The integuments having retracted, the glutæus maximus is to be cut from its insertion in the linea aspera, and the tendons of the glutæus medius and minimus from the top of the trochanter major. The surgeon now placing the flat edge of the knife on the line of the retracted muscles of the first incision, cuts steadily through the whole of the muscles, blood-vessels, &c. on the inside of the thigh. The artery and vein, or two arteries and vein, if the profunda is given off high up, are to be taken between the fingers and thumb of the left hand, until the surgeon can draw each vessel out with the tenaculum, and place a ligature upon it. Whilst this is doing, the assistants should press with their fingers on any small vessels that bleed. The surgeon then cuts through the small muscles running to be inserted between the trochanters, and those on the under part of the thigh, not yet divided; and with a large scalpel opens into the capsular ligament, the bone being strongly moved outwards, by which its round head puts the ligament on the stretch. Having extensively divided it on the fore and inside, the ligamentum teres comes into view, and may readily be cut

through. The head of the bone is now easily dislocated, and two or three strokes of the knife separates any attachment the thigh may still have to the pelvis. The vessels are now carefully to be secured. The capsular ligament, and as much of the ligamentous edge of the acetabulum may be removed as can readily be taken away. The nerves, if long, are to be cut short, the wound well sponged with cold water, and the integuments brought together in a line from the spinous process of the ilium to the tuberosity of the ischium. Three sutures will in general be required, in addition to the straps of adhesive plaster, to keep the parts together; the ligatures are to be brought out in a direct line between the sutures, a little lint and compresses are to be placed over the wound, and on the under flap, to keep it in contact with the cotyloid cavity, and assist the union of the parts. A piece of fine linen is to be laid over them, and the whole retained by a calico bandage put round the waist, and brought over the stump.

It is recommended to pare the bone of its cartilage; and if this could be readily done, I would willingly agree to it, but the cartilaginous surface of the acetabulum is not to be cut away without much difficulty and some time, which cannot be spared; for I consider the success of the operation to depend very much upon the quickness with which it is performed, not on account of hæmorrhage, but to avoid the shock the constitution receives from

the continued exposure and irritation of so large a surface in the immediate vicinity of the trunk of the body. It is proved by experience to be unnecessary at the shoulder joint; and will, I think, be found equally so at the hip joint.

When I wrote these observations, and shewed the method of performing the operation in the Peninsula, I thought I was the first to recommend that the artery should not be tied previous to commencing the operation. M. Baffos, however, has the priority in practising it, which I readily grant to him, and am gratified in having his authority to adduce in support of the measure.

Union by the first intention is to be wished for in a great degree, as lessening the surface of the wound; but as all the parts beneath the skin cannot unite, and especially about the acetabulum and the inside of the glutæus muscle, it is not advisable to let the skin adhere on the middle and lower part of the stump; for as the parts deep-seated must suppurate and granulate, a fair opening for the discharge should be preserved, and collections of matter in any part should be carefully guarded against by gentle pressure, compress, and bandage.

The after treatment will be the same as in other cases of amputation: the shock, however, of the injury and the amputation will be so great, that the antiphlogistic regimen to the extent of blood-letting will not be necessary. If the patient be very low, cordials in small quantities, with opiates, should be

given, and a light nourishing diet. If inflammatory symptoms come on, the appropriate remedies formerly recommended must be employed without delay. If there be heat or uneasiness in the wound, it must be kept wet with cold water.

If the surgeon called upon to perform this operation, has not been in the habit of dealing with large arteries, he may feel an unconquerable repugnance to cutting through the femoral artery before it has been tied; and although I can most positively assure these gentlemen, there is nothing to fear in doing it, still they may tie the artery first, if they cannot overcome this feeling of danger. It is to be done by cutting through the integuments in the usual manner, and then dissecting for the artery and vein, previous to cutting through the muscles.

Amputation of the Thigh.

This operation is a very frequent one in military surgery, arising from the more serious nature of all wounds affecting the lower extremities, from the difficulty generally attending their cure; and from the greater number of injuries they are exposed to, from their length, structure, and situation, in relation to the body.

The value of a primary or a secondary operation, can only be justly estimated by military surgeons, by those who have performed them frequently on the

field of battle, and who have seen the fatal effects of them, when done at a later period in our hospitals ; but as the danger is greater in proportion as the amputation is higher or lower in the thigh, it becomes an object of the first importance to ascertain when the operation is necessary, that it may be performed as near as possible to the seat of injury, before the inflammatory symptoms and the symptomatic fever are established.

The important difference of success in primary and secondary amputations, arising from many causes which it would be unnecessary to repeat, renders a due consideration of severe wounds of the thigh essentially necessary ; and the knowledge, skill, and just discrimination of a surgeon, are perhaps no where more tried, than in deciding upon cases of severe wounds of the thigh, as requiring amputation or not ; for delay improperly advised is almost tantamount to a sentence of death, whilst immediate amputation may be considered as the harbinger of safety.

Wounds from cannon shot or shells, in general shew their nature sufficiently to enable the surgeon to decide without much chance of error. There are cases, however, in which it becomes more difficult, as in the case related, page 138, which, although successful under particular circumstances, would have been otherwise in a different situation. In cases then of extensive wounds of the integuments and muscular part of the thigh by cannon shot,

where the great vessels, the bone, or the great nerves are not injured, the limb should not be amputated, as with care they may do well ; but if this care cannot be given, and the operation is required as high as the middle of the thigh, the patient will have a better chance of recovery, if it be done immediately.

If a cannon shot strike the back part of the thigh, and carry away the muscular part behind, and with it the great sciatic nerve, amputation is necessary, even if the bone be untouched ; for although the wound might in some measure heal, the motion of the leg would be lost, and it would become an insupportable burthen to the patient. In this case I would not perform the operation by the circular incision, but would preserve a flap from the fore part, or sides, as I could get it, to cover the bone, which should be short : I would then cut away the injured part leaving a clear incised surface, enforcing at the same time the most severe antiphlogistic regimen, and reducing the local inflammatory symptoms as they appeared, by the application of cold or iced water, and leeches. The object to be gained by this kind of operation, is to prevent its being done very high up, which the circular incision would render necessary ; and which is more readily explained by the following case :—A cannon shot strikes the outer part of the thigh below its middle, and fractures the bone with much laceration of the muscles of the outside, the muscles and integuments

on the inside remaining sound : allowing the bone to be but little splintered, amputation by the circular incision will require its removal at the lesser trochanter, on account of the want of soft parts ; whereas, if the covering for the bone be saved principally, or entirely from the inside, the amputation may be safely done much lower down, and the surgeon has the advantage, by the flap operation, of examining the bone as he proceeds, and making his flaps accordingly.

A cannon-shot in full force, breaking the bone in any way with a wound of the integuments, will always require amputation ; and if the integuments be not divided, in consequence of the diminished velocity of the ball, it will yet in general be necessary, from the comminuted nature of the fracture, and the total disorganization of the soft parts between ; but these cases are of rare occurrence.

A cannon-shot destroying the artery and vein on the inside, without injuring the bone, requires amputation. I have seen an eight pound shot lodge in the thigh without making a large opening, and remain undiscovered until the thigh was amputated, when it rolled out. A one or two pound shot may pass through without much evident mischief, and as the artery when fairly divided, does not necessarily bleed for any length of time, the injury may not appear very extensive, when the man reaches the surgeon : but amputation is not less necessary,

for the patient would otherwise not only lose his leg, but probably his life.

In a wound of this kind, from a musket ball, or small cannister shot, dividing the artery or vein, or passing between them without opening into either, a different practice is to be adopted. The injury will sometimes not be discovered, until pointed out by the gangrene of the toes and feet. The hæmorrhage will often, under different circumstances, sufficiently indicate the mischief, and if it continue the vessels are to be cut down upon and examined; if the artery alone is wounded, both its ends should be secured in sound parts, and the result carefully awaited; but if the artery and vein are both injured, amputation will, I think, be necessary. It is most certainly a very severe measure for a wound apparently of little moment, which, even in some cases, after a few minutes, shall not bleed; and yet I do believe that when the femoral artery and vein are both wounded, that it must ultimately be performed, or the patient will die of gangrene of the extremity. Few persons will, indeed, submit to so formidable an operation, or can be made sensible of their danger, from so apparently slight a wound, until they see that danger approaching with rapid strides, in the shape of mortification, on the third or fourth day; and this should always be kept in view in such cases, that the operation may be done as soon as possible, after the preservation of the limb

is obviously impracticable. In every case I have seen in which the femoral artery and vein were both wounded, gangrene of the limb was the consequence.

An injury of the artery requiring an operation, accompanied by fracture of the bone of the most simple kind, is a proper case for immediate amputation; for although many patients would recover from either accident alone, none would I believe surmount the two united, and the higher the accident is in the thigh, the more imperious is the necessity for amputation.

If, after a fracture by gun-shot, that is successfully treating as far as regards the consolidation of the bone, which is always more or less irregular, any accident, or motion of the limb should cause a rough part of the bone to wound the artery or vein, (and I have seen a case of this kind, causing hæmorrhage,) amputation is advisable as being the best calculated to save the patient's life. The operation for aneurism higher in the thigh will inevitably fail, and cutting down upon the vessel to tie both its extremities, would cause so much action in a part not in a perfectly healthy state, that the consequences would be fatal; and if amputation be subsequently resorted to with the view of obviating them, it will be done under very unfavourable circumstances.

I am aware that many surgeons will oppose to these opinions, the whole doctrine of the treatment

of aneurism ; and can bring a multiplicity of facts, drawn from this source, in support of their arguments, but I do not think they are applicable to the cases in question ; and shall content myself at present by stating, that whenever I have seen the doctrines of aneurism applied in practice to wounded arteries, and I have frequently seen it, the operation has been invariably unsuccessful ; and although I know of one successful case, I believe it to have arisen from a peculiar state of the artery ; and as will often happen in surgery, to have been successful in spite of the surgeon.

Injuries of the femur from musket-balls, are the more common wounds that render amputation necessary, and the treatment of the most favourable cases, requires the greatest attention and considerable surgical knowledge ; it is here my intention, to point out only such cases as require amputation on the field of battle ; for in secondary cases, the operation is indicated in general from the health of the patient, except where accidental circumstances occur in the wound, that render it necessary. — Having had a very extensive practice in wounds of this kind, I feel obliged to agree in the opinion of M. Larrey, expressed in his inquiry into the practice of Faure, in the 2d Vol. of his *Campagnes*, page 503. The case was a simple fracture of the body of the femur by a musket ball, without particular injury to the soft parts, on account of which amputation was performed the forty-second day.

He says, " I do not disapprove of this operation, for my experience has taught me, that all wounds with fracture of the thigh, are very dangerous, and almost all require amputation, which cannot always be done in the first instance ; and it is one of those cases in which it may be deferred to the secondary period of operation."

Fracture of the femur from musket balls, is then, a very common cause of amputation ; and this may appear singular, when contrasted with the ease with which simple fractures are cured in domestic surgery ; and even with the success attendant on compound fractures in other parts. This difference arises principally from the manner in which the bone is broken ; in accidents in civil life, the bone is in general merely broken across, or obliquely, with the point thrust through the soft parts. In gun-shot wounds, it is generally the reverse, being much shattered and not appearing through the integuments ; depending very much on the part of the bone injured, and the manner in which it has been struck by the ball.

If a musket-ball, in passing through the thigh, merely touch the bone, it may fracture it directly across, but it will generally do it obliquely, so as to cause some little shortening of the limb when cured under the most attentive treatment ; but when a ball strikes the body of the femur, it shatters the bone in every direction, although it shall not pass through : it does not merely break off four or

five small pieces, which may be taken away by cutting down upon the bone, but it breaks it into large pieces, generally oblique and very pointed, that retain their attachment to the muscles inserted into them; the fractures extend far above and below the immediate part struck by the ball, and as far as depends upon my information from the examination of limbs that were amputated, further downwards than upwards; so that from a fracture in the middle of the thigh, I have often seen fissures extend into the condyles, and cause ulceration of the cartilages of the knee joint; but they seldom extend upwards as high as the trochanters. Of such cases, there can be no doubt as to the propriety of immediate amputation, but if the fracture did not communicate with the joint, when the middle of the body of the bone is broken into several large pieces, it is better to amputate before the inflammatory symptoms come on, than afterwards; for it must then be done higher up, or probably cannot be done at all.

The danger and difficulty of cure attendant on fractures of the femur from gun-shot wounds, depend much on the part of the bone injured; and, in the consideration of these circumstances, it will be useful to divide it into five parts. Of these, the head and neck included in the capsular ligament, may be considered the first, the body of the bone which may be divided into three parts, and the spongy portion of the lower end of the bone exte-

rior to the capsular ligament, forming the fifth part. Of these, the fractures of the first kind are, I believe, always ultimately fatal, although life may be prolonged for some time. The upper third of the body of the bone, if badly fractured, generally causes death at the end of six or eight weeks of acute suffering. I have seen few escape, and then not with a useful limb, that had been badly fractured in the middle part. Fractures of the lower or fifth division are in the next degree dangerous, as they generally affect the joint, and the least dangerous are fractures of the lower third of the body of the bone. Of these even I do not mean to conceal, that when there is much shattered bone, the danger is great; so that a fractured thigh by gun-shot, even without particular injury of the soft parts, is one of the most dangerous kind of wounds that can occur.

Upon a review of the many cases I have seen, I do not believe that more than one-sixth recovered so as to have useful limbs; two thirds of the whole died either with or without amputation; and the limbs of the remaining sixth, were not only nearly useless, but a cause of much uneasiness to them for the remainder of their lives. They were indeed much in the same state as Bilguer's invalids, who were incapable of any employ, civil or military.

It would be an interesting, and I am sure a useful inquiry, to examine the lists, or cause lists to be

made, of British soldiers, who receive pensions on account of incapability for service, from wounds with fracture of the thigh bone ; and I am satisfied the number would be small, although the accident is not infrequent ; and of the number thus receiving pensions, I will venture to predict, that in seven eighths, the bone was broken below the middle of the thigh.

After the battle of Toulouse, forty-three of the best of the fractures of the thigh were attempted to be saved ; having been carried from the field of battle but a very short distance, well accommodated in hospital, and attended for the most part with great care and surgical attention ; of this number, thirteen died ; twelve were amputated secondarily, of whom seven died ; and eighteen retained their limbs. Of these eighteen cases, the state, three months after the battle, was as follows : “ Five only can be considered well, or as using their limbs. Two more think their limbs more valuable (although not very serviceable) than a wooden leg ; and the remaining eleven wish they had suffered amputation at first, as they are not likely to do well ; and if they eventually recover, which, in many is doubtful, the limb will be distorted and unserviceable.” Of two officers with fracture of the femur, one died in the hands of the French surgeons, in whose charge he fell during the action, and by whom he was skilfully treated ; the other, with the greatest

possible attention and care, has preserved a limb, which I think he will hereafter wish exchanged for a cork leg.

In the five successful cases, the injury was in all, at, or below the middle of the thigh. In the thirteen others, who retained their limbs, the injury was not above the middle third; and of those who died unamputated several were near, or in the upper third, and either died before the proper period for amputation, or were not ultimately in a state to undergo the operation. Of the seven amputations that died, two were at the little trochanter by the flap operation, and the others, for the most part, unfavourable cases. In one case only was the head or neck of the bone fractured by a musket-ball, which had entered on the outer and back part, and afterwards went through the scrotum and penis. This man was not pointed out to me for some days, and was not at that time, or ever afterwards, in a state to render amputation likely to be successful. He lived however for two months; and, from the dreadful sufferings he endured, I always regretted amputation at the hip-joint had not been performed at first.

After other battles, in which I have had the care of fractures of the femur, the success has not been so great, but they were generally under less advantageous circumstances; and from the sum of knowledge thus acquired on many occasions, I am induced to believe, that in this injury, amputation



ought to be a more frequent operation than it is at present ; and I think I am borne out in this supposition by the above statements, and by the general opinion of my brethren formed during the peninsular war.

I think it will also be conceded by those who are disposed to allow the advantage and safety of primary operations ; that if the thirty-six of the forty-three who died and have only partially recovered, had been amputated on the first day, the country would have had at least twenty-five stout men, able, for the most part, to support themselves by their labour, instead of five, or, at most, ten, who will not be entirely dependent upon their pensions and parishes for their subsistence.

As secondary amputation is totally inadequate to produce this effect, the patient should be carefully examined, and amputation performed, when necessary, on the field of battle. If the heat of the weather be great, as in the summer of the Peninsula, Asia, or America, the hospital to which the patient must be removed, at some distance, the means of conveyance bad, or the wounded very numerous, it is better to amputate, even in a doubtful case ; and if the surgeon, by following this rule, should even cut off a limb that might have been saved, he will be amply compensated by the preservation of a number of lives, that would be lost by delay under precisely similar circumstances.

In regard to officers, some little more latitude is

to be granted than the above suggestions allow; for as they can often procure cool apartments in summer, good conveyance, plentiful attendance, and the best professional advice, all of which are occasionally wanting to soldiers; cases of disease and injury will always succeed in a greater proportion with them than with private soldiers in hospital; but not in so great a degree as to counteract my opinions in cases that are really serious.

It is a difficult thing to persuade a surgeon, unaccustomed to the treatment of gun-shot wounds, or the patient himself, when he sees but a small wound, that amputation is necessary; and as cases of success have been heard off by all, whilst the fatal ones are buried in oblivion, many officers will not chuse to submit to it, and will rather hazard their future health and happiness, and undergo the most dreadful sufferings, for months, to save a limb, which, when cured, and their wishes are obtained as far as circumstances will permit, they find a useless burthen, and a source of inconvenience for the rest of their lives.

Wounds from musket-balls, injuring the lower part of the bone, without communicating with the joint, do not require primary amputation; they are proper cases for delay, except there be great destruction of parts.

Wounds of the knee-joint, with fracture of the great bones composing it, from musket-balls, require amputation, as I do not consider excision,

of the knee-joint likely to succeed in military practice; or, if it succeed in an individual case, ever to become general, from the great care, quietude, and attention it requires, independent of the danger to which it exposes the patient. It is almost unnecessary to state, that the relief for wounds of this kind is to be obtained by amputating the limb; and, from an extensive practice in wounds of the knee-joint, with fracture of the articulating surface of the femur or tibia, I have no hesitation in declaring amputation to be imperiously demanded, and that it ought to be performed with the least possible delay consistent with propriety; and on no account should the surgeon wait to give the wound a trial; for I most solemnly protest I do not remember a case do well in which I knew the articulating end of the femur or tibia to be fractured by a ball that passed through the joint, although I have tried great numbers, even to the last battle of Toulouse. I know that persons wounded in this way have lived, for a recovery it cannot be called, where the limb is useless, bent backward, and a constant source of irritation and distress, after several months of acute suffering, to obtain even this partial security from impending death; but if one case of recovery should take place in fifty, is it any sort of equivalent for the sacrifice of the other forty-nine? or, is the preserving of a limb of this kind an equivalent for the loss of one man? The answer is, I believe, clear, and the practice ought to be

as decisive; for secondary amputation offers not half the chance of success, and many will not outlive the inflammatory symptoms and fever that ensue. I am aware that this point has been much argued, but the practice of the peninsular war has been so great and so decisive, that the opinion of all the surgeons of the British army of experience, is for immediate amputation in cases of this kind.

Fractures of the patella, without injury of the other bones, admit of delay, provided the bone is not much splintered. If the ball has pierced the centre of the patella, and passed out nearly in an opposite direction behind, the limb will not be saved; or if the ball has struck the patella on its edge, and gone through it transversely, opening into the joint, it will also not be saved; but if it be merely fractured, there is hope under the most rigorous antiphlogistic treatment, and delay is proper.

A ball will occasionally penetrate the capsular ligament, and lodge in the knee-joint, without fracturing the bone; if it cannot be extracted without opening extensively into the cavity of the joint, and the extraction of the ball is absolutely necessary, amputation had better be performed at first, for it will be ultimately advisable.

The condyles of the femur and the lower part of the bone being spongy, a ball may pass through them, or between them, and fall into the knee-joint; or, it may make a prominence on the side of the

patella, without passing out, or immediately interrupting the motion of the leg, for the soldier may walk some distance afterwards; the popliteal artery may also be divided in addition, and either of these cases will render amputation necessary; for the ball must be taken out on the fore part, and the general inflammation of the joint will either destroy the patient in a short time, or, after much distress and hazard, leave him no alternative but amputation.

If a ball lodge in the condyles of the femur, within the capsular ligament, and cannot be easily extracted, amputation is advisable; for the limb, if preserved, will not be a useful one. If the ball, on the other hand, lodge without the capsular ligament, and cannot readily be extracted, the wound should be healed as soon as possible; and although it may cause some little inconvenience to the knee-joint, it will preserve the limb and life of the patient; as I have seen in many instances, when a continuance of persevering efforts to extract it, would have exposed both to great hazard.

Many cases of wounds of the knee-joint, in which the capsular ligament is wounded, and the articulation opened into without injury to the bones, do well, as simple incised wounds, made with a clean-cutting instrument, suddenly withdrawn after inflicting the wound: but several are ultimately amputated, or the patient recovers with a limited use of a contracted knee. Some few indeed ankylose

straight, but this number is very small. All these cases admit of delay, except when the capsular ligament is extensively opened into, as by the cut of a sabre, when immediate amputation is to be performed. The success of wounds of the knee-joint depends upon the continued application from the first of cold, or iced water if it can be procured, to diminish the increasing heat, of copious general and topical bleedings, and, in short, the most decided anti-phlogistic regimen. When a poultice is applied to a gun-shot wound of this kind, I consider it the precursor of amputation.

I could relate an infinite number of cases on these points, terminating fatally, or in amputation, where the injury was severe, or apparently at first but slight; and but few cases where the capsular ligament has been opened into by a musket-ball, where the patient has preserved the use of the limb; and in every case, where the wound was known to be serious, I have invariably been disappointed in the hope of saving the limb.

The following case, as an instance of apparent simple injury that frequently occurs, will shew the danger of all these wounds, and the very great care and attention that is necessary for their cure.

An officer was wounded at the battle of Talavera, in the knee-joint, by a musket-ball; it gave him so little uneasiness, that when a roller had been put on his leg with some simple dressing, he could scarcely be persuaded to proceed to the rear. At

a little distance from the fire of the enemy, we talked over the affairs of the moment, when, tossing his leg about on his saddle, he declared he felt no inconvenience from the wound, and would go back, as he saw his corps was very much exposed. I explained to him the dangerous nature of wounds of the knee-joint, and after he had staid with me a couple of hours, I persuaded him to go into the town. This injury, although at first to all appearance so trifling, and under the best surgical care, caused the death of this officer in a very short time, and proceeded so rapidly, as to prevent any relief at last being obtained from amputation.

When amputation of the thigh is necessary, it is to be done in two ways, by the flap operation at the upper part of the thigh, and by the common circular incision at the middle and lower part.

The flap operation at the upper part of the thigh is very similar to that proposed for the hip-joint, and is preferable to the circular incision, as it permits the head of the bone to be removed if found necessary, allows it to be examined and cut shorter with greater ease, and makes a much better covering afterwards. The difference between this operation, and that at the hip, consists in its being done lower down on the fore part of the thigh, and of the flaps being preserved more immediately from the out and inside of the thigh, the inner flap being the largest, to prevent the inconvenience that will result from the external one being tightly stretched over

the end of the bone ; and from this same cause it is advisable, that the bone be sawed off close to the lesser trochanter, even when the nature of the injury would allow of its being left an inch longer ; for this inch would only add to the danger of protrusion, without being of any utility to the patient ; and it is of vital importance, that all the parts after an operation of this kind should be free from pressure and irritation.

The patient should be placed in a position nearly horizontal, on a low table, and properly supported. A flannel or calico roller is then to be fastened round the waist, and the inguinal artery compressed against the os pubis. The surgeon standing on the inside of the left thigh, and the outside of the right, commences his incision through the integuments on the anterior part of the thigh, and carries it down with a gentle curve to the inner and upper part : he then makes the outer incision in the opposite direction, and brings it round underneath, to meet the point where the other ceased ; these should cut through the fascia, and the whole should be separated from any attachment to the parts beneath, with the point of the knife, so as to admit of further retraction by the hands of the assistants. The muscles are then to be divided down to the bone, slanting upwards in the direction of the first incision, and the femoral artery and profunda secured. The outer and under incisions are then to be made in the same way : the whole is to be separated from

the bone, and pressed upwards by common broad pieces of linen as retractors, assisted by the hands, whilst the bone is sawed through, which is done without difficulty, either from the out or inside, as may be most convenient to the surgeon. The pressure on the flaps made by the retractors and the hands of the assistants, as well as the compression on the artery against the os pubis, will prevent any hæmorrhage of consequence, while the bone is removing. The vessels are now to be secured according to their importance, even to the smallest that bleed; the stump should then be washed with cold water, and well dried; the flaps are to be brought together, and retained by a suture in the middle, and good adhesive straps, the ligatures being brought out above, below, and directly forwards, as their course may point out. Compresses are to be laid upon the sides of the wound, and the whole supported by the bandage brought down for the purpose, but not made to press upon the surface of the stump.

Amputation by the circular incisions, is done on the two lower thirds of the thigh; and in these cases the tourniquet should be used to stop the circulation of the blood; and especially where the surgeon is not much accustomed to operative surgery, the assistants bad, and the loss of a larger quantity of blood than usual might prove fatal. The tourniquet should however be completely slackened as soon as the principal vessels are secured; for the

natural retraction of the muscles is prevented by the strap of the instrument, which often causes some difficulty in high operations, in sawing the bone, by preventing the retraction of the soft parts. In consequence of these, and other inconveniences attending the use of the tourniquet in operations high in the thigh, I recommend compression to be made on the artery against the os pubis, in preference ; but this requires a self confidence young operators do not in general possess ; and, as they are taught to look for safety in a tourniquet, it is only practice will convince them of its frequent inutility, and constant disadvantage, in this particular place of operating ; for of the number of amputations at the middle of the thigh I have done, and seen done under my direction ; in few has the tourniquet effectually controuled the circulation, whilst pressure on the artery as it passes over the os pubis has invariably done it. The strap of the instrument may indeed occasionally compress the branches of the glutæal and sciatic arteries in the thigh, but they are really not worth consideration. I may add, that when I have performed the operation without a tourniquet, my patient has lost little blood, and that when I have used a tourniquet, I have frequently had considerable hæmorrhage ; indeed I once lost an officer in consequence of hæmorrhage during the operation, although the tourniquet was in the charge of a surgeon of ability. In a case of this kind, where it is found of little benefit, the surgeon should not continue twisting and

turning it, whilst his patient is bleeding, but quit it altogether, and compress the artery against the pubis. I would not in private practice amputate without a tourniquet, except under particular circumstances; but if an accident of this kind was to occur to me again, I would give up the tenaculum to an assistant, and take charge of the artery myself.

When the tourniquet is to be applied, the pad should be firm, and rather narrow, and carefully held directly over the artery, whilst the ends of the bandage in which it is contained are pinned on the thigh. The strap of the tourniquet is then to be put round the limb, the instrument itself being directly over the pad with the screw entirely free. The strap is then to be drawn tight, and buckled on the outside, so as to prevent its slipping, and not to interfere with the screw, which is to be turned until the pressure is sufficiently strong to stop the circulation. If the screw require to be turned for more than half its number of turns to effect this, the strap is not sufficiently tight, or the pad has not been well applied; and they must be replaced.

The patient being placed as before, the assistants are carefully to retract the integuments upwards, and put them on the stretch downwards; by which means their division is more easily and regularly accomplished. The surgeon standing on the outside, passes his hand under the thigh, and round above quite to the outside; where he begins his in-

cision with the heel of the knife, and with a quick steady movement carries it round the thigh, until the circular of the skin, cellular membrane, and fascia is completed. The knife is not to be held loosely in the hand, but firmly grasped, so that the operator may be aware of the force applied, and what will still be necessary to carry the incision fairly through the fascia, and I am the more particular on this point, because the skin cannot be sufficiently retracted without the fascia be divided; and because I know this step of the operation is frequently neglected, or thought unnecessary, and the cellular substance separated from the fascia, instead of being retracted with it.

By beginning the incision towards the heel of the knife, an opportunity is allowed with the remaining part to cut what is left undivided, as far as regards the depth to which this incision should be carried; and gives a facility in completing the last two inches of the circular, by bringing up the point of the knife, when the bending of the wrist would hardly allow the lower part of it to be applied, and as the division of the skin is certainly the most painful part of the operation, it ought never to be done by two incisions, when the largest thigh can most readily and speedily be encircled by one.

If the fascia should not be completely divided by the first circular incision, it is to be cut with the point of the knife; and at the same time any attachment to the bone or muscles beneath, is to be

separated to allow of its complete retraction ; and on the under part where it is attached to the bone, it will always require this assistance. The amputating knife is then to be applied close to the retracted fascia and integuments, and the outermost muscles are to be divided by a circular incision, with any portion of the fascia that may not have equally retracted. The edge of the knife, whilst it revolves round the limb, being constantly a little inclined upwards, so as to cut the muscles in an oblique direction. This incision completed, the knife is immediately to be placed close to the edge of the muscular fibres which are cut through, and the remainder of the soft parts divided to the bone in the same manner. In making these two incisions, and I consider two and sometimes three necessary, I would mark well the usual course of the great artery, and care should be taken to cut at least half an inch on each side of it by one incision, which should be either the first or second, as was most convenient ; and this caution, however trifling it may appear, will, to young operators, in the facility of securing the vessels, bring its own reward. The muscles attached to the bone are to be then separated with a scalpel, for about two inches and a half to three inches in large thighs, by which means the bone will be fairly imbedded when sawed off. The common linen retractor is now to be placed on the limb, and the muscles steadily kept back while the bone is sawed through. The periosteum is to be

divided by one circular of the scalpel, after the retractor is put on; the heel of the saw is then to be applied, and drawn towards the surgeon, so as to mark the bone, in which furrow he will continue to cut, with long and steady strokes, the point of the saw slanting downwards almost in a perpendicular direction, until the bone be nearly divided, when the saw is to be lightly pressed upon, to avoid splintering it, which this manner of sawing will also tend to prevent. During this operation, the thigh should be held steadily above, and in such manner below, that the part to be cut off, does not weigh on the bone above; at the same time, it must not be pressed inwards, or upwards, or, it will prevent the motion of the saw, or splinter the bone.

The retractor is to be removed, the great artery is to be pulled out by a tenaculum passed through its sides, separated a little from its attachments, and firmly tied with a two-threaded strong ligature, and the tenaculum is not to be withdrawn until this is accomplished. Any other vessels that shew themselves may be secured, and compression should now for an instant be taken off the artery, when others will start. The tourniquet should now be removed, and the small remaining vessels will be discovered. If the great vein continues to bleed, after some pressure has been made upon it in vain, a single-threaded ligature should be put over it. If the cancelli of the bone should bleed freely, the thumb of the left hand pressed steadily upon it, whilst the

vessels are tying, will in a short time suppress it. Any inequality of bone may now be removed by the forceps; the ligatures should also be shortened, one end of each thread being always cut off at the knot, when the vessel is secured. The stump is to be washed with cold water and dried, the bandage rolled steadily down the thigh; the muscles and integuments brought forward, and placed in apposition horizontally across the face of the stump, and retained by adhesive plasters carefully applied, from below upwards, and from above downwards. The ligatures being brought out nearly as straight as possible, in two or three places between the slips of plaster; a little dressing is to be placed over them, a compress of lint, two slips of bandage in the form of a Malta cross, vertically and horizontally, and the whole secured by a few more turns of the bandage. No stump cap is to be applied; the stump is to be raised a little from the bed in which the patient lies on his back, and if the bone appears to press too much against the upper flap, the body may be a little raised, which will relieve it.

In secondary amputation of the thigh, the integuments may not be sound, and will not retract; here they must be dissected back to an equal distance all round. If the muscles are much diminished in size, or flabby, they should be left even longer than may appear necessary for the formation of a good stump; and this is to be done more especially on the under part, for the bone will fre-

quently protude under these circumstances, when enough has been supposed to have been preserved. In all these cases, the bone should be short, and the skin should, if possible, have its attachments to the parts beneath. I have never seen an inconvenience arise from too much muscle and skin in a circular stump ; but I have frequently seen it from too much loose skin.

In primary operations, there will be from five to seven vessels to be tied ; in secondary ones, from ten to sixteen ; and even then, there shall be an oozing from the stump. In this case a little delay in searching for the vessels is necessary ; the tourniquet and all tight bandage should be removed, and the stump well washed with cold water, before it is dressed. A certain degree of oozing is to be expected from all stumps, although it does not always occur ; but when there is really any hæmorrhage, so that blood distils freely through the dressings, the stump must be opened, when the bleeding vessel will generally be readily discovered, although not before visible.

When the operation is performed near the knee, the gradual thickening of the thigh, prevents the retraction of the integuments, and has an effect on the vessels of the stump ; both of which evils are avoided after the circular incision is completed, by making a little cut of an inch and a half in length in the integuments, through the fascia on each side,

in the horizontal direction in which they are recommended to be placed, after the operation is finished.

When the operation is performed in the middle of the thigh, the femoral artery will be found on the upper part of the stump, a little above, and to the inside of the bone, between the sartorius and the triceps muscles; lower down in the thigh it will be on a level with the bone, and about one third of the distance above the knee; it will be on the inside, and rather below the level of the bone, its round white open mouth, will in general readily point it out, on the first inspection of the stump.

In secondary amputations, where the parts are diseased, it will not only be useless, but dangerous to attempt to unite them by the adhesive inflammation. The roller should be well, and carefully applied to the thigh above, down to the edge of the stump, the integuments may be supported over the face of the stump by one or two straps of plaster, and simple dressing; and when due suppuration and granulation have taken place, compression may be made use of, by adhesive plaster and bandage to accelerate the cure. Where union is not likely to take place, as in diseased parts, or in operations performed by necessity, at an improper period, the ligatures should be cut away close to the artery, and allowed to drop off in the discharge; from which, as they would otherwise be numerous, and matted into strings, relief will be obtained. In all

these cases, the bone should be at least an inch shorter than usual.

Amputation of the Leg.

This operation, has not, I think, been of such frequent occurrence in the practice of the surgeons of the British army, as that of the thigh; arising from the nature of wounds from cannon-shot, which generally strike near the knee; from wounds by musket-balls attended with fracture, being more manageable, and in general less extensive, than in the thigh; and perhaps from an error which is generally current, that when the stump cannot be left at least four inches long below the knee, it had better be removed above; which generally decides in cases of secondary amputation, in favour of the operation on the thigh.

Cannon-shot seldom strike the leg without destroying it, or doing so much injury as to render amputation necessary; but there are many serious wounds from cannon-shot or shells that do not require this operation.

If the calf of the leg, be in part torn away without injury to the bones, it would be improper to amputate on the field of battle; for cases of this kind occasionally do well, although after a tedious treatment. If, in addition to the injury of the soft parts, the tibialis postica, and peroneal arteries be

divided, amputation should be performed, and the knee-joint preserved, which might by delay be implicated in the disease.

A piece of a shell, from the sharpness of its edges, sometimes causes more of a lacerated, than a contused wound, when it strikes the calf of the leg; considerable hæmorrhage will ensue, and the parts appear tumid with blood; here the appearance of the wound should not alone be attended to, it should be carefully examined; if the tibia be sound it may yet do well; the wound should be cleared from blood, any vessels of importance secured, and the result awaited under the most vigorous antiphlogistic treatment, and the constant application of cold water to the seat of injury.

If the tibia be broken with a wound of this kind, amputation is absolutely necessary. The fibula, however, may be broken, and a piece carried away with considerable injury to the soft parts of the leg, and the patient preserve a useful limb; injuries, therefore, of this kind admit of delay.

Wounds from musket-balls do not in general fracture both bones; and so much advantage is obtained from the support of the fibula, and the superficial situation of the tibia, that very considerable fractures of it may be successfully treated; the danger being greatest in the vicinity of the joints of the knee and ankle.

A fracture of the tibia alone, with a wound of the anterior or posterior tibial artery by the same

ball, does not authorize amputation, except the limb be stuffed with blood; and the incisions necessary to secure both ends of the bleeding vessel, leave, in addition to the fracture, so great an extent of injury, that there shall be little or no probability of success. It must not be forgotten, that if there be free openings for the discharge, which should not be allowed to collect, below the gastrocnemius and solæus muscles, much may be done towards saving the limb, from the very great command the surgeon has over it.

When both bones are seriously fractured, with a wounded posterior tibial artery that cannot be secured on moderate search, or the limb be injected with blood, amputation is the best remedy to prevent further evil. With a wound of the anterior tibial artery, an effort should be made to save the limb.

If the tibia and fibula be broken in two places, by two distinct musket-balls, which have passed through the leg, it will, I believe, be better to amputate; for although it might be saved (and I have saved limbs under an injury of this kind), it would be a useless inconvenient member, which the patient, after some months of pain and uneasiness, would most readily part with. I recollect one case in particular, after the battle of Roliça, in which the leg was shattered in two places at the same moment. Six months afterwards, I saw the man with his wounds quite closed, and his limb straight; but it

was a burden to him, he was willing to lose, after having sacrificed his health in the endeavour to preserve it.

A wound from a musket-ball, which passes through the thick part of the tibia, below the level of the tuberosity, and injures the articulation of the head of the fibula, allowing the bones to bend and grate immediately below the knee, is very dangerous; for it will always, more or less, implicate the joint, and frequently terminates in amputation or death. It is not a case absolutely requiring amputation, in the same manner as when the joint itself is injured in young and healthy subjects, until every effort to preserve the limb by the most strict antiphlogistic regimen has proved unavailing; but in elderly men who have drank hard, or have been free livers, with bad constitutions, or who have been many years in tropical climates, I recommend immediate amputation; for I not only do not recollect a case doing well in such persons, but they have almost all terminated fatally in a few days, from the great constitutional irritation.

Wounds of the ankle-joint from gun-shot are extremely dangerous, and in general require amputation. The success that has attended the treatment of compound dislocations of this joint, has induced many surgeons, unmindful of the nature of gun-shot wounds, on the field of battle, and the circumstances in which soldiers are generally placed afterwards, to believe, that the foot may be saved at

the expense of an anchylosis between the tibia and astragalus; and cases have not been wanting to confirm this supposition, even when parts of the articulating surfaces of these bones have been extracted from the wound. But for every case of this kind that has recovered, nine have died, or have preserved their lives by submitting to amputation. It is not the local injury alone that destroys the patient, but the constitutional irritation which ensues, and which is only removed by the amputation of the offending cause. In comparing these cases, it should not be forgotten, that the gun-shot wound has destroyed a great part of the articulating surface of the bone itself; whilst the compound dislocation has done little more than injure the ligaments.

Musket-balls, or grape shot, striking near the joint, or lodging in its vicinity with injury to the capsular ligament, require only to be removed, and the most strict antiphlogistic regimen, and the application of cold to be enforced. If the capsular ligament be a little further injured, or the tibia, or astragalus, in part fractured, the same plan should be adopted to its greatest extent, and amputation only resorted to, when it can no longer be avoided. But if a musket-ball, or grape shot, passes fairly through the ankle-joint, the case is widely different; if the tibia and astragalus be both fractured, and destroyed in the track of the ball, with other injury usually attendant on such accidents, the joint will not do

well; it will not ankylose but in very few instances, and, to attain these few instances, many lives must be sacrificed; and in private soldiers, it is humanity to avoid this unnecessary exposure of life. If the shot should have passed laterally through the joint, with destruction of the lower head of the fibula, thereby including the three bones, amputation is necessary without delay. If the astragalus only be injured, the limb may be saved, and a certain degree of motion preserved in the other joints of the foot.

When the most strict attention cannot be paid to wounds of the ankle-joint, with fracture of the bones of any kind, after a battle, it is much better to amputate the leg on the spot; whereby much constitutional injury will be avoided, and the patient at the end of six weeks be a healthy man, instead of then undergoing the operation with considerable hazard.

In cases of officers, or where there are but few wounded, and every attention can be paid; and where the tibia and fibula are not injured at the same time, delay is proper, to see what nature can effect; and it need hardly be added, that when amputation is not performed at first, it is not to be resorted to afterwards, until it is necessary to relieve the constitution from an injury, the effects of which it can no longer sustain.

Amputation of the leg is performed in two ways; by the circular incision, and by the flap operation.

The circular incision being most applicable to the fleshy part of the leg about the calf; and the flap operation to the lower and tendinous part near the ankle, where sufficient integument and muscle cannot be obtained, to make a good cushion for the bones in the usual manner.

The latter operation has been recommended, with the view of preserving a long stump, to which, an artificial foot might be attached, and the deformity and inconvenience caused by the operation, obviated as much as possible by art. In private life, it is certainly a very great advantage to many, who are able to procure the necessary machinery; but, in the army, where this is not granted, and the soldier is discharged after much travelling and exposure to accident, with a common wooden leg, on which this stump is stretched out behind; and his circumstances in life will seldom afterwards permit his purchasing an artificial foot, whilst he retains the perfect use of the knee; the good intentions of the surgeon are not only completely frustrated, but they prove very prejudicial; for the length of stump behind is always inconvenient, and often gives rise to accidents, attended with much pain and distress.

In the French armies, and in France, where artificial feet are not so generally used, and are not within the reach of the soldiery, the operation is never practised; and although the injury requiring amputation be at the ankle, they cut off the limb

about four inches below the knee ; and in so doing, they say they render their patients more comfortable, and better able to get their livelihood, than if they left them a long stump, intended for a foot they can never acquire.

This kind of reasoning is equally applicable to the British soldiery, and has frequently prevented the operation being done, when the patient himself has decided, in consequence of his probable inability to procure the artificial foot required. This point should then be settled by the patient ; for it is the duty of a surgeon to give the best assistance of art, and to enable those committed to his care, to obtain their future subsistence with the greatest ease and advantage to themselves. It is an operation that will not permit of any motion after its performance, as its success depends, in a great measure, on the due adhesion of the flap forming a convenient cushion and covering for the stump. When the patient must be removed any distance after the operation, it is better to do it higher up, when he will be comparatively but little inconvenienced.

In elderly men, who are not likely to make use of an artificial foot ; or, in people who have reached that time of life, that they do not think the trouble of acquiring the habit of walking with it, compensated by its advantages ; or, in labouring men, who follow no trade, or cannot procure the machinery, the operation near the knee is preferable ; for it

must not be overlooked that when the artificial foot is not to be used, the long stump is always a great incumbrance. In soldiers suffering from, or subject to scrophula, I would also prefer the other operation.

The operation by the circular incision is performed in the thick part of the leg; and the bone is usually sawed through about four inches from the patella, that when the stump is healed, there may be sufficient length of bone left, to support with steadiness the weight of the body, without exposure to injury, by projecting out behind; and that greater facility may be given to the motion of the leg, from the preservation of the insertions of the flexor tendons.

The most eligible place for the application of the tourniquet, is about one-third of the length of the thigh from the knee, on the inside, where the artery perforates the tendon of the triceps muscle; and where it can be most conveniently compressed against the bone, by a small firm pad, the instrument being on the outside, or opposite the pad; or, the compress may be placed between the hamstring tendons, a little distance from the hollow behind the joint, the instrument itself being on the fore part of the thigh. In this method, the pad must be thicker, and the compression is more painful, and not more secure.

The surgeon should stand on the inside of the leg to be operated upon, that he may more readily

saw the fibula at the same time as the tibia, by which the chance of splintering the fibula is diminished; for this bone is held much more steadily under the saw, when the tibia is undivided, whatever pains may be taken by the assistants to secure it. The limb should be gently bent, and the circular incision made with the smaller amputating knife, or the catlin used in operations on the forearm, through the skin and integuments to the bone, on the fore part; and to the muscles on the outside and back part; and as the attachment of the skin to the bone will not readily allow of its retraction, it must be dissected back all round, and separated from the fascia, the division of which in the first incision would avail nothing, from its strong attachments to the parts beneath. The muscles are then to be cut through on the back part, and on the outside, nearly on a level with the first incision, and down to the bones. The interosseous ligament between the tibia and fibula is to be divided with the catlin; and as several of the muscles cannot retract, in consequence of their attachments to the bones, they are to be separated with the knife; and in the same manner the intermuscular septa, or expansions running between them, are to be divided, as they will still prevent their retraction. The retractor with three slips is now to be put on, the centre slip running between the bones; by which the soft parts may be pulled back to a sufficient distance, any adhering part being divided by the point of

the knife. The bones are to be sawed through with the usual precautions, and the retractor removed, when the three principal arteries should be secured. The anterior tibial, on the fore-part of the interosseous ligament, between the tibia and fibula; the peroneal artery behind the fibula; and the posterior tibial near it, more inwards and behind the tibia; this artery will frequently, however, contract very much, and only shews itself on the compression being taken off the artery above; it in general causes more trouble in securing it than the others, and I have two or three times seen the needle dipped around it in despair, when, merely pulling out the artery with the tenaculum, and dissecting a little round it, would have shewn the small retracted bleeding vessels arising from it, and have prevented, in all probability, a secondary hæmorrhage. The tourniquet being removed, the smaller vessels tied, and the stump washed with cold water and dried, the integuments and muscles should be brought forward as much as possible, and the straps of adhesive plaster applied from side to side; that is, the wound is to be closed vertically, or nearly so, that the straps of plaster may not in any way press upon the fore-part of the tibia; by which the protrusion of it will be avoided, an occurrence which almost invariably follows in military practice when the line of approximation is horizontal, and the straps of plaster press upon the bone; and, although this method of closing the wound is recommended by gentlemen of authority in the pro-

fession, I am satisfied it is very unsafe in military surgery. When the wound is dressed in the way recommended, a sufficient covering of muscle and integument is obtained for the formation of a good stump, which heals in a very short time, and is completely cured, as I have seen in many instances, in less than a month. An error is often committed by young operators, in detaching too much skin after the first incision; whereby a pouch is formed that collects the discharge, and retards the cure. If the spine of the tibia be very sharp, and the patient very thin, it should be removed by the saw.

In the British army the operation has principally been performed after this method; for when the nature of the wound has precluded the possibility of amputating lower down than two inches and a half below the tuberosity of the head of the tibia, the limb has often been removed above the knee, from an idea that the operation, so close to the joint, might cause it to be affected with inflammation; and that so small a portion of the tibia would rather be of disservice, the attachment of the flexor tendons being for the most part removed; and also from the idea, that when a fracture extends so far up as to prevent the leg being amputated at the usual place of election, the injury will in all probability have affected the joint.

Further experience proves these opinions to be erroneous in military surgery, and appears to have established, that when the limb is amputated nearer the tuberosity, when the patient was previously in

a healthy state, no bad consequence ensues to the joint, provided it has not been originally affected; and that the motion of the thigh, as dependant on the action of the flexor muscles of the leg is not entirely lost, and what is of more importance, the direct progressive motion of the thigh is preserved.

This operation has not, as far as I am acquainted, been performed of late years in England. Mr. Bromfeild,* on the subject of amputation of the leg, says, at page 185, " But if the leg is to be taken off, then the amputation is to be made as near as possible to the knee, without risk of cutting the ligament of the patella that the stump may not extend beyond the wooden leg, when it is wore;" and this direction points out a very different place of operating to that usually selected, and is precisely that of several French surgeons of the present day. I can readily conceive that it would not succeed when indiscriminately done in the hospitals of large cities, and I believe it was but little practised; or rather, from its failure, was discarded, and the rule of amputating the thigh adopted, when the bones of the leg could not be sawed off at least two inches and a half below the tuberosity of the tibia.

Many of the French military surgeons, and especially Messrs. Larrey and Garrigues, have amputated at, and immediately below the tuberosity, with success; and I have myself frequently done it

* Chirurgical observations and cases.

much within the place of election ; but the Baron Larrey, to whom the credit of introducing it into the French military practice is due, and to whom I am indebted for my immediate acquaintance with it, declares he has not met, after repeated trials, any of the evils usually represented as attending its performance ; and that it is not more dangerous than the operation at the usual place of election, provided the bone be not sawed higher than the level of the tuberosity of the tibia, or at farthest, immediately below the insertion of the ligament of the patella. He says,* “ A transverse line, drawn directly outwards on the level of the tuberosity of the tibia, generally runs below the articulation of the fibula with the tibia, and in the thickest part of the head of the bone ; but as the relative situation of the tuberosity of the tibia, and the head of the fibula, is not constant, the tuberosity must be always considered as the point above which the saw must not be applied ; for, on cutting above it, the attachment of the ligament of the patella is cut off, the bursa mucosa between it and the capsular ligament is opened into, and frequently the capsular ligament itself, from which the most serious symptoms may arise, affecting the life of the patient, or rendering amputation of the thigh necessary. By not cutting above the level of the tuberosity of the tibia, the

* See *Memoires et Campagnes de Chirurgie Militaire*, vol. iii. page 391.

attachment of the ligament of the patella is preserved, as well as of the flexors of the leg, the capsular ligament is uninjured, and the head of the tibia is cut sufficiently low to obviate the fear of caries.

“The advantages of this operation are very great when compared with that of the thigh, which it is intended to supersede in all such wounds of the leg in which it is practicable. The danger of the operation is less; it is not more difficult in its performance than any other; and the stump heals as readily as in the thigh. I have never seen caries of the bone occur, on the contrary, the cicatrix has readily formed over it without any evident exfoliation. When the fibula is left short, which is usually the case, it is to be extirpated as useless and troublesome in the application of the artificial leg, and the skin is to be left as long as possible, to cover the stump.

“The stump, including the knee, and one or two finger's breadth of the tibia, forms a solid support for the body in the erect position, and enables the patient to walk without difficulty, and without the aid of a stick. The shortness of the stump, which is bent backwards, readily permits the adaptation of an artificial leg, as it does not extend beyond the calf; in which it may be included with as much advantage to the patient in the movement of the limb, as if the operation had been performed above the ankle.”

In cases then, where the injury done to the bone does not extend into the knee-joint, this operation may be performed instead of amputation of the thigh, care being taken that the saw is applied below the tuberosity of the tibia, the prominence of which is readily felt on the fore-part of the bone. The skin, in these cases, must be sound for a sufficient distance below, to form a covering for the stump; and when the injury is so close to the knee as to render it uncertain whether it extend into it or not, an incision should be made on the tibia, to ascertain this circumstance, and it need not interfere with the operation, if found to be practicable.

I saw the operation performed, with great dexterity, by the Baron Larrey, in the Hospital of the Imperial guards at Paris; and I also saw two persons who had each lost a leg in this way, walking with a wooden one with great ease, and without the aid of a stick.

The tourniquet is to be applied where the artery perforates the tendon of the triceps, and in this operation, not in the ham. The circular incision of the integuments is to be made, in the usual manner, and the skin turned back; the muscles on the under part and outside are then to be divided and cleared from the bones, which are to be sawed off, the retractor having been used to prevent injury to the muscles. The skin over the fibula is now to be separated from it, and the small amputating knife, on account of its strength and the ease with which it is managed, applied close to the

upper edge of the head of the fibula, which, by a little inclined motion of the hand, may be easily cut from its articulation with the tibia. The large artery or arteries will be found in the ham retracted behind the head of the bone, from whence they must be pulled out and cleanly secured, as well as any muscular branches that may bleed. The nerves are to be shortened, if they happen to be longer than the stump.—The removal of the fibula allows the integuments to be readily brought down over the stump, and muscle will be found to cover a part of it on the under and outer side; the upper part can only be covered by the integuments, but I think this would unite as readily as it does lower down, under nearly similar circumstances. The French surgeons, however, merely bring the parts over the stump by the circular bandage, and dress it from the bottom with lint, until granulations form; when they endeavour by circular compression and bandage, to approximate the parts and procure cicatrization, and in a number of instances in which M. Larrey has performed it, he says, he has not failed of success.

I can readily conceive that this operation will not succeed in the hospitals of great cities, but I am satisfied it may be frequently practised in military surgery with advantage, provided the surgeon saw through the tibia below its tuberosity.

Baron Larrey, who, in my mind, deserves much credit for this operation, has, in his estimation of its

value, discredited the flap amputation lower down, and I think unjustly; for it is in many instances a valuable operation, and not exposed to the accidents he is inclined to attribute to it. In France it has been very little tried, because as an operation in military surgery it did not succeed; in England it is commonly practised, and in the British army when well done, and under favourable circumstances, has proved very successful; but requiring a greater degree of attention on the part of the surgeon, than the one performed higher up.

It appears to be an operation even in England, that has been practised more from necessity than choice; to have been disused at one period, and again brought forward from a conviction of its utility, as may be collected from the works of Messrs. O'Halloran,* White,† and Bromfield.‡ M. Hey,§ who has contributed very much to the improvement of this operation, gives the following description of its performance, to which, as I have little to add, I prefer giving nearly in his own words:

“ To ascertain, with precision, the place where the bones of the leg are to be divided with the saw, together with the length and breadth of the flap, I draw upon the limb five lines, three of them circular and two longitudinal. The situation of these lines is determined in the following manner: I first

* See O'Halloran on Gangrene. † White's Surgery.

‡ Bromfield's Chirurgical Treatises. § Hey's Surgery.

measure the length of the leg from the knee to the ankle; that is from the highest part of the tibia to the middle of the inferior protuberance of the fibula. At the midway, between these two joints, I make the first, or highest, circular mark upon the leg, this mark is to point out the place where the bones are to be sawed through. At this mark also I measure the circumference of the leg, and thence determine the length and breadth of the flaps, each of which is to be equal to one third of the circumference. In measuring the circumference of the limb, I make use of a piece of marked tape or ribbon, and place the extremity of this measure upon the anterior edge of the tibia. I will suppose the circumference to be twelve inches, in which case I make a dot in the circular mark on each side of the leg, at the distance of four inches from the anterior edge of the tibia. It is evident that these dots will be found four inches distant from each other, when the measure is applied to the posterior part of the leg. From each of these dots I draw a straight line downwards four inches in length, and parallel to the anterior edge of the tibia. These lines mark the course which the catlin is to take in the formation of the flap. At the extremity of these lines I make a second circular mark upon the leg, which points out the place where the flap is to terminate. Lastly, I make a third circular mark at the distance of an inch below the superior one which was first made, which intermediate mark

is designed to direct the circular incision, through the integuments on the anterior part of the limb. The course and extent of the different incisions being thus marked out, the operation may be performed with the greatest precision.

“ The catlin which is used for the purpose of making the flap, ought to be longer than those which are commonly made for a case of instruments, and I push it through the leg, a little below the place where the transverse incision is to be made of those muscles which are not included in the flaps. Having placed the limb in a position nearly horizontal, with the fibula upwards and the knee bent, I push the catlin through the leg at *d*, and carry it downwards, along the course of the longitudinal marks, till it approaches the lowest circular mark which it joins in the course of the curved line, and the incision then terminates a little below the inferior circular line, *e e*.

“ The flap being held back, I divide the integuments on the anterior part of the limb along the course of the circular mark, *b. d*. There is always a considerable retraction of the skin after it is divided, if the integuments are in a sound state, and if a proper allowance were not made for this retraction the extremity of the tibia would be left uncovered, and the flap could not be applied with so much ease to the patient, nor with a certainty of an union by the adhesive process.

“ The muscles, which are not included in the flap,

are then divided transversely a little below the place where the bones are to be sawn through; but no great quantity of muscular flesh can be conveniently preserved below the extremity of the divided bones, on account of the adhesion of the muscles to the bones, nor is it necessary, as the flap, when made in the middle of the leg, contains a portion of the gastrocnemius and soleus muscles, sufficient to make a good cushion for the extremity of the bones.

“ When the bones are sawn through, it is advisable to cut off a little of the extremity of the conjoined flat tendon of the gastrocnemius and soleus muscles, as it is apt to project beyond the skin when the flap is placed in its proper situation.

“ The large crural nerve is frequently found lying upon the inner surface of the flap. It should then always be dissected out, and when gently extended, should be divided near the extremity of the stump. By this method it will retire so far as to suffer no compression from the flap.”

I have frequently succeeded in this operation, but it requires much attention in the after dressing, that the flap be properly supported, or the spine of the tibia will protrude, causing ulceration of the skin above; which I have several times seen; a protrusion of the end of the fibula on the side of the flap will also sometimes occur, both of which inconveniences may be avoided in military practice, where the attention paid, during the cure, can seldom be so great

as in private life, and where the patient is often obliged to be removed some distance after the operation, by sawing the fibula at first half an inch shorter than the tibia, and by then sawing off, in a slanting direction, the sharp spine of the tibia, when the skin may be laid down upon it without fear of its coming through.

I consider sutures, or rather stitches, one on each side to support the flap, as indispensable; for I have always found the straps of plaster alone insufficient and painful. The sutures may be cut away on the sixth or seventh day after the operation, or they will in a short time ulcerate themselves out.

It is of the greatest importance that the flap be well supported at all times during the cure, and especially for the first fortnight, both while the straps of plasters and dressings are changed, and the limb is lying on the bed; for if it be allowed to depend upon the adhesions it may have formed without proper support of bandage and position, the operation will fail, and a bad stump, tedious of cure, will be the consequence.

I recommend this operation in all its steps to young operators, for when they depend upon the eye alone, they are often in error, and I have seen some very bad stumps the consequence of it; but the catlin necessary for this operation not being contained in military cases of instruments, I have generally performed the operation with the smaller amputating knife; and as the directions and marks above related are a little tedious, I have formed the

flap by the eye, according to the size of the limb ; and in doing this, the knife is to cut obliquely inwards and upwards, the same kind of flap that the catlin would cut outwards, taking care to have it rather too long than too short : and this method I prefer, even if the measurement be taken, as the flap is then more equally made, for the catlin frequently cuts out more of the muscle than is necessary, and which must afterwards be removed. The incision on the back part being completed, the knife is to be drawn circularly over the bones, so as to join the two angles of the flap ; the undivided muscles are then to be cut through in the direction of this last incision, separated from their attachment to the bone, the retractor applied, and the bones sawed through as before, the fibula being shorter than the tibia, and the sharp spine of the tibia being removed. The vessels being secured with the caution about the nerve being short, the flap is to be brought up, and a suture made on each side. The straps of plaster should be so applied as not to press upon the tibia, or as little as possible : the muscles of the calf of the leg should be well bandaged down from above the knee, and the flap always supported until firm union has taken place ; and while this process is going on, the surgeon should carefully prevent protrusion of either bone, or ulceration of the integuments over them from any unequal pressure. Mr. C. Bell has given a plate of this operation.

Amputation of the Foot and Toes.

Wounds of the feet seldom occur from cannon-shot, without encroaching so much on the ankle as to render amputation by the last-described operation necessary; but the end of the foot is occasionally injured by cannon-shot, or shells, so as to require amputation at the joints of the tarsus and metatarsus, or the metatarsus and the toes: both these operations are of infrequent occurrence in military surgery, as injuries requiring amputation seldom include more than one or two of the toes, or they destroy a considerable part of the foot.

The feet generally suffer from wounds from musket-balls, and as the parts in the foot, although bearing a general resemblance to the hand, are more complex and difficult of management, so are wounds of the foot more dangerous and more generally followed by defective cures, from apparently slighter causes. The treatment of these wounds requires greater attention, and more aid from surgery, than is necessary in other parts; for a musket-ball will seldom pass through the foot without injuring a joint of some kind, or wounding a tendon or nerve; and the injury to the fascia, which is very strong on the sole of the foot, and frequently covered by much thickened integument, is always attended with inconvenience. The extraction of balls, of splinters of bone, of pieces of cloth, and the

discharge of matter, become more difficult, and often cause so much disease as to render amputation of the foot ultimately necessary. Tetanus is often brought on, a disease in its acute form remediable by no operation or medicine that I am acquainted with, and lameness is frequently the result of wounds even under more favourable circumstances.

Wounds of the foot require at first most particular examination, whether amputation be supposed necessary or not; and all operations of this kind likely to be required afterwards, should not be deferred until they cannot be dispensed with; but the necessity for doing them should, if possible, be superseded. The operative surgery of the foot should be done as soon after the injury as can be conveniently accomplished, for a large, clean, incised wound is a safe one, compared with a torn surface and splintered bone, with extraneous substances of much less extent; and as a ball lodged in the foot is always very dangerous, greater attention should be paid in the examination even of slight wounds; for although the opening be apparently too small to permit a ball to pass in, still I have several times seen one found at a later period, and the most serious consequences ensue from its not having been discovered sooner.

A cannon shot can seldom strike the foot without destroying it altogether; it may, however, merely strike the heel, and destroy a considerable part of the os calcis, without rendering amputation neces-

sary, if the ankle-joint be untouched; for by due attention in removing the spiculæ of bone at first, and by making free openings for the discharge of matter in every direction, in which it may appear inclined to insinuate itself, the limb may be preserved in something of a useful shape.

Wounds from cannon shot injuring the fore part of the foot are best remedied by amputation at the joints of the tarsus with the metatarsus, than by sawing these bones across; but when the injury affects only one or two toes, they may be removed separately, recollecting that it is of greater importance to preserve the great toe than any other, and that this toe is worth preserving alone, when any one of the others would be rather troublesome than useful.

Musket balls seldom, I believe, commit so much injury as to require amputation as a primary operation, although they frequently render it necessary as a secondary one. To be able to judge if amputation be requisite, or indeed in the treatment of any severe wound of this kind, it will almost always be necessary to enlarge the original wound, which, from the position of the soldier, may be said to be on the upper part, or side of the foot. The splinters of bone are to be removed, if possible, the ball and extraneous substances are to be taken out, and if the bones, tendons, and blood-vessels, are so much injured as to render the attempt to preserve them useless, amputation is to be performed; but if the preservation of

the limb be thought practicable, and it generally will be so in wounds from musket-balls, the attempt must be made under the most rigid antiphlogistic treatment, the local application of cold water from the first, and with free openings for the subsequent discharge.

Musket-balls seldom injure the metatarsal bones, so much as to require their removal with their toes, under the treatment above mentioned ; these wounds will in general be healed without further operation. Wounds from grape shot occasionally render the removal of the metatarsal bone of the great toe at the tarsus necessary ; although much should be done to save it. The little and adjacent toes are also sometimes removed at the tarsus ; the middle ones but seldom, as it is not an easy operation to perform, in consequence of the natural close attachment of these bones, and the additional compactness they have acquired from the pressure of the shoe. I have never performed this last operation, and I think the removal of the pieces of the bone, with free openings for the discharge, will in general supersede the necessity of doing it in these cases.

In the consideration of amputation from wounds, in any of these parts, it must be recollected, that wounds of the feet have less tendency to heal than elsewhere, and that this process is also more slow in elderly people ; so that in an old man a wound may render amputation advisable on the field of battle,

which in a young and healthy man might with propriety be deferred.

Hæmorrhage from the arteries of the foot authorises in a very slight degree amputation, even when superadded to other causes ; for the incisions necessary to secure the bleeding vessels will not in general add much to the original injury, except they are very extensive indeed ; on the contrary, they will render the wound less complicated, and more manageable.

Amputation of the foot, performed with the view of removing tetanus, even when the original injury has been trifling, has completely failed in my hands. It is a very violent attempt to remove a disease that few people will submit to in the mild tetanus, and it has been useless in the acute, in all the cases in which I have tried it.

Amputation at the tarsus has been recommended and practised of late years in injuries of the foot, for which the leg had been formerly amputated. It is not so common an operation in military surgery as might be expected, and is performed as follows, when it is proposed to save the flap from the under part of the foot.

The joints of the metatarsus, with the tarsus, being well ascertained, an incision is to be made from half to three quarters of an inch across the foot, in the direction of the joints, but nearer the toes, and the integuments retracted back over the tarsus. From the out and inside of the end of this inci-

sion, two others are to be made along the sides of the great and little toe, for about two inches and a half, according to the thickness of the foot; and the ends of these two incisions are to be united by a transverse one down to the bone on the sole of the foot, by which the corners may be rounded off, as in Plate iii. The flap thus formed on the under part is to be dissected back from the metatarsal bones, including as much muscular flesh as possible, as far as the under part of the joints of the tarsus. The metatarsal bones are now to be removed by cutting into, and dislocating each from the side, which facilitates the performance of it. The arteries are now to be secured; any long tendons and loose capsular ligament are to be removed with the knife or scissars, and the under flap formed from the sole of the foot is to be raised up, so as to make a neat stump, when brought in contact with the upper portion of integuments that were first turned back; the whole to be retained in this position, by sutures, adhesive plaster, and bandage.

When the skin of the under part of the foot is much torn, as may occur in a wound made by a piece of a shell, the flap cannot be preserved from it: in this case it must be saved in a great measure from the upper part; but the integuments being here so much thinner, the flap is not so good a defence against external violence, and will be more readily affected by cold. I have seen the metatarsal bones sawn across in a straight line, in preference to re-

moving them at the joint; and although the whole may be sawn across at once with more ease than any one of them individually, except the outer ones, still I do not think the stump can ever be so good, or so much protected from external violence, as when the operation is performed at the joint of the tarsus.

Amputation of a single metatarsal bone, on the out or inside of the foot, is generally recommended to be done, by an incision round the root of the toe terminating in a line on the outside of the foot, which is continued down to the joint of the tarsus. The integuments are turned back above and below from the metatarsal bone, which is to be dissected out with the toe attached to it, and the flaps brought together, so as to leave but one line of incision. This operation is delineated by Mr. C. Bell in his *Operative Surgery*, and it is the best way of doing it, where there is no injury or external wound: but in military surgery there is always a wound, and when the removal of the bone is necessary, it is in general of some extent, and with loss of substance, so that covering cannot be saved in this way, especially on the upper part of the foot, where the ball or piece of shell strikes. The military surgeon must therefore be prepared to look for his covering on the under part, where he will occasionally not be able to procure it in sufficient quantity; and it must not be forgotten, that the neighbouring parts will often be injured. The ob-



ject must then be to save the integuments from such parts as are uninjured, so as to cover in the wound as nearly as possible, when the bone is removed. In doing this, the first incision should commence at the upper and inside of the toe, and be carried round, so as to separate the toe from its attachment to its fellow. If the injury be entirely on the upper part, the continuation of this incision must be so regulated as to form the whole of the flap from below, and the commencement of it above must be continued round the injured part, so as to meet the lower end near the articulation of the bone with the tarsus, and vice versa. If the ball has gone directly through, destroying the integuments above and below, the incisions must surround the injured part in such manner, on the upper and under side of the foot, as to allow the flaps to be formed in every other part, except where the injury was inflicted, and from whence granulations must arise. By saving skin every where else, the wound will be much diminished in size, will heal sooner, will be less liable to suffer from external violence, and less obnoxious to the subsequent pain, which always at intervals attends wounds of this kind.

Amputation of the phalanges of the toes, is done in the same manner as of the fingers; but as these operations on the foot are by no means so common as on the hand, I shall reserve the description of them until I come to operations on that part.

R



Amputation at the Shoulder Joint.

This operation has until lately been considered of the utmost danger and importance, not only to the life of the person who is unfortunately the sufferer, but to the reputation of the surgeon who has the performance of it: many and various have therefore been the methods recommended for conducting it, all impressing on the mind of the operator the great extent of danger, and tending to disturb the steadiness of his judgment. Anatomy, which has thrown so much light on operative surgery in general, has not failed in the last few years to dispel the cloud that obscured this part of military surgery; and experience has proved it to be as simple, easy, and safe an operation, as any other of importance performed on the field of battle. The knowledge acquired from this source of its success, has given to military surgeons a confidence in performing it, that divests it of half its former terrors, and by removing from the mind of the patient the idea of his having suffered a hopeless operation, diminishes the subsequent danger, and most materially aids his recovery. The dread formerly entertained of this operation was very great, even by men of the best abilities; and under certain circumstances in domestic surgery, it may still be tedious. It can never however again be considered formidable in

military surgery, except under bad management, and from extreme ignorance.

The distinction between the necessity of the operation, and the possibility of avoiding it, requires in many cases the exercise of the nicest judgment, and a due consideration of attending circumstances ; for there is no part of military surgery, in which an operation can be performed with more advantage at the instant ; or, delayed for a few days with a view of gaining information, with more prejudice ; inasmuch as the necessary incisions are made in the first instance, in parts disposed to take on healthy actions, and in the best possible state for undergoing surgical operations. The constitution of the patient being also at that moment generally good, and able to sustain the demands upon it, under untoward circumstances ; or of supporting, without future injury, the restraint and controul requisite for the successful accomplishment of the cure.

The difference between cutting in sound and diseased parts is justly appreciated by every surgeon, both as to his personal convenience and ease in operating, as well as to the future healing of the wound ; and the advantage here is particularly great, as from the contiguity of the wound to the chest and the principal organs of life, it is advisable to avoid any excess of action ; and experience has demonstrated that the evil to be apprehended from the equilibrium of the circulation being destroyed,

is infinitely less than it would be at a subsequent period of three or four weeks, after high suppurative action has been going on. In the latter, the operation is delayed until the parts to be divided have been long carrying on an increased action, and may even be diseased. The health and strength of the patient have been so much reduced, that he may be unable to support the additional pain and shock of the operation, which increase with the delay, or of giving that assistance requisite for the consolidation of the wound. Another and great consideration, is the ease and safety with which a person can be moved after the operation, compared with the danger and pain resulting from the disturbance of broken bones, the increase of inflammation, and other attendant evils under the same circumstances. It cannot be therefore too strongly impressed on the mind, that the necessary examinations should take place; and the operation be performed in those cases demanding it, as soon after the injury as possible, consistent with the state of the patient; and the surgeon should not satisfy himself with the idea of being able to accomplish it as safely, or as successfully, when suppuration has been established, and when perhaps he may have better assistance at hand; a kind of self deceit that is occasionally permitted, but which cannot be too much reprobated.

The importance of the arm is so great, and even a limited use of it so valuable, that much should be hazarded to save it, when there is a tolerably fair

prospect of success : the situation also and structure of the upper extremity, together with the command the surgeon has over it, and the less proportionate inconvenience resulting from a severe wound in that part to any other of equal value, renders its preservation after a serious injury, more practicable, and less dangerous than is frequently supposed. The operation should not therefore be performed, unless simple amputation by the flap operation cannot be successfully accomplished ; or, where the limb is evidently destroyed, or, the injury seriously affecting the articulation itself, while the general health of the patient, or the unfortunate circumstances of situation, render the attempt at a farther perseverance in saving the limb improper.

Injuries from musket-balls penetrating the capsular ligament, attended with fracture and destruction of the head and adjacent parts of the humerus, and wounding the axillary artery, require immediate operation. A simple penetrating or incised wound of the joint, of small extent, does not call for any operation, as the patient, with due care, will escape with a certain degree of loss of motion, and of debility in the joint ; nor is it proper in a wound from a musket-ball, where there is even some partial injury of the bone, as these cases frequently do well, and the patient preserves the use of the fore-arm.

There is, however, some difficulty in ascertaining this circumstance to have taken place, even

with a careful examination, as sufficient injury may have occurred within the capsular ligament to cause the bone to exfoliate, without being so obvious as to be immediately detected, or to indicate the necessity of any operation; and as every exertion, or motion of the part, adds to the mischief already committed, it is advisable, even on the suspicion of such injury, to desist from further examination, and treat the case as a simple one; being one of these that ought to be deferred until the subsequent processes of nature have pointed out the extent of the mischief, and her inability to overcome it. A teasing inquiry into its nature may make a simple penetrating wound as dangerous, as if it had been originally more extensive and complicated; and allowing a knowledge to be acquired, by a continuation of these attempts of a greater injury, there is nothing gained to compensate for the inconvenience that will most probably be occasioned, by the efforts attending it. On the other hand, if the wound and splinters of bone point out the head of the humerus to be totally destroyed with fracture extending to its body, the operation ought to be performed, and the patient's future health preserved, in preference to the chance of an ankylosis taking place at the end of many months, with its destruction; for although some have recovered after such wounds, many more than a fair proportion have perished in the attempt at preservation. I have not performed the operation of amputation, in conse-

quence of any wound from a musket-ball ; but, where one passes fairly through the head of the humerus, destroying its substance, the best practice will be either the removal of the head of the bone, or the extremity ; and in a person subject to scrofula, or when the army is in motion, and the greatest attention cannot be paid, there is little choice, amputation being the most advisable operation ; for excision, under these circumstances, would not prove successful. The capsular ligament surrounds the head of the humerus closely, and preserves its form even when considerably injured, so that the fulness of the shoulder is not much destroyed, without there be considerable mischief done to the neck and body of the bone, as well as to its articulating surface ; and it is only in a case of this kind, where injury is done to the head, neck, and body of the bone, and that by a large shot, that it can, or, I believe, ever does feel like a bag of sand under the deltoid muscle ; and this is not a proper case for any other operation than amputation, for the injury must be very great indeed. I have seen a ball pass through the head of the humerus, without materially destroying its shape, or injuring the capsular ligament, and yet the patient died from hæmorrhage, and large depots of matter round the joint. It is not fracture of the bone alone that is the cause of the evil in cases of this kind, it is the inflammation of the capsular ligament and synovial membrane of the joint, which frequently follow

even a simple incised wound, without fracture ; and which will be kept up by a variety of causes, independent of the irritation of the bone, until it destroy the patient, if the whole of the diseased parts are not removed. I do not mean to deny, that cases can recover, even where the extensive injury above mentioned has occurred, and the injured parts only have been removed ; but I am satisfied that the loss of lives, in military practice, will be comparatively very great, and that when the injury extends in the length of the body of the bone, amputation is by far the safest remedy. In a severe injury of the head and neck of the humerus, the extent of which is uncertain, the surgeon should carefully examine the wound ; if the splinters extend to the body of the bone, amputation should be performed : if it be confined to the head and neck of the humerus, excision may be practised, as described under that head.

A wound from a musket-ball causing a fracture beneath, and exterior to the capsular ligament, although in its immediate vicinity, by no means demands amputation from this cause alone, except a large portion of the bone, or surrounding integuments, be destroyed. With a wound from a musket-ball passing through the soft parts and the bone in the same situation, without destroying its substance to any great extent, the arm has frequently been preserved. The inflammation and suppuration are to be kept within bounds by due care, and

the sufferer will have a chance of retaining an arm, which will be more or less perfect, according to the extent of injury and other attending circumstances, and if the attempt prove unsuccessful, the operation is the last resource. If the brachial artery (on its becoming so) below the edge of the pectoral muscle, be divided, in addition to a fracture of the bone, it makes the case more complicated, and will be, taking the extent of the injury and other causes into consideration, a sufficient cause for an operation. In a favourable case, however, where the bone is not much, or hardly splintered, the integuments not torn, or stuffed with effused blood, the artery should be secured by a small incision, each end of the vessel being tied; which would be of little or no consequence superadded to the gun-shot wound, and, in some instances, might facilitate its improvement, by the more ready removal of the spiculæ of bone. The principal danger does not arise in this instance from either the fractured bone, wounded artery, or the mischief likely to occur in the immediate seat of injury, but from the probability of gangrene taking place in the lower part of the extremity, from the anastomosing branches being unable to support and nourish the limb, under the additional pressure of the actions going on above. If then, even with the most favourable case, (simple amputation of the arm not being practicable,) the appearance of returning circulation in the hand should not be evident after a few hours' delay,

but, on the contrary, it gradually becomes colder and painful, with some subsequent numbness and flaccidity, and all the usual appearances of approaching gangrene; the operation should be resorted to without further delay, before any inflammation of importance has taken place in the parts to be divided, or gangrene have established itself in the whole limb.

A wound from a piece of a shell, or cannon-shot, in which the humerus is broken, and splintered high up, requires the operation, not only from the nature of the fracture, which is frequently extensive, but from the destruction of the muscles and integuments rendering the preservation of the arm impossible; or, the latter may be so much injured above a fracture of less extent, as to demand the removal of the whole, from the impracticability of preserving sufficient to cover the bone by the flap operation; or from the bone being splintered into the joint, or denuded of its periosteum.

A fracture of the bone, or a wound of the artery, are, however, the principal circumstances from which the decision is to be formed, inasmuch as a large portion of the muscular part of the shoulder may be carried away by a cannon-shot, and the patient yet recover with a limited use of the joint. The fore and outer part of the deltoid muscle may be torn away by a round shot, and the capsular ligament so laid bare, that the movement of the head of the humerus in the glenoid cavity within it shall

be very apparent; yet the operation will not be necessary from this cause alone, as at a favourable season, and in a good constitution, very little slough is frequently thrown off, from a wound of this kind; especially if cold and sedative applications be used from the first, to diminish the rising inflammation, instead of warm poultices, or emollient applications, that cause a degree of suppuration and relaxation unfavourable to the fulfilment of the future indications: which, after the wound is clean, consist in a due support of the wounded parts by position, compress, and bandage. The bone fractured, in the simplest manner, in a case of this kind, by cannon-shot, admits of no delay in the operation.

A cannon-shot can but seldom strike the inside of the arm, without fracturing the bone, wounding the artery and vein, and destroying the muscles and integuments in such a manner as to authorise the removal of it by simple amputation; or, at the joint, according to the practicability or propriety of its performance: or, the less degree of mischief done to the arm, is more than counterbalanced by that committed in the chest, the great extent of which may prevent the operation from motives of humanity. It will frequently happen, that the arm shall be irrecoverably shattered, and the thorax partake in a less degree of the injury, there being only apparent some contusion or grazing of the skin; if low down, the elasticity of the false ribs may have prevented the integuments being much

injured in appearance, although the blow has been violent ; yet, the force of the ball may have ruptured the liver or spleen ; or, if higher up, perhaps fractured the ribs, in addition to a more severe contusion of the integuments. When these accidents occur, the symptoms arising from the wound or contusion of the trunk of the body are to be first considered ; if, at the proper time for the performance of the operation, they do not indicate a speedy dissolution of the patient, or the prospect of such an event in two or three days, the operation ought to be performed, and a chance of recovery given to the sufferer which he would not have, the arm being retained, and the injury of the chest remaining the same. The danger to be apprehended in the more favourable cases, is from inflammation ; and this will be rather diminished than increased by the operation, the immediate shock of which is readily borne : the danger of deferring it is manifest and certain, the injury committed in the thorax or abdomen is not ascertained, and its effects may be obviated. The loss of blood, during the operation, acts as a sedative, and obviates inflammation, thereby securing to the patient a greater degree of comfort, which, together with his more easy management afterwards, are in favour of the attempt ; and if the termination be unfavourable, it can only be a matter of regret for the sake of the individual, and not for the non-performance of a duty. If the cavity of the chest be laid open, or several ribs beaten in,

or a stuffing of the lungs take place from a large ruptured blood-vessel, all of which circumstances are obvious and cannot be mistaken ; the operation would be an unnecessary cruelty. A hæmorrhage of short duration, or the expectoration of blood in small quantities, although very dangerous, is not to be considered as depriving the patient of a reasonable chance, as they frequently follow blows from more common causes, and from which many have recovered. If the operation be delayed to ascertain what injury may have been done to the chest, from the symptoms that will follow, the danger resulting from both will be increased from their mutual action upon the system ; and when a knowledge is acquired of little mischief existing in the thorax, the operation cannot be performed with propriety, from the inflammation that has supervened ; and the patient probably dies, when he would have recovered, under a more decided mode of treatment.

A round shot or flat piece of a shell may strike the arm, rebounding from the ground, or when nearly exhausted in force, without breaking the skin, or only slightly ; yet all the parts within may be so much injured as not to be able to recover themselves. The bone may be considerably broken or splintered, the muscles and nerves greatly contused ; or, the injury may not be quite so extensive, the bone may be merely fractured, and yet the soft parts may be so much destroyed as not to be able to carry on their usual actions, or a rup-

tured blood-vessel, may, with a slight external wound, pour its blood between the muscles, and inject the arm nearly to double its size; all of which are causes that render an operation necessary, and require decision, as inflammation will come on in a short time, when the moment for operating will be lost. The nature of the substance inflicting the injury, and the want of sensation in the part, with the immediate appearances and extent of mischief, must guide the judgment of the surgeon, who will recollect that much greater injury is committed to the parts beneath, by a blow of this kind, the skin remaining tolerably sound, than when it has been destroyed by the collision of a body acting with more direct impulse.

Independent of accidents in the field, the nature of which leaves no doubt on the mind of the surgeon of the propriety of the operation, there are many subsequent occurrences that may render it equally necessary.

Suppose, that some days after the infliction of an injury in the arm, near the head of the humerus, considered likely to do well, a hæmorrhage shall occur which cannot be suppressed by simple means; or which, after the necessary incisions have been made to secure the open vessel by ligature, leaves little hope of a successful issue; the operation must then be resorted to: or, when it has been delayed, and the slough and loose pieces of bone are removed by the suppurative process, the extent of the injury

shews the impossibility of preserving the arm ; or, the health and strength of the patient may be unequal to carry on the actions required ; or to sustain the irritation caused by the diseased parts. The judgment must in this case be formed according to the general principles of surgery, differing in no wise from a disease caused by other means.

The general appearance, strength, and health, must necessarily, under the pressure of a severe wound, suffer considerably ; and the care of the surgeon is directed to prevent these sinking below what can be restored. The difficulty consists, in ascertaining how much can be suffered, and the patient still have sufficient force to bear the operation, and sustain the necessary actions for his final recovery. When the injury is not doing well, independent of the external appearances of the wound, the countenance of the patient becomes more anxious and pale, the centre of the cheeks have a hectic flush, the eyes sink, the general irritability increases, with constant pain in the parts affected ; the appetite is greatly impaired, or the stomach even rejects its food, the fever is increased towards evening, the pulse quick, sharp, and weak, frequently 120 in a minute, the nights are restless, the skin, for the most part, hot and dry, except when, towards morning, profuse perspirations break out, frequent diarrhœa, and partial cold sweats soon close this scene, without relief be obtained in due time from the operation. A proportion of all these

bad symptoms will occur in every severe wound from which people recover ; but when, from a due consideration of all circumstances, it is supposed they can no longer be endured, the operation must be performed as a last resource, and particularly if the appearance of the wound also indicate the necessity ; and it should be done without attempting to strengthen the patient previous to its performance, for the removal of the diseased parts will be found the best restorative. To prevent discredit occurring to the operation under these, or other unfavourable circumstances, the patient should be carefully and candidly informed of his situation, and the fears, hopes, and expectations to be derived from it ; he will then generally suffer himself to be guided by the opinion of the surgeon, who will, by this fair and honourable conduct, avoid censure, and bring no discredit on the operation, if the result be unfortunate.

The manner of performing the operation must depend entirely on the situation of the wound. The directions, therefore, that are generally given for conducting it, after any particular method, can only be occasionally useful, as the surgeon may not be able to select the parts to be divided, or retained, but must decide according to circumstances. A correct knowledge of the relative situation of the parts concerned in the formation of the shoulder-joint will be his best assistant, and may prevent some mortifying reflections ; as the success of the

operation depends in a great measure in any of the methods proposed, on preserving just so much of the surrounding muscles and integuments, as will cover the vacuity left after the separation of the humerus, and be as near as possible in contact, to afford the best chance of union by the first intention.

The articulation of the humerus with the glenoid cavity of the scapula, forms a joint moveable in every direction, confined by a strong capsular ligament, supported and retained in its position by the muscles around it, and having the great vessels and nerves passing on its inner and under side to be distributed to the arm. Eleven muscles surround; or are connected more or less with the shoulder, and must necessarily be divided: they are, proceeding from above outwards, the *deltoïdes*, *supra spinatus*, *infra spinatus*, *teres minor*, the long head of the *triceps extensor cubiti*, *teres major*, *latissimus dorsi*; on the anterior part, the *pectoralis major*, and, underneath this muscle, the *biceps flexor cubiti*, *coraco brachialis*, and *subscapularis*.

The artery which supplies the upper extremity with blood is given off from the top of the arch of the aorta, on the right side, in a common trunk with the carotid; it then lies across the root of the neck, as it does on the left side, having been sent off as a separate trunk from the lower part of the arch of the aorta; the artery having passed outwards between the anterior and middle *scalenus* muscles, inclines downwards under the clavicle, and it is at

this spot, where it comes out between the *scleni* muscles, that it can be compressed against the first rib with ease and certainty in the living body, when operations are required; the artery having passed under the clavicle, inclining outwards and sloping downwards, assumes the name of axillary, having the nerves above it, and the great vein before and to the inside; in this course it gives off several branches, which are more or less regular, but are not concerned in this operation.

When the artery has passed under the clavicle, it may be compressed against the second rib, but it is not so conveniently done, the instrument being more in the way of the operator. The artery in its passage to the edge of the *pectoralis major*, where it again changes its name for that of brachial, gives off,

1. The *mammaria externa*, generally in four branches, one only of which, the *thoracica humeriana*, rising up between the deltoid and the pectoral muscles, will commonly give any trouble during the operation.

2. *Scapularis externa*, running towards the root of the coracoid process, and passing through the semi-lunar notch to the outer surface of the scapula; this branch is out of the way of the knife, except when injudicious attempts are made on the coracoid process.

3. The *sub-scapularis*, which is a large artery given off nearly opposite the neck of the scapula, and in all common operations is not exposed to in-

jury; it attaches itself to the lower edge of the scapula, and divides into two great branches, both of which remain untouched when the operation is judiciously performed.

4. The *arteria circumflexa posterior* is given off below the *sub-scapularis* at the distance frequently of near half an inch, sometimes however immediately with it; it is large artery passing backwards and outwards, between the lower edge of the *sub-scapularis*, and the upper edge of the *teres major*, lying close against the bone, between it and the long head of the *triceps*, and is largely distributed to the *deltoid* muscle and to the *capsular ligament*, and must be divided in the operation.

5. The *arteria circumflexa anterior* comes off at the same place as the former, or frequently arises from it, and is a much smaller vessel; it passes under the *coraco brachialis* and short head of the *biceps flexor cubiti* towards the bone, and below the *capsular ligament*, where anastomosing with branches from the *circumflexa posterior*, it is lost in the *deltoid* muscle and on the fore-part of the arm. The *subclavian vein* passes out of the chest anterior to the artery, having the *anterior scalenus* muscle between them; after it leaves the *clavicle* and becomes the *axillary vein* it is still anterior to the artery or nearer the integuments, the artery being underneath, and between it and the *cervical nerves*, forming the *axillary plexus*; it receives branches corresponding to those given off by the artery.

The nerves of the upper extremity have their origin from the four lower cervical, and the first dorsal nerves; they pass between the anterior and middle scaleni muscles into the axilla, but higher up than the artery, where, surrounding this vessel with ~~its~~ ^{their} meshes, and forming the axillary plexus, it gives off seven branches—the supra scapularis, circumflexus, cutaneus externus, ^{mulo-spinal} radialis, ulnaris, muscularis, cutaneus internus; the last six are cut across in the operation.

There are also other nerves coming out from the intercostal spaces, which supply the integuments of the arm; but they are of no importance as far as regards this operation.

The axillary artery, vein, and nerves, are therefore protected from injury by the humerus externally, and two muscular folds laterally; on the fore-part, or anterior side formed by the integuments and pectoralis major; on the back part by the integuments, latissimus dorsi, and teres major; they are all surrounded by a fatty substance, and some absorbent glands.

The depth of the subclavian artery from the surface, and the protection afforded it by the clavicle, pectoral muscles, and integuments, and to the axillary artery by the anterior fold of the arm-pit, have been the cause of much alarm in the performance of this operation; some surgeons having supposed that an artery of the magnitude of the subclavian could not be effectually compressed through so thick a cushion; and that a degree of circulation existed

that might be embarrassing to the operator, and dangerous to the patient. This fear of hæmorrhage had great weight with all who have written on the subject; and the generality of authors declare it to be a fearful and terrible operation, in consequence of the impression on their minds of the impossibility of commanding the flow of blood, and the mischief likely to ensue from any sudden movement of the body, or accidental derangement of the pressure; the attention of surgeons has therefore been frequently turned to a variety of instruments for compressing the subclavian artery, each holding out his own method as the most to be depended upon for this purpose; whilst others more distrustful, have even proposed taking up the axillary artery as a preliminary step to the operation. When the minds of men were so much alarmed at the thought of the axillary artery pouring forth its blood, it is not surprising that every consideration should give place to the important one of attaining this object; the patient was therefore made to undergo an operation worse than useless, inasmuch as it cannot be effectually performed without more trouble and dissection than is required to complete the whole; and when done, is rather an inconvenience than an assistance, independent of the feelings of the patient, and the unnecessary suffering from a prolongation of the operation.

Experience in military surgery has taught us, that the division of the axillary artery is not to be

^{it}
 dreaded, as ^{it} is readily secured and retained between the finger and thumb until a ligature can be put over it. From the same source, I have learned so little to fear an accident resulting from it, that I consider it in my own practice, of little consequence whether the vessel be compressed or not, prior to its division; indeed, I prefer feeling the pulsation of the artery that I may be certain it is afterwards properly commanded. The axillary artery does not throw out so much blood at each pulsation as has been conceived; the blood thus thrown out immediately declares its situation, and if the judgment be not obscured by the hurry of the moment, very little pressure with the closed hand on the surface of the wound commands the hæmorrhage, until the operator is prepared to tie the artery; for when it is divided, it shrinks amongst the surrounding nerves, and if not in full action, requires some little search before it can be discovered, as must have been observed by many in performing amputation at, or near the shoulder-joint. I have even been obliged to take some pains in dissecting for the mouth of the artery in a simple flap operation, where the head of the humerus remained in the glenoid cavity, before the contraction of the vessel would allow of its being discovered; and frequently I have seen the tourniquet removed in a high operation, and all pressure taken off for some time, before the artery could be fairly drawn out, or made to bleed. Whenever a good assistant is to

be obtained, it is advisable not to employ a tourniquet in any military operation on the upper extremity, except under particular circumstances of extreme debility on the part of the patient. The military surgeon must, indeed, entirely divest himself of all fear of hæmorrhage from the axillary artery; and while he is willing to receive any assistance that may be at hand, he must be prepared, in case of accident, to compress the artery with one hand, and finish his operation with the other. Having his mind free from the apprehension of danger resulting from hæmorrhage, he will proceed to the operation with satisfaction, and will be surprised to find how little formidable it is in reality, compared with the general opinion that has so long existed of its immediate danger; for the subclavian artery can be compressed most effectually, and the operation in a healthy subject free from previous disease of the parts to be divided, may be accomplished with less loss of blood than in a simple amputation of the arm only. The most convenient instrument for compressing the artery, is formed of the common screw tourniquet of the capital case of instruments, the handle of which should be made even, as the new ones generally are, or if curved, a little lint must be wound round in the form of the figure of ∞ horizontally, to fill up the inequalities; a small fold of linen or lint is laid upon this, to take off the sharpness of the edges, and the strap partly folded over to keep it tight, as in the

usual method of packing up a tourniquet in the case; the remainder of the strap is then twisted round to secure it, leaving a firm narrow compress incapable of hurting the skin, and yet sufficient for compressing the artery. The thick end of the tourniquet is conveniently held in the hand, and allows as much force to be used with ease as can ever be necessary. I consider this mode of applying pressure preferable to the thumb or finger of the best assistant, as a greater force may be used with more ease and certainty on a larger space directly across the vessel: the necessity of commanding the flow of blood is in general so impressed upon the minds of all, and the exertion consequently made, so great, that the hand is tired before the moment of dividing the artery arrives, and the compression is probably imperfect, when it is alone necessary. This instrument also gives a greater extent of pressure, if any accidental circumstance or movement of the patient should alter his situation with regard to the assistant; and I can also state, that it so perfectly fulfils its object, that when properly applied, not one drop of blood shall issue from the artery on its division. Compression may be made either above or below the clavicle, as the circumstances of the case render it most convenient. I at one time used two of these instruments, one above, the other below the clavicle; but, on dividing the artery, I found that the pressure, either from above, or below, equally impeded the circulation, the cir-

cumflex artery only bleeding when both were removed. As there can no longer be a doubt of the possibility of compressing the subclavian artery above the clavicle, without inconvenience to the patient, and with perfect safety, it becomes the most eligible place, as the assistant, who performs this duty, is out of the way of the operator, and has the complete command of his instrument, and the artery. The cessation of the pulsation of the artery in the axilla, is a proof that the instrument is properly applied, and that the circulation is suppressed; as a general rule, however, about midway between the acromion process and the sternum, will be the place where the compression should be made above the clavicle, and I have never known it fail with the instrument recommended: below the clavicle it should be from a quarter to half an inch more outward, nearer to the acromion, or the direction Camper has given may be observed, "that if the shoulder be thrown back, and compression made upon the axillary artery with the finger between the clavicle, the coracoid process, and the pectoral muscle, the pulse instantly ceases, and is only observable on removing the pressure."

Surgery is indebted to the French surgeons for this operation, as it appears to have originated with them; the first clear statement of its occurrence is referrible to the elder Le Dran, who performed it on the Marquis de Coetmadeu, and allowing for the precautions taken on account of the artery,

appears to have done it extremely well, the wound having healed with a small cicatrix in the course of ten weeks. In this instance, arising from an exostosis and caries of the humerus as high as its neck, the integuments must, I conceive, have been diseased, and Le Dran, so far, very properly began his incision high up, cutting across the deltoid muscle, and into the cavity of the joint, after having secured the artery lower down in the arm by passing a needle between it and the bone; having then separated the bone from its articulation with the scapula, he made a second ligature above the first, which he then cut away with all the superfluous muscles and integuments. In doing this, I conceive he must have left more flap than has generally been supposed, or have made his incision lower down on the humerus.

Garangeot followed Le Dran with the same precautions with regard to the artery, but considering that it was the state of the integuments that frequently decided the mode of operating, he recommended the formation of a flap above, by commencing the incision three fingers breadth below the acromion, across the deltoid muscle; and then forming another on the inside and under part to go over and meet the upper one when laid down, by the approximation of which the wound might be diminished in size and more readily heal; and this idea of Garangeot's should be kept in mind most particularly by military surgeons, as the utility of

it will frequently come under their observation in practice. La Faye, in his paper on the Amputation at the Shoulder-joint in the 2d Volume of the Memoirs of the Royal Academy of Surgery, in France, recommends the whole of the flap to be formed on the upper part of the shoulder by the integuments and deltoid muscle; he says, "I make a transverse incision with a common straight bistoury about three or four fingers breadth below the acromion, across the deltoid muscle down to the bone: I then make two others between two and three fingers in width, on the fore and back part of the arm, to fall perpendicularly on the first transverse incision, so as to form a sort of flap; under which, having separated it, I pass the knife to cut the heads of the biceps muscle, and the capsular ligament: drawing the head of the bone towards me, and disengaging it with the bistoury, I cut from one side to the other, and between the bone and flesh of the arm-pit which sustains the vessels, carefully keeping the cutting edge of the instrument towards the bone. I then tie the vessels as near the arm-pit as possible, and separate the arm a finger's breadth below the ligature; the flap being brought down, covers the glenoid cavity of the scapula, and leaves merely a semicircular wound." He then adds, that since he read his paper in the year 1740, many celebrated surgeons adopted this method, and practised it with success. He also mentions, that Le Dran, jun., in

his *Treatise on Operations*, recommends that the ligature should not be made until after the arm is totally separated, but disapproves of the proposal as liable to some inconveniences which are avoided by his method; now these inconveniences could only be the fear of hæmorrhage, and if Le Dran did ever perform the operation as La Faye says he recommended, and as he states himself to have done, he was a bolder surgeon in this respect than very many of his successors. Sabátier in his description of La Faye's method, says the flap is to be made of the shape of a trapezium, from which I apprehend the perpendicular incisions are made to approach each other gradually on the transverse line; but more modern surgeons have discontinued this transverse incision, gradually rounding off the lower end of the perpendicular ones, so as to make them meet in a semicircular form below; and this practice prevails with many military surgeons.

Sharp's operation commencing with an incision from the vicinity of the acromion down to the armpit, about two inches below the joint and through the pectoral muscle, to enable the operator to put a ligature on the vessels with more care, and then continued round the joint in a circular manner, has, I believe, never been practised.

Bromfield* recommends the flap to be formed nearly in a semilunar shape, the inner point commencing

* *Chirurgical Observations*, page 248.

over the tendon of the pectoralis major, passing a little below the termination of the deltoid, and ascending as high as the external fold of the arm-pit. He then makes a perpendicular incision from the acromion process through the deltoid down to the transverse incision, a little below its insertion, dividing thereby the flap into two portions, taking care to leave the outer one the larger of the two: the artery and vein are to be separately secured by a double ligature being passed under them, between which they are divided; the nerves are to be cut shorter than the vessels, and the arm then removed from the body. This operation allows the flaps to be thrown back on each side, and gives a greater facility in securing the vessels, and turning out the head of the bone: it is, however, unnecessarily tedious; much useless flap would be preserved, and it presupposes the integrity of the whole of the integuments, even to the insertion of the pectoralis major, which can seldom be the case, when the operation is absolutely requisite.

Alanson performed the operation in the following manner, by candle-light, in a case of gun-shot wound of the arm, in the year 1774.* “The patient was placed upon a table of convenient height, covered with a double blanket, and the shoulder brought off the side of the table suffi-

* See Alanson's Practical Observations on Amputation, &c. page 184.

ciently to give room for the operator's hand and knife; and the requisite pressure was made upon the subclavian artery, by the fingers of a judicious assistant. A circular incision was made about a hand's breadth below the acromion, and carried through the skin and membrana adiposa round the arm: the deltoid and posterior muscles were divided obliquely up to the capsular ligament; this was much facilitated by an assistant drawing up the skin with his fingers. I then divided the tendon of the biceps muscle and the capsular ligament upon the anterior and posterior part of the joint; after which an arterial branch discharged so freely, that we were convinced the pressure upon the subclavian artery was not effectual, although judiciously made; therefore I tied this vessel with the assistance of the tenaculum, and determined to finish the operation in the following manner:—To divide the tendon of the pectoralis major, the capsular ligament all round, and the rest of the parts, except the artery, veins, nerves, and cellular substance immediately adjacent; and as it was very difficult by so obscure a light to distinguish these parts so accurately as to be able to tie the blood vessels, and cut through the nerves higher up, as directed by Mr. Bromfield, I included the whole in a temporary ligature, held just tight enough to prevent hæmorrhage: below this the parts were divided which finished the operation; that is, separated the limb; after which the artery and veins being drawn out together by the tenacu-

lum, and included in the same ligature, the temporary one was removed."

"Integuments being thus saved all round, they were approximated in such a manner, as to form a line of division across the face of the stump, the ligatures brought out at the angle next the chest, and the wound dressed as in general use at present."

At page 193, he confesses that although he accomplished his operation with only a circular incision, yet it was executed with some difficulty, and would have been more readily performed by Bromfield's perpendicular incision from the acromion. He thinks however, that the greater exclusion of air from the cavity of the joint, by the circular incision, counterbalances the difficulty; but he did not recollect, or was not aware, that this, or nearly similar incisions, heal in general by the first intention.

The French surgeons in the early part of the present war, improving from the frequent necessity of performing this operation, gradually rounded off Bromfield's angular flaps; and M. Larrey,* who first performed it as to the external line of incision in this manner, and nearly as Mr. Bell has shewn in the first edition of his work on Operative Surgery, uses a straight sharp pointed knife, and where the state of the integuments will admit of the flaps being formed from the sides, he passes it through the arm

* Tome II. page 170, de Chirurgie Militaire.

on the outside close to the bone, and forms his outer flap, clearing it backwards, so as to expose fully the joint, which he then cuts into from behind upwards, carrying the arm forwards and inwards over the breast, to enable him to divide the capsular ligament and surrounding tendons; he then grasps with his left hand the parts on the inside for the inner flap, taking care to include the axillary artery, to prevent hæmorrhage: passing his knife behind the head of the humerus, and keeping its cutting edge turned as much as possible towards the bone, he forms the flap, and with it completes the separation of the arm from the body; by which means he avoids wounding the axillary artery, or of cutting it too high, so as to render the application of the ligature inconvenient. He does not remove the cartilage from the glenoid cavity, and prefers ~~the~~ having the flaps short; he does not lay them down with the idea of adhesion by the first intention, but approximates them by means of a gentle compress and bandage, dressing the wound from the bottom, and at a subsequent period promoting union and consolidation by the usual means.

When the state of the integuments will permit of a choice, I consider them to be preserved in the most advantageous manner after this plan, but differ from him in the mode of performing the operation, and in dressing the wound afterwards, my idea being to lay down the parts immediately, as clean and as fairly divided as possible, with the view of

obtaining adhesion, or of considerably contracting the wound ; and I think the operation is rendered perfectly easy, and free from any danger, by the following method, even for surgeons of limited capacity ; as the artery, the great cause of dread to all, may be secured before the last incision without even being divided, and the successive steps of the operation, point out the respective situation of parts, and prevent the errors that are frequently made, by cutting unadvisedly, or at hazard.

It is now time to correct another misapprehension that the fear of hæmorrhage has introduced into this operation ; I allude to the idea prevalent amongst many surgeons, that it is to be performed in a different manner from any other of importance ; that instead of the calm, steady determination that distinguishes a surgeon of ability, who feels himself master of his subject, he is to forget or lay aside, what on all other occasions is considered most valuable, and endeavour to attain a peculiar precipitation and haste of manner, that is excluded from all other parts of surgery. There is still a practical point usually overlooked, that in military surgery there is little or no arm left to use as a lever in facilitating the operation, and that the separation of the head of the bone depends upon the surgeon, and not upon the assistants.

The patient should be placed on a seat lower than the surgeon ; (in the field an hospital pannier is the best) and so supported that he may not be able to

slide off during the operation, the assistant in charge of the tourniquet, or instrument described, standing behind, and regulating the support in such manner that he may always be able to make steady compression when required. The shattered arm or stump is then to be raised from the body, sufficiently to enable the hand of the operator to examine the axilla, and ascertain that his assistant can compress the artery when he pleases ; for this simple motion of raising the arm to near a right angle with the body, to afford access to the axilla after the pressure is made, will frequently render some alteration of it necessary. The arm should be also raised, so as to point out more clearly the insertion of the pectoralis major, and the posterior fold of the arm-pit ; and as being more convenient to the operator, who, placing his finger on the lower end of the acromion process in the centre of the shoulder, (the hair in the axilla having been previously removed) with the smaller amputating knife commences his incision immediately below it, and with a gentle curve carries it downwards and inwards through the integuments only, a little below the anterior fold of the arm-pit, and which the raising of the arm readily points out. The second incision outwards, is made after the same manner, but something lower down, and is continued underneath, so as to shew the long head of the triceps at the under edge of the deltoid, without dividing any of the muscular fibres ; by which means the skin has time and freedom to

retract, which is a great object, being the part in general most wanted, and when retracted allows of subsequent extension. The third incision commencing at the same spot as the first, but following the margin of the retracted skin, divides the deltoid on that side to the bone, and exposes the insertion of the pectoralis major, which must be perfectly cut through, to shew the short head of the biceps flexor cubiti, and the coraco brachialis, which are then readily known by their longitudinal fibres, and the freedom the arm or stump receives from losing its attachment to the fore part of the chest: these two muscles however are not to be touched, although the flap thus formed is to be separated, and raised so as to expose the head of the bone, nearly as far as the coracoid process of the scapula. The fourth incision outwards, in the same manner divides the deltoid muscle down to the bone, and extending to the long head of the triceps, which it is not necessary to touch, as it would be afterwards divided: this flap is to be well turned back, so as to shew the insertions of the teres minor and infra spinatus, coming across horizontally from the scapula, to be inserted into the great tuberosity of the humerus; the posterior circumflex artery will be divided close to the bone, the anterior circumflex, and the continuation of the thoracica humeriana on the integuments of the arm, and some other small vessels may bleed, if the compression be not correctly applied; they ought not however to be tied,

but merely stopped with the finger, and particularly the posterior circumflex, as this must again be divided, and pressure on the subclavian readily commands it; both the outer and inner flap being now raised, the head of the bone may be rolled a little outwards, and the *teres minor* and *infra spinatus* cut across upon it with a large scalpel, opening at the same time into the cavity of the joint; by which means the error of slitting up the bursa under the acromion, instead of the capsular ligament, will be avoided, and continuing the incision upwards, cutting through the capsular ligament, the tendon of the *supra spinatus*, and the long head of the *biceps flexor cubiti* as close as possible to the edge of the glenoid cavity. The surgeon placing his fingers on the head of the bone, cuts through the inner side of the capsular ligament, and with it the *subscapularis* muscle, going to be inserted into the lesser tuberosity of the humerus. The edge of the knife being constantly towards the bone, he divides the under part of the ligament, separating the head of the bone from the glenoid cavity: resuming the small amputating knife, he cuts through the long head of the *triceps*, to prevent its hanging too much into the wound, and then with one sweep he connects the points of the two first incisions underneath, separating the arm from the body, dividing again the circumflex arteries above the first incision, the *teres major*, *latissimus dorsi*, *coraco brachialis*, long head of the *triceps*, axillary artery,

veins, and nerves. This being the only dangerous step of the operation, the surgeon should inform himself if the artery be sufficiently compressed, which he will know by the posterior circumflex artery not bleeding, and the want of pulsation in the axilla: he should caution the assistant to preserve the steady position of the patient, and have another ready to press his closed hand upon the artery, if it should bleed. Laying down the knife, he takes the artery if bleeding between the finger and thumb; or if compressed pulls it out with a tenaculum, and ties it firmly with a small ligature of two good threads. The vessel is found contracted amongst the nerves in the lower third of the wound; all pressure being removed, the anterior and posterior circumflex arteries will bleed, and must be secured; or, if the artery subdivides high up, there may be a fourth large branch.

In recent cases of injury I have seldom had occasion to take up more than three arteries, and no cutaneous or other vessels, besides those divided by the last incision. The nerves, if hanging in the wound must be shortened, which though painful, prevents a source of irritation hereafter from their adhering in the neighbourhood of the cicatrix. The axillary vein, if it continue to bleed, should be secured with a single thread, as it allows some blood to pass into the wound after it has been brought together, and, what is of more material

consequence, permits it to pass into the loose cellular membrane surrounding the vessels down to the clavicle, which may cause considerable mischief, as the position of the patient is favourable to its gravitation.

All compression having been taken off the artery, the wound should be well cleansed, and here a little delay may be allowed. If the tendon of the long head of the biceps flexor cubiti be left long, it ought to be cut off with the scissars, as well as any ragged portions of the capsular ligament. The glenoid cavity need not be deprived of its cartilage. The pectoralis major will be observed to have retracted considerably, and to have doubled or folded in the skin covering it; through this (the parts being brought together,) a suture should be put to the opposite side, and the whole properly supported and compressed by strips of adhesive plaster and bandage, the ligatures being brought out direct. The incision then forms but one line from the acromion downwards, curving at the bottom to the fore part of the chest, the skin at the axilla being always a little wrinkled, and much inclined to retract. The flaps of the deltoid meet firmly, sink a little into the hollow under the acromion, lie close upon the glenoid cavity and the coracoid process; and from the pressure of the adhesive plaster and compress, with the evenness of the wound, the skin of this part nearly unites by the first intention; the hollow round the glenoid cavity is comparatively small to

what might be expected, and the consolidation in healthy subjects, where every thing has done well, goes on steadily, so as not to leave any cause of future inconvenience. The surgeon, in all his dressings, should take care that no collection forms any where by keeping up a regular and proper compression in the course of the artery, the coracoid process, the pectoralis major, and the muscles from the scapula and back. The pain and sensation principally complained of is from the hand and arm; there is seldom any hæmorrhage, and the patient does not suffer more than in any other common amputation.

I have insisted on the arm being raised from the first, because in all operations that require the principal artery to be compressed, it should not be done until the limb be placed in the situation in which the operation is intended to be performed, as the mere alteration of posture removes the pressure from its destined point, as must frequently have been observed, when the tourniquet is applied without this caution in the axilla, or thigh. This elevation also allows more freedom to the knife in every direction, and points out more clearly the situation of parts. I beg, however, to be understood as not recommending the arm to be raised in secondary cases, when there is partial ankylosis, or thickening of the ligaments, or other fair obstacles to its being done with ease to the patient.

It is not necessary to lay bare the acromion, on the

contrary, the finger should be placed immediately upon it, to insure the first incision, being near half an inch below it, if the eye of the operator be not a sufficient guide; the flaps turn aside sufficiently without it, the head of the humerus is extricated with equal ease, and there is no subsequent danger if the stump should slough, or of the acromion coming through and being a future inconvenience to the patient.

In making the last incision of separation, care should be taken to save as much of the integuments as the nature of the operation will permit; and this is done by keeping the head of the bone as far from the glenoid cavity as the attachment of the teres major and latissimus dorsi will allow, and by then cutting as close to the bone as possible. The long head of the triceps muscle is divided before the last incision, to prevent its hanging too long in the wound, and interfering with the approximation of the integuments. The anterior and posterior circumflex arteries require only a single thread; the latter will be divided about three quarters of an inch from its origin, and the axillary artery in general near an inch, from where it gives off the subscapularis.

On the principle, that the processes of bone with the cartilage of the glenoid cavity are in the way of the adhesion of parts, and that the removal of them facilitates the cure, by preventing the collections of matter and the formation of disease in

and about the joint, which have in the end, it is said, frequently proved fatal; it has been proposed lately by Mr. Fraser, Deputy Inspector of Hospitals at Gibraltar, in his Essay on Amputation at the Shoulder-joint, at page 30, 31, 48, to remove a part of the acromion and coracoid processes, of the scapula, with the whole of the cartilaginous surface of the glenoid cavity, as an improvement upon the more simple operation.

The operation is performed like the first described, until the separation of the arm from the body is effected, with this exception, that the first incision is begun about an inch above the edge of the acromion, a few lines before its connexion with the clavicle. The integuments and the deltoid muscle being then cleared away, near two inches in length of the bone, and six or eight lines in breadth, are to be sawed off. The coracoid process is then to be cleared of its muscular attachments, and a portion of it also sawed, and removed with the ligament running between it and the acromion, the cartilage of the glenoid cavity is then to be taken away, and the flaps brought together in the usual manner.

Mr. Fraser conceived, that all irregularities being thus removed, the muscular parts and bone will readily adhere in such manner, as to prevent any subsequent inconvenience to the patient, and compensate by its advantages for the increase of misery occasioned by the longer continuance of the ope-

ration. It does not appear, however, that the advantages so said to be derived, are equal to the disadvantages likely to result from it.

In the performance of a common amputation of the leg or arm, fresh incised parts are laid down upon each other, both prepared, or likely to take on the same actions, yet no one expects they will perfectly do so; or if they did expect such an occurrence, they would find themselves disappointed in many instances: it is not therefore surprising, that parts differently situated, and fulfilling opposite functions, should not take on this desirable action, and a part of the deltoid muscle adhere to the cartilaginous surface of the glenoid cavity of the scapula; indeed it is hardly to be believed, that this could have been expected to take place; but merely that the muscular parts should in the first instance adhere in the vicinity of the glenoid cavity, the cartilage of which, in the course of time, would be removed, and the whole gradually consolidated. The great principle, in my mind, of this operation, is, that the less there be destroyed, and the less the parts be disturbed consistent with propriety, the less nature will have to restore; and the shock the constitution suffers will, in proportion, be diminished. With this idea, I conceive, the acromion should not be touched, the first incision should commence below it, that part of the deltoid muscle arising from it should be left in its natural situation; and when the head of the humerus is

taken out of its place, although the muscle sinks in, it does so naturally with its attachments, and if the patient be not much wasted by previous disease, which is seldom the case in military surgery, it does not leave a considerable space for the insinuation of synovia, or other matter that may be secreted, except it be in large quantities, or from diseased parts, and when they have been much neglected; for the horizontal mode of applying the adhesive plaster across the wound, with the usual compresses, will in fair cases, prevent any evil consequences of this kind. The surgeon should also take particular care, that a good communication be kept up with the lower part of the wound, and the matter daily discharged, until the parts around the glenoid cavity are firm and consolidated.

Few surgeons, I believe, ever expected the inside of the deltoid, which frequently in all its extent, is not a cut surface to adhere to the cartilage of the glenoid cavity; they are aware, that in the more trifling operation of removing a phalanx of the finger a little fluid is generally collected between the cartilage and the united integument where the operation has succeeded by the first intention, which remains some time while the cartilage is removing by absorption, previous to the integuments adhering to the bone; and in the amputation of the shoulder, where there is no external communication in consequence of the adhesion of the parts around the scapula, the same process must go on, but is considerably

shortened where this communication is regularly kept up, and is generally complete in from six to twelve weeks, as has been proved in a very great number of operations that have been performed lately in the Peninsula where the cartilage was not removed; and in not one case has any evil consequence of this kind occurred, although several of them, for a longer period, have had a small discharge from the neighbourhood of the joint, but then only when the flap operation was performed. The glenoid cavity cannot however, be scraped by any common operation in such manner as to render it a surface to which the deltoid muscle can, or is likely to adhere, in the same way as the muscles and integuments do to the femur, without it be intended to place the bone in the same situation, by also sawing off the articulating surface of the scapula itself, which I can hardly conceive to be intended in a military operation, on a healthy subject, free from scrophulous disease of the joint.

Where there has been much previous disease in the joint, the recurrence of it, or of other evil, should rather be attributed to other causes than the cartilage alone, or what will become of the operation recommended for the removal of the articulating ends of bones, where the cartilage and capsular ligament are left entire, and under much more unfavourable circumstances? Instances are given of the recovery of patients who have undergone these operations, and they must either be given up

on this particular objection above all others, or the cartilage and remaining portion of capsular ligament must not bear all the blame of the ill success of the operation. There can be no doubt that as much as possible of the capsular ligament should be removed, on account of the synovia that might continue to be secreted from it, and its disinclination to unite with other parts. The glenoid cavity may be even pared if it really appears to be diseased, which it is not the work of a moment to do effectually ; but, the removal of the cartilage of the glenoid cavity of the scapula, so as to leave a rough bony surface, to which the inside of the deltoid may adhere, cannot be considered but an unnecessary, cruel, and dangerous addition to the operation, and to the misery of the unfortunate patient.

To saw off a portion of the acromion, it is necessary to detach that part of the deltoid muscle arising from it, and the flaps so formed cannot be supposed likely to take on healthy adhesive action with the bone beneath ; if, however, the operator should have inadvertently laid bare the process to any extent by his first incisions, so as to make it come through by the subsequent retraction of the skin, or any accident should render it advisable to remove a part of this bone, it may be done without any other consequence than the inconvenience of doing it, and the greater deformity it occasions in the appearance of the patient. Boucher, in the second volume of the *Memoirs of the Royal Aca-*

demy of Surgery in France, mentions in his second part, that M. Le Faure, an assistant-surgeon in the French army, after the battle of Fontenoy, performed this operation, removing a part of the acromion in consequence of its having been injured by the ball, and that it subsequently exfoliated, the patient, an English volunteer, ultimately getting well; and it has been several times done lately in the Peninsula, without any bad effect.

With regard to the coracoid process, it appears to me perfectly distinct from the operation; indeed, I consider the integrity of this part, as essential to its success; forming a barrier on one side for the protection of the artery and the fore-part of the chest, by the firmness of the parts arising from, and situated in its neighbourhood; and by their remaining in their natural situation, preventing the formation of abscesses and sinuses towards the thorax, which must otherwise inevitably occur in all unfavourable cases. The artery on its division sinks into sound parts, is well supported in all its extent, and placed in the exact situation of a vessel on the face of a stump; whereas, if the upper part of the coracoid process be sawed off, the muscles attached to it must, I conceive, be set at liberty; the short head of the biceps flexor cubiti, and the coracobrachialis muscle are cut from their origin, and the pectoralis minor from its insertion into the inner side of the process, and to this, I think, there are serious objections; for the retraction of this muscle

is great, and the hollow left by sawing off the coracoid process and the origins of the short head of the biceps and coraco brachialis, leaves a channel under the pectoralis major and minor to the chest, through all the soft, cellular, fatty substance surrounding the vessels and nerves, which are thus laid open to the external wound, when they would otherwise have been safe, and free from danger.

The retraction of the pectoralis minor would alone cause some suppuration, independent of the matter that must collect from gravitation; for the channel of the wound is so direct, and the position of the patient in general so favourable, that it would be impossible, in bad cases, to prevent it under the most strict observance of any regulations. From matter formed or collected in this spot, immediately in the passage of the great vessels under the clavicle, deprived of their natural and proper support; and from its immediate vicinity to the ribs and chest, such formidable results may in general, be expected, as to me appear to outweigh the greater simplicity of ill's said to attend the operation usually adopted, in which the extremity alone is taken away. The misery of the unfortunate sufferer is considerably increased by these sawings of the scapula, for, being very moveable, it is not readily fixed, and the operation of sawing off the acromion and coracoid processes would be extremely unpleasant, and is accomplished in the living subject with some difficulty, independent of the danger

likely to result in unexperienced hands, from wounding the great vessels in the neighbourhood of the latter. The object proposed to be gained by the removal of the coracoid process is, in my mind, effectually frustrated, and a dangerous space is subjected to diseased actions, that would otherwise have been firm and entire. In the improvement proposed, the shock to the constitution must be considerably greater; but, independent of this and the additional suffering of the patient, I consider the unsupported state of the vessels beyond where they are divided, with their free communication with the wound even to where it passes under the clavicle, and the subjection of this space to the possibility of disease, when it would otherwise remain inviolate, such serious objections, and such fertile sources of irremediable evil, that if subsequent diseases of the articulation were even more frequent than they really are, I think the usual operation would be still more successful than the one proposed. I again repeat, I am not aware, in military surgery, of the ill success mentioned, or of the subsequent diseases alluded to, as all the persons I have seen recover, have done so entirely; they may, months or years afterwards, have had other complaints, but I doubt their ever having occurred in so many instances as to render the proposed improvement advisable. Too much importance is attached to the idea of even surfaces and their speedy union being necessary to the success of this, or any other

amputation, it will not be denied that they expedite it, but that they can be dispensed with, the following fact will shew. On receiving the returns, and examining the French wounded on the surrender of the town of Olivença, in April 1811, the French surgeon-in-charge pointed out a man whose arm had been taken out so completely, by a cannon-shot at the shoulder-joint, at the siege of Badajoz, under Marshal Soult, that it was only necessary to cut off the ragged edges of the integuments, and secure the artery. Under the French method of dressing large wounds by stuffing them with char-pee, good granulations formed; and when I saw him three months after the accident, the glenoid cavity was quite shut in, and a surface not so large as the hand, covered with healthy granulations, remained only to be cicatrized to complete the cure, the man's general health being good, and the discharge puriform. In this case, there were not even the aid of muscular parts to fill up the inequalities, or cover the glenoid cavity; but every thing had been done under the greatest disadvantages, by the shooting out, and approximating of the granulations.

The operation recommended by La Faye, with the improvement of lengthening the flap to near the insertion of the deltoid muscle, has been and is generally adopted by our military surgeons, and makes a semicircular wound of moderate extent that heals soundly, as far as I have seen, where the parts



have been originally healthy. It is objected to this large flap of the deltoid, that it does not readily unite with the parts on which it is laid down, that sinuses form underneath it, that are eventually very troublesome; this may occur, but the most important objection is much overlooked, namely, that when in a gun-shot wound this flap can be formed, the operation may frequently be dispensed with, the simple flap operation being performed in its place, leaving an inch and a half or two inches of bone in the articulation. I allude particularly to the flap made of nearly the whole extent of the deltoid muscle, because I know cases will occur in which the flaps cannot be made with advantage from the sides, when they can be saved from above and below; but then the deltoid muscle and the integuments also are torn, and this, in the cases requiring amputation is so frequent an occurrence, that in proposing an operation on this principle, I would, as a general rule, advise one partly after La Foyes method, recommending in some measure, Garenggeot's under-flap, which La Foye appears to have adopted in part, without being aware of it; for in cutting the integuments the length he did below the ligature upon the vessels, he allowed for their great retraction at this part, and thereby gained, unknowingly, something tantamount to a flap; for if the integuments be cut across close in the axilla, it must be a very large flap of the deltoid that will meet them below, and

on this supposition it is advisable to gain something on all sides. In the flap operation, formed by the integuments, and deltoid muscles above, as commonly recommended, the first incision should be made through the skin and integuments, to allow them to retract, commencing an inch above the posterior fold of the arm-pit, and carrying it round in a curved form to the same height on the anterior fold; the lower part of the incision being five fingers breadth from the point of the acromion, the posterior end or point of it being something higher than the anterior one. The deltoid muscle should be cut through close to the retracted skin, the edge of the knife slanting upwards to avoid the whole thickness of the muscle at the lower part; the flap thus formed is to be turned up over the acromion, so as to shew the head of the bone in the capsular ligament; the tendon of the pectoralis major is to be cut through on the forepart close to its insertion, the infra spinatus and teres minor on the upper and outside near to their insertions—the capsular ligament being opened into, the incision should then be carried over the head of the bone, which is to be raised from the glenoid cavity, the whole of the capsular ligament divided, and with it the subscapularis muscle; separating the bone from the glenoid cavity, it ought to be detached as low down as will allow the amputating knife at one sweep to cut through the remaining muscles, nerves, and vessels, thereby removing the arm from the body; and

as the integuments on the under part always retract considerably, it is advisable, to cut as low down as circumstances will permit on the under part of the arm, to allow for this retraction. The vessels being secured as before, the flap is to be laid down in apposition with the lower edge of the integuments and secured by one or more sutures as may be judged proper; two are generally sufficient at each end of the flap; a good compress and bandage must be retained upon the flaps, and care taken that no collections form round the glenoid cavity, by keeping the flap perfectly in approximation with it, and a direct opening for any matter that may form, which should be daily evacuated; indeed, in these cases, the last part to cicatrize, is generally a small opening, from which a little matter may be pressed out.

It will frequently occur that only three fingers breadth of the deltoid muscle, and integuments shall be left entire, which will not be sufficient to cover the wound, without something be saved elsewhere; this in general may be done on the under part of the arm when the upper is destroyed, or perhaps from the outside. In these circumstances the upper flap should be left square, or with a little rounding on the outer corner, the operation should be continued as in the last instance, until the head of the bone be removed from the articulation, when, instead of detaching just enough to allow the arm or stump to be separated by one

sweep of the knife, the shattered bone should be dissected out, and so much flap then left on the under part, as will meet the upper one when turned up towards it: the bone is taken out without any fear of wounding the artery above where it be divided, if the surgeon keeps the edge of the knife constantly turned towards it; and is free from hurry. This flap must of course be kept up to the other by three sutures; it retracts but little after they come away, and much facilitates the cure, as I had an opportunity of shewing in the case of a German Artilleryman, after the battle of Salamanca. In fact, with due knowledge of the anatomy of the shoulder-joint, there can be no difficulty in performing the operation under any circumstances. If integuments cannot be saved from one point they can from another, or from two or three different places, and be made to meet in apposition afterwards; or, if none can be procured any where, the artery must be secured fairly on the face of the wound, a slight compress laid on its course to give support, the wound dressed lightly, and the rising inflammation prevented or allayed by cold applications.

The Baron Larrey, who, from his numerous opportunities after the many great battles fought by the French armies, and from his predilection for the operation, has performed it perhaps oftener than any man, declares his conviction of its safety, without fear of subsequent injury, and without scraping or

cutting away the cartilage of the glenoid cavity.—In sixteen cases that occurred in Egypt he lost but two—of fourteen subsequent to the battles of Wagram and Essling twelve recovered, and one of the remaining two, destroyed himself; and in the late campaigns, and under other circumstances, he invariably met with the same success. In several of these cases the scapula was injured by the ball, in others the clavicle and scapula. From amongst them I have selected the two following, one of primary the other of secondary operation, although not following a gun-shot wound,—and for which reason it may perhaps be equally acceptable.

*“ During the battle of Wagram, the General of Artillery, Daboville, was brought to the Field Hospital, at a short distance from the spot where he was wounded; a cannon-shot having struck him on the fleshy part of the top of the right shoulder, destroying the articulation of the humerus with the scapula, and tearing away a considerable part of the pectoralis major, deltoides, and latissimus dorsi muscles, breaking off the acromion, and fracturing the scapular extremity of the clavicle. The head of the humerus was broken into three portions, and driven inwards towards the axilla, and one of these had torn some of the meshes of the axillary plexus of nerves. The axillary artery was near bursting

from the almost aneurismal distention of its coats. The pulse was scarcely perceptible, the countenance deathlike, the eyes dull and watery, the voice hardly distinguishable; hiccup, and other convulsive movements, denoting approaching death had supervened, and I doubted for a moment whether he could survive the operation. The delay of a few minutes more would have been fatal, and I performed it less with the hope of success than with the idea of giving him some ease, from the horrible torment he was suffering. The amputation, which was completed in a few minutes, to my great surprise, gave considerable relief; it had been, however, necessary to cut through a part of the pectoralis major, to tie the artery above the injury it had received; and the first success of the operation, still left me little or no hope. I had placed him on a straw paillasse, or rather, a bed of dung and dirt, on which he remained in the greatest state of quietude until his removal to Vienna, where he was carried on a litter prepared for the purpose, the several faintings he had had in this period rendering it doubtful if he could bear the removal, which was consequently delayed as long as possible. The external dressings were changed, but the whole were not removed until the fifth day. The wound was enormous and frightful, the patient was however calm and collected, his voice was stronger, and he had even slept some hours of the first and second night. The dressings were simple

and methodical, the General gained strength by degrees, the wound daily improved, and in three months he was perfectly well." This case is a good instance of that degree of nervous commotion attended by pain that is only relieved by the operation.

* Henry Schup, aged 22, by birth a Dutchman, of the corps of Lancers of the Imperial Guard, was sent to the fever-ward of the hospital the 7th of June, 1811, on account of some scrophulous pains which he had felt for some time in his right arm, combined with a severe pulmonic affection. The remedies otherwise properly advised by the physicians had not prevented the progress of the disease; he had constant cough and expectoration of pus, hectic fever and clammy sweats every night, with little sleep, and could hardly bear on his stomach his bouillé and rice-milk. Suddenly a large abscess appeared above the right elbow, and although the physician considered it critical, he sent him to the surgical wards for treatment. The abscess being large, and the fluctuation manifest, I opened it immediately, the soldier himself, although in the greatest state of emaciation, also requesting it. The first incision gave vent to a quart of fetid matter of a bluish grey colour, mixed with coagula of blood. Several counter openings were made,

through which I passed some strips of linen thread, and after covering them with lint, I surrounded the arm with compresses, dipped in very hot camphorated wine. The soldier, whose strength was nearly exhausted by the continuance of his disease, fainted under these operations, and was, with some difficulty, recovered. He took some claret, with sugar and æther, shortly after, and I ordered for him an antiseptic and cordial mixture to be taken in small quantities frequently night and day, some strong beef tea, and some good wine. He was relieved, and became more cheerful during the next fifteen days. The purulent expectoration and exacerbations of fever were diminished, but the cough remained the same; some new formations of matter appeared above the former abscess, which were opened, and a quantity of blackish ichorous matter discharged. The patient was for a short time easier, but the next morning a hæmorrhage occurred, which would have been fatal, if the orderly officer on duty had not been in the ward to suppress it; searching for the artery a quarter of an hour after, I was surprised to find the lower third of the humerus denuded, and consequently in a state of necrosis as far as the elbow joint, which was also open in several places."

"These circumstances determined me to remove the arm at the shoulder joint immediately."

"He was taken to the operating room at the time the pupils were assembled for my clinical

lecture, but was so faint as to be unable to sit in the usual chair for operations; indeed, his situation appeared so alarming, that every one present supposed he would die under my hands. Seeing, however, that he must inevitably perish if something was not done, the hæmorrhage being hardly suppressed by the assistants, I decided on operating without delay. The flaps were formed in a few moments, the axillary artery, which was held up to me with the inner flap, did not lose a drop of blood, and it was conveniently secured, as well as all the smaller vessels. The proper dressings were applied, and the patient slept in the theatre, where he also remained some days. The operation acted upon him like a cordial. I ordered him some wine and good beef tea, covered him with hot flannels, fomented his belly and chest with very hot camphorated oil of camomile, and directed his medicines to be continued."

"The dissection of the arm shewed the ligaments of the elbow destroyed, the ends of the bone carious, with the inferior half of the humerus in a state of necrosis, and a carious spot was perceivable on the head and neck of the bone; the soft parts were putrefied, and one of the collateral arteries open."

"During the five first days, I had little to hope for, in spite of the ease he felt after the operation; he remained weak, and apparently dying; the soakings from the wound were sanious and black co-

loured; the pulse small and weak, and the usual excretions had nearly ceased. The tonic medicines administered were increased; a strong digestive, sprinkled with camphor and some drops of sulphuric acid was applied to the stump, and the strictest care and attention were given to the patient. On the night of the fifth day he had an exacerbation of fever, followed by an unhealthy copious sweat, which appeared a favourable crisis. From this moment, the discharge became plentiful and healthy, the organs of life resumed by degrees, the due exercise of their respective functions, a tranquil sleep relieved the patient of his pain, and rendered him easy; and, to our great surprise and gratification, he gradually improved until the 10th of October, when he was discharged the hospital quite well, being seventy-five days after the operation. With the principal disease, or the disorganization of the arm, the symptoms of phthisis, as well as of his general scrophulous habit, entirely disappeared; he had even acquired flesh, and the regular performance of the whole of the natural functions of the body. The longitudinal cicatrix of the stump hardly exceeded the third of an inch in width."

Of the comparative success of the operation of amputation at the shoulder-joint, I can speak most favourably. I consider it in fair cases to be less dangerous than amputation of the thigh. It has been hitherto supposed, that five out of six recover, but this mode of judging is not perfectly fair, for, if in thirty cases, three or four fatal ones that were

performed under unfavourable circumstances, be added to the general average, it will be perhaps less successful; but my opinion is, that if all were fair cases the success would be infinitely greater. In my own practice and under my own immediate observation, it has been one sixth; but the relation of the fatal cases will diminish the proportion considerably, and leave it rather one-twelfth, for the third case related is the only one that can fairly be attributed to the operation.

CASE I.

John Henderson, of the Royal Artillery, was struck on the 18th of January, 1812, at ten o'clock in the morning, by a shell in the batteries at the siege of Ciudad Rodrigo, which grazed his right side over the false ribs, and shattered his arm above the lower edge of the pectoral muscle leaving it a wreck.

The constitutional injury appeared greater after the lapse of two hours than is usual, he did not suffer much pain, but was unequal to bear any operation during the day. Some cordials being given in the night he became more composed, took some tea in the morning, did not complain of severe pain, but referred the greater part of what he suffered to the side which was not apparently much bruised; he breathed with little difficulty and was anxious to be relieved from the weight of his arm.

Placed in an erect position on a field pannier, with the remains of the arm extended, the subclavian artery was compressed above and below the clavicle with the padded handle of the screw tourniquet, by Dr. Armstrong, now of Mount Rath, Queen's County, Ireland. The cuticular incisions were made, the muscles next in order divided, and the head of the bone turned out; no vessels spouted: The assistants carefully attending to their compression, the last separating incision was made, and the arm removed without the slightest jet of blood. I allowed the compression above and below to be raised in turn, purposely to shew its effects, and they both succeeded equally well. I then tied the vessel with a three threaded ligature. All pressure on the subclavian artery being taken off, the anterior and posterior circumflex arteries shewed themselves, and were tied. The pulsation of the axillary artery being very evident, and no hæmorrhage appearing after a little delay, the parts were brought together without force, leaving only a single line of incision. The patient did not say a word during the operation, which lasted but a few minutes, and was exceedingly thankful for its performance when finished. He was put on his blanket and mat, and appeared to have suffered but little.

Ciudad Rodrigo being stormed that night, I did not see him until the next morning, when he was evidently beyond hope of recovery, from the injury sustained on his side: he died at night. I sent his

body five leagues for the convenience of inspection, and found that the false ribs had given way to the stroke of the ball without being damaged, but it had ruptured the lower edge of the right lobe of the liver, from whence a gradual hæmorrhage must have taken place, a considerable quantity of blood having insinuated itself under the peritonæum, round the fat of the kidney, and into the cavity of the abdomen, which was the cause of his death.

The lungs were sound, adhering on the right side by old adhesions to the pleura costalis. This operation was exactly what it ought to be, either regarding the mode of conducting it, or the time required for its performance; no vessel of sufficient size to attract observation appeared, until the circumflex arteries were allowed to bleed, the arm being removed; during the whole operation, the man did not lose six ounces of blood, indeed there were not two table-spoonsful on the floor. The shoulder and adjacent parts being dissected, a quantity of blood from the axillary vein appeared to have gravitated in the cellular membrane surrounding it, as far as its passage under the clavicle, the pectoral muscle had retracted, folding or turning in the lower and inner part of the skin covering it. The axillary artery was divided about an inch below where it gave off the subscapularis, the anterior and posterior circumflex arteries were from one half to three quarters of an inch long; the three ligatures were found clean and firm on the arteries without any

intervening substance; and the muscles were divided in such manner as to have afforded the speediest union, if the injury of the liver had not carried off the patient.

CASE II.

Manoel José Gonsalvez, of the Portuguese Artillery, at mid-day on the 18th of January, 1812, had his side bruised, and his left arm shattered by a shell, leaving just sufficient room to place a tourniquet in the axilla, but which was of no use, as the brachial artery hung out near three inches beyond the wound, pulsating strongly between my fingers, its end being slightly covered by a little coagulated blood, just sufficient to shew the mouth of the artery much contracted. The bone being destroyed to nearly the head of the humerus, without injury to the integuments concerned in the double flap operation, I performed it in the usual manner; four vessels were tied after the removal of the bone, the patient losing upon the whole about half a pint of blood. This man not being of a healthy constitution, the incisions did not unite, on the contrary, they separated, and a tendency to sloughing was observable in the wound.

On the 7th of February the ligatures were all away, the wound open, the artery pulsating strongly at the bottom; an erisypelatous inflammation that

had appeared for the last day or two was gradually increasing, matter formed under and in the course of the pectoral muscles, and a small slough being taken away on the 14th, a considerable quantity of pus was discharged. The patient was supported by wine, bark, &c. and the most nourishing diet; but the integuments over the clavicular portion of the pectoralis-major sloughed, leaving it as clean as if dissected, and the acromion process came through the wound. On the 24th, the wound was quite clean and granulating, but discharging greatly, his health very much reduced. In this state, on the 4th of March, on the troops breaking up for the campaign, he was sent into the Portuguese hospital, at Almeida, and I am uncertain whether he ultimately recovered.

CASE III.

A Russian, a private in the Chasseurs Britanniques, had his right arm carried away by a cannon-shot at the battle of Salamanca, the head of the bone only being left in the socket, the integuments particularly towards the axilla, being very much destroyed. The operation was proposed to him the next day, the 23d of July, but he would not submit to it, until such time as he should be in an hospital, although he saw several British soldiers suffer amputation who were lying with him. On the even-

ing of the 24th, he was got into hospital at Salamanca, and as early as possible on the morning of the 25th the operation was performed. He was an elderly man, and had suffered much from the heat and privations during the three days he had kept this arm hanging by the integuments, but recovered a good deal on the first day after the operation, eat, and said he was better, on the fourth he died from exhaustion, more than from any complaint, the wound looking extremely well.—If great care, after the operation, could have been paid to this man, or if he had suffered his arm to have been removed on the 23d, his life would have been saved; being a foreigner in our service, I did not choose to insist upon his submitting to the operation, although I could then have sent him into town with little inconvenience.

I do not conceive either of these three cases can justly be considered as fair ones, or be calculated upon in estimating the comparative success of this operation; death being unavoidable in the first, having been rendered probable in the second, by a succession of circumstances that would most likely have occurred in any other amputation; and in the third it was much to be feared from the delay in performing it, and the age and appearance of the patient; indeed, if the calculation of success influenced an operation beyond a certain point, this poor man would have been left to die untouched, and deprived of that chance which, under happier

circumstances, would have had (I am much inclined to think) a more favourable result.

In the nine successful cases, three only have any thing remarkable; in one, a soldier of the 74th regiment, at the siege of Ciudad Rodrigo, on whom the operation was performed at midnight, the axillary artery was not in the least compressed at the instant of its division, and filled my eyes with blood, when a general expression of alarm burst from all present. At this moment of affright, one of my assistants, Mr. Mahoney, now surgeon of the Royal Fusiliers, who was previously prepared if such an accident took place, pressed his closed hand on the vessels until I was ready to secure the artery with my finger and thumb, which was most readily effected. The man did not in all lose twelve ounces of blood, and is now perfectly well in England.

Another is the case of a Frenchman, who was wounded at the battle of Salamanca, by a musket-ball, in the middle of the arm, which broke the bone, and whom I found, after a number of vicissitudes, in Lisbon in April 1813, suffering from hospital-gangrene, which had spread round the arm, nearly into the axilla; destroying all hope of preserving it, and if retained any longer, rendering his life very precarious from the rapidly sinking state of his health. I deemed it necessary, from the state of the muscles, integuments, and bone, to remove the arm at the shoulder; but though all the muscles on the under part were so

much diseased as to destroy the hope of union taking place, yet the success I had met with in amputating in cases of gangrene, from defect of circulation, induced me to attempt it here in a case of hospital-gangrene ; and which, although depending on very different causes, would I am convinced, have done well from the first, if the man had been removed into another hospital free from the contagion of this disease. In four days half the integuments had united on the upper part ; not so the lower, which was inflamed, painful, and swelled ; on the 20th, eight days from the operation, the ligatures were thrown off, the lower part was in a gangrenous state, and the upper part, that had united, entirely separated, but the glenoid cavity was not exposed. On the 1st of May, the whole surface of the stump was in a gangrenous state, and continued so until the 17th, by which time a considerable portion of the muscles on the under part were destroyed ; the wound at this period became cleaner, and the disposition to gangrene ceased. On the 24th, as the muscles had commenced granulating in every direction, the integuments were drawn a little together, and pressure made by sticking-plaster and bandage. From this time the wound gradually filled up and contracted, leaving a very small cicatrix, compared with its open surface when in a state of gangrene.

This man was only saved by the attention of three servants, who constantly waited upon him,

by the administration of wine and the most generous diet, varied according to his caprice or inclination, and a change to the purest air of Lisbon.

If he had been in an hospital where the means were limited either in point of accommodation, diet, attention, or medical assistance, he must inevitably have died. The last case has nothing peculiar in it, save that the patient at the same time lost the right fore-arm.

I have the detail now before me of nine cases, which were all successfully performed after the storming of St. Sebastian ; seven of them by raising the flap of the deltoid muscle. One I shall transcribe, for the sake of the distinctness, with which it notes the fact, of the subclavian artery being effectually compressed above the clavicle.

“ John Beard, a private of the light company of the 2d battalion, 59th regiment, received a very dreadful wound from a cannon-shot, at the assault of the town of San Sebastian, the 31st of August, 1813, which nearly tore off his arm, almost as high as the shoulder-joint, carried away the greater part of the outside of the deltoid muscle, shattered the head and neck of the humerus to pieces, and contused, to a considerable degree and extent, the surrounding soft parts, particularly the pectoral muscles of the right breast. Amputation at the shoulder-joint was immediately determined upon as the only chance of saving the patient's life ; and the operation was performed in the presence of Mr.

Gunning, the surgeon-in-chief, by staff-surgeon Hill, who commenced it by an angular incision on each side, from above the head of the bone and acromion scapulæ, so as to remove as much of the deltoid muscle as possible, and make a double flap of the remainder. The head of the bone was next dissected out from the glenoid cavity, and the operation finished by a single division of the integuments and muscles underneath, by which the limb was at once removed. The artery, from which not a drop of blood escaped, was compressed by Mr. Gunning with a boot-hook above the clavicle as it passed over the first rib, and secured by the operator. Some oozing of blood ensued from the smaller vessels; the part was therefore directed to be kept constantly wet with cold water. From the very violent shock and extensive injury which the constitution of the patient had sustained, the success of the operation was at first considered extremely doubtful, he complained of much pain for two days after it, with loss of appetite, thirst, restlessness, and a general derangement of the whole system. A symptomatic fever supervened, with great debility, the pulse quick and small, and much heat of skin. On the third day the first dressings were carefully removed, when the wound (from which there was an excessive discharge of dark coloured grumous blood with a very offensive smell) looked particularly unhealthy, and the surrounding skin much discoloured to a considerable

extent. He however expressed himself greatly relieved when dressed, and from that time the febrile symptoms began to subside, his appetite returned, his general health altogether improved, and he continued gradually to gain strength and recover daily. Before his removal to the General Hospital of Santa Cruz, the wound was nearly healed, with the exception of a small portion of the under part of the flap. The ligatures did not come away until the sixteenth day, after which the man quickly recovered.

The whole of the nine cases are reported by Mr. Gunning, surgeon-in-chief, in whose presence they were performed. They were all done shortly after the injury in the field of battle, and the symptomatic fever was in none of them so severe as in the case related, illustrating, I think, in the strongest possible manner, the advantage of immediate amputation where necessary ; and proving the error of those who inveigh against its performance : and, if I considered this point required further support, I could bring fifty more cases of the same kind, of this operation, to substantiate it.

I have not included in my calculation of success very many cases that have come under my observation, in which the arm, scapula, &c. (with more or less injury of the adjacent parts) have been carried away by cannon-shot or shells, which have been nearly all fatal ; but as the operation was not performed, except in the removal of fragments,

it cannot of course be considered as affecting the surgical operation of amputation. In such cases all broken pieces of bone are to be taken away as speedily as possible, the jagged, rough, and destroyed parts removed, the smaller arteries opened by these operations, secured, and the principal vessels searched for and tied, if they can be found by fair examination, without hazarding the life of the patient, by unnecessary and tedious search. If the axillary artery be found injured, it must be followed up, if necessary to the clavicle by cutting through the pectoralis major from the wound, and tying the vessel in the hollow between the pectoralis minor and the bone.

In giving an account of the success of some of my cotemporaries in the campaigns in the Peninsula, I must premise that the operation has become much more common among military surgeons than formerly ; whether it be that its own utility has rendered it necessary, or that our surgeons are better operators, or that it has been occasionally performed without due discrimination, I cannot determine. Perhaps a combination of the whole of these circumstances may have been the cause of its multiplication ; the latter, I am desirous of believing, to have little increased the number.

The following returns of the operation, as performed in the army under the Duke of Wellington, during a period of six months, from the 21st June to

the 24th December 1814, may not perhaps be uninstruc-
tive. It includes the wounded at the battle of
Vitoria, the destructive siege of St. Sebastian, and
the battles of Pampeluna and the Pyrenees, and is
another remarkable illustration of the necessity of
operating on the field of battle, in preference to
the delay of a secondary operation: the operations
with the divisions of the army having been all pri-
mary, at the general hospitals, secondary.

General Hospitals.	Number of operations performed.	Died.	Cured, or out of danger.
Vitoria,	13	10	3
Bilboa,	5	5	0
Passages,	1	0	1
Total	19	15	4

Divisions of the Army.	Number of operations performed.	Died.	Cured.	Transferred, but considered out of danger.
1st,	3	0	2	1
2d,	1	0	1	0
3d,	1	0	1	0
5th,	12	0	12	0
6th,	1	1	0	0
Light,	1	0	0	1
Total	19	1	16	2

The 5th division performed the duties of the siege

of St. Sebastian, and the men were principally wounded in the upper part of the body.

The loss with the divisions of the army was as one in nineteen in favour of the primary operation ; a success truly astonishing. In the General Hospitals, under surgeons equally able, the loss was fifteen in nineteen, a want of success as disheartening, as in the other encouraging ; and arising from all the causes mentioned in the remarks on "Amputation," as concurring in the ill-success of secondary operations.

Bromfield * states, that before his time the operation had been performed in the British armies, but unsuccessfully, which I believe was frequently the case when formerly attempted. It is now, however, the reverse, is in general successful, and performed by military surgeons, without hesitation or fear ; and I trust I have proved, that this once formidable operation may now be considered as safe, as simple, and as little hazardous, as any other of importance performed on the human body.

Excision of the Head of the Humerus.

Having treated of wounds requiring amputation at the shoulder-joint, the operation of sawing off,

* Page 209 of his *Chirurgical Observations and Cases*.

or removing the head of the humerus, when alone injured, next deserves the particular attention of the military surgeon. It has been recommended as a substitute in many cases for amputation, by which means the limited use of the fore-arm is preserved ; for cases of gun-shot wounds do certainly occur, in which this operation may be practised with success, where the removal of the arm would appear a severe measure from an apparently trifling wound.

This operation of removing the head of the humerus was first noticed by Boucher, in his paper inserted in the *Memoirs of the Royal Academy of Surgery in France*, and practised nearly about the same time by M. Thomas, a surgeon at Pezenas in Languedoc ; that of sawing off the head of the bone was first recorded by Mr. White of Manchester, in 1769, who performed the operation in 1768 : it also appears that M. Vigarous, senior of Montpellier, did it in the year 1767, on a lad of seventeen years of age, who died a very short time after ; but as he did not make this operation publicly known, until the year 1788,* the credit of its introduction indisputably belongs to Mr. White. It was subsequently recommended in England by Mr. Park of Liverpool, in 1783 and 1789, and about the same time in France by Moreau, father and son, and shortly

* *Œuvres de Chirurgie Pratique*, par I. M. I. Vigarous Junior. Montpellier, 1812.

afterwards by Sabatier, Percy, Larrey, and other of the French surgeons. It was first recommended in cases of caries of the joints in domestic surgery, but has not, I believe, been much practised either in France or England, and particularly in the latter, where it met with much opposition; and it has not prevailed in the British army, although in the French it has met with considerable support from Messrs. Percy and Larrey. The disapprobation it has met with from the medical department of the British army, arose not from any experience of its ill success, but possibly from too great an attachment to the operation of amputation; as it is more than probable that some fair cases, in which the sawing off the head of the bone might have been tried, have offered themselves in the course of the late campaigns, and have been disregarded. The first and most successful case of removal of the head of the humerus that ever occurred is the following.

M. Thomas, surgeon at Pezenas, in Languedoc, was desired, in the month of August 1740, to see the daughter of a labourer four years of age, who was suffering with a very acute pain in her left arm, from which she had no respite, and which was dreadfully increased whenever the arm was touched: it was first felt after the confluent small pox, which she had two months before; but the pustules had not properly matured, and the child since that had suffered from a low fever. He carefully examined

the arm, and found it considerably swelled about the joint of the shoulder, without any discoloration of the skin, and concluded that a large abscess was forming in the joint itself, which might prove fatal to the little patient. The first indication was to assuage the violence of the pain, and for this purpose an opiate was given proportionate to her age; and an anodyne poultice was applied to the tumor, which was afterwards varied according to circumstances. Under these applications the abscess broke spontaneously at the anterior and upper part of the arm, four fingers breadth below the acromion, and discharged a very great quantity of purulent and glairy matter; the tumor diminished in size, and through the opening a very irregular portion of the bone could be distinguished.

This opening being considered too small, M. Thomas enlarged it by an incision upwards towards the acromion, and downwards towards the insertion of the deltoid. The wound was dressed with dry lint, an appropriate bandage applied, and the limb placed in a proper position. At the second dressing he was not a little surprised to see coming out of the wound about an inch and a half of the humerus denuded of its periosteum, and which appeared to have separated from the head of the bone, which he supposed to have remained in the glenoid cavity.

The disease was treated as a fracture, and the greatest attention paid by compress and bandage to keep the bone in its place, but in vain, as it con-

stantly protruded through the wound. M. Venel, senior, was now consulted, and after an attentive examination, they agreed in thinking that the cure of the disease should be left to nature, and that they should confine their endeavours to assisting the exfoliation of the exposed bone by the proper remedies. Thirty days afterwards, the extremity of the bone was felt to vacillate, and the next morning M. Thomas extracted a portion of the cylindrical part of the upper extremity of the humerus, of about an inch and a half in length. The day after he brought away the epiphysis forming the head of the bone. After the removal of this piece the wound healed, and six weeks afterwards, the bone which was taken away was completely replaced by a new formation, and the health of the child entirely re-established.

The child recovered the perfect use of the arm, which was of the same strength, length, and appearance, in every respect as the other, and at fifteen years of age was able to do the household work of a whole family. She was afterwards drowned, but M. Thomas was not able to examine the body, to ascertain the nature of the regenerated bone.

Mr. White,* in a case of a caries of the head of the humerus, after an abscess with two openings, one

* White's Cases in Surgery, page 57.

under the acromion process, sawed off the head of the bone in the following manner, being the first operation of the kind then on record. "I began my incision at that orifice which was situated just below the processus acromion, and carried it down to the middle of the humerus, by which all the subjacent bone was brought into view. I then took hold of the patient's elbow, and easily forced the upper head of the humerus out of its socket, and brought it so entirely out of the wound, that I readily grasped the whole head in my left hand, and held it there until I had sawn it off with a common amputation saw, having first applied a pasteboard card betwixt the bone and skin."

He adds, that not more than two ounces of blood were lost during the operation. The patient gradually recovered. Two months after the operation he took away another large piece of bone that had been denuded by the matter, and in less than four months he was discharged cured. The bone taken away was alone four inches long; the arm was but one inch shorter, with the perfect use of the joint; and it would appear that a regeneration of bone had actually taken place. These, the first cases on record are by far the most successful of any hitherto published.

Moreau,* junior, gives the following case from

his father's practice.—“ On the 15th of June 1786, my father was called to see the wife of M. Vivy, proprietor of the forges at Cousances. She was in her forty-fifth year. She had for ten months been affected with a complaint in the left shoulder-joint; the shoulder and arm were very much swelled; the fore-arm and hand were œdematous. When any attempt was made to move the joint, she felt the most acute pain. Indeed she was in constant uneasiness, had lost her appetite, and got little sleep.

“ Some months previous to the time when my father was consulted, M. Balthazard, surgeon in the town, had, on account of an abscess, made a longitudinal incision, about three inches in length, on the foreside of the joint.

“ My father, being of opinion that the joint was carious, persuaded the woman to have the diseased parts removed; which he accomplished on the 8th of July, in the following manner.

“ He made a longitudinal incision on the posterior side of the joint, beginning a few lines below the acromion, from which it extended three inches downwards. This incision was parallel to, and four inches distant from the one which had been formerly made. He laid them into one above by a transverse incision, which cut through the flesh about six lines below the upper attachment of the deltoid muscle. Thus a large flap, of about four inches in breadth, and three in length, was pro-

duced ; which, after being detached from the bone, he folded down on the arm.

“ He next made two other incisions, one from each end of the transverse incision. The anterior of these pointed towards the outer end of the clavicle, and the posterior towards the spine of the scapula. This gave him a new flap, which he raised ; and then he had no difficulty in discovering the whole extent of the caries.

“ This done, he dislocated the os humeri, and having pushed it up, and ascertained how far down the caries extended, he there sawed the bone across ; after which, with the gouge, he rounded the corners of that part of the bone which was left.

“ He next lowered the arm, and made it be held close to the side, and then, with ease, he removed, by the gouge, the whole external angle of the scapula, together with a part of the acromion.

“ After having taken away as much of the cellular substance, that was filled with hardened lymphatic matter, as he could, he put the patient to bed, and placed the limb in such a position, that the arm formed a right angle with the trunk, the elbow-joint being half bent. He brought the flaps together, fixed them by stitches, and covered the wounds with caddis, which he secured by compresses and the eighteen-tailed bandage.

“ During the first day, the patient was in great pain. The following night she got a little sleep.

For some days she was feverish. Till the eighth she was kept on a low diet, when she was allowed something more nourishing. On the eleventh she was permitted to rise for a short time; on the fourteenth she did not feel much pain, when the arm was gently moved; the upper wounds were beginning to unite; the anterior and posterior humeral flaps were discharging pus, both good in kind, and abundant in quantity; and the œdema was disappearing. A small quantity of bark was ordered for a few days, and her bowels were regularly kept open. On the twenty-first day, the suppuration had nearly subsided, and she could move the arm.

“In the month of October following, the cure was retarded by a phlegmonic tumor, which appeared spontaneously on the middle of the arm. It had no communication with the wound, and, in a short time, it healed.

“After the cure was complete, a hollowness remained at the top of the shoulder, as in luxations of the humerus downwards. The upper end of the os humeri rests on the ribs, anterior to the external edge of the scapula. In so far as can be perceived, its size is nearly the same; and it has formed a kind of symphysis with the surrounding parts, in such a way, that the arm can perform all its motions, except that of elevation, which is very much confined.”

Baron Larrey *, on this subject, says, “it some-

* Tome ii. page 173, de Chirurgie Militaire.

times happens, that a ball fired at a short distance shall strike the humerus immediately below its head, and break it short off. The extent of the injury is not immediately perceived; two small openings only are seen, and the shoulder preserves its natural fulness, because the head of the bone has remained untouched, or if broken in pieces, still is retained in its relative situation to the glenoid cavity of the scapula. There is, however, a mode of discovering the mischief done to the joint; for if in the first instance the fingers are pressed moderately in the course of the bone between the two wounds, a deep hollow is felt, being the want of continuity of the bone, caused by the retention of the head of the humerus in its capsular ligament to the scapula, and the separation of the body of the bone, which sinks and turns a little inward by its own weight.

“Under these circumstances it would be useless to dilate the entrance and the exit of the ball, as the dilatation cannot be made with propriety sufficiently large to allow the head of the bone to be easily extracted.

“Yet the presence of this body become a foreign substance, since it has lost its communication and connexion with the body of the humerus, causes irritation and inflammation of the joint; abscesses, sinuses, and caries, soon become evident, and there is no resource but in amputation.

“I have had the good fortune, in ten cases, to

prevent this unfortunate result, by extracting either the head of the humerus, or its fragments, without delay, and in the following manner :

“ I make an incision in the centre of the deltoid muscle parallel to its fibres, carrying it downwards as far as possible, and separating the edges of the wound to shew the joint, the capsular ligament of which is generally open ; with the curved blunt-pointed bistoury, I readily cut the attachments of the supra spinatus, infra spinatus, teres minor, subscapularis, and the long head of the biceps ; I then disengage the head of the bone, and turn it out through the incision, by pushing it from below with my fingers, or by any appropriate lever from the lateral wounds ; the arm is then to be approximated to the shoulder, and retained in position by a proper bandage and sling. In this way I have extirpated the head of the humerus in ten cases. One of these died of fever, two of scurvy at Alexandria, a fourth of the plague after our return from Syria ; the others were sent to France cured ; the arm had ankylosed with the shoulder in some, and in others had formed a sort of artificial joint which allowed of some motion.

“ The fractured part of the bone must exfoliate, and to aid nature in her operations, and prevent caries of the medullary cavity of the bone, the incisions must extend as far downwards as the bone has been injured, by which collections of matter or the formation of sinuses will be avoided ; the

dressings should be frequently, carefully, and gently exchanged, as the suppuration is generally plentiful, sharp, and ichorous, and irritates and inflames the neighbouring parts; in the first stage emollient fomentations and poultices are useful.

“ When the exfoliation is complete, the humerus is to be placed in contact with the glenoid cavity of the scapula, the cartilaginous surface of which is already effaced, and readily forms an ankylosis; but if the exfoliation is slow, this does not take place, and a sort of joint is formed, which diminishes considerably the strength of the limb. After the poultices can be dispensed with, recourse must be had to gentle compress and bandage moistened in edulcorated wine.

“ This operation should be performed as soon as possible, as it prevents irritation, inflammation, abscesses, sinuses, and extensive caries of the humerus, that would require amputation of the arm.

“ Jean Fischer, grenadier of the 69th demi-brigade, was wounded by a musket-ball at the taking of Alexandria; the ball entered about an inch from the clavicle, near the axilla, passed through a part of the pectoralis major, and coraco brachialis muscles, and fractured the humerus below its tuberosities, with some few splinters of the body of the bone, the head remaining untouched, and retained in its situation by the tendons inserted into the tuberosities; the ball then passed out opposite to its entrance, dividing the circumflex arteries,

which bled considerably, and much weakened the patient.

“ Having ascertained the nature of the injury, I dilated deeply the entrance and exit of the ball; but not being able to dislocate the head of the bone in this manner, I made a longitudinal incision in the middle of the deltoid, at the most prominent point of the joint, and raising the shoulder, the edges of the last mentioned wound being separated as much as possible, I cut with my blunt pointed bistoury the ligament and tendons surrounding the joint, and turned out the bone through the opening. All the splinters were carefully removed, the arm approximated to the scapula, and in sixty days the cure was complete. The broken end of the humerus exfoliated, and the bone ankylosed with the scapula.”

The following case is even more remarkable, from the nature of the wound, and from its fortunate result.

“ Jean Gravel, aged 17, a drummer of the 32d demi-brigade, was wounded at the battle of the Pyramids in the act of beating the charge, by a four-pound shot, which, in striking the top of the shoulder, did not carry away the fleshy parts, but merely broke the skin over the point of the acromion process, fracturing underneath the head of the humerus, the scapular end of the clavicle, the acromion and coracoid processes; the deltoid muscle was also very much injured by the impetus of the

blow. I entertained a hope of saving this limb in defiance of the extent of injury, the axillary vessels, nerves, and tendons in the axilla remaining sound. I readily took away the displaced portions of the acromion and clavicle, by cutting down upon them; the extraction of the head of the humerus was more difficult, in consequence of its being firmly retained by its attachments in contact with the glenoid cavity of the scapula.

“The young man bore the operation with fortitude, and no untoward accidents occurred in its performance; the first fifteen days were, however, passed in extreme danger. After considerable swelling, with pain, redness of the skin, fever, watchfulness, &c. a plentiful suppuration came on, with advantage to the wound, and general relief to the patient. A part of the humerus, destroyed by the fracture, and afterwards a portion of the spine of the scapula, with the glenoid cavity, exfoliated. After this, the wounds soon cicatrized, the arm ankylosed with the shoulder, by the gradual approximation of the former, and this young man at last was perfectly cured, when he embarked for France with a party of invalids, who were lost at sea, having never more been heard of.”

The injury in the case of Jean Gravel was nearly of that nature which is attributed to the wind of a ball; and M. Larrey, in accounting for the skin remaining entire except where it met with the resistance of the acromion process, explains his idea of

the nature of this injury, by supposing that the ball, in all these cases, has lost much of its direct velocity of impulsion, but still retains its motion on his own axis, which causes it in a certain degree, to roll round any elastic body, rather than to tear it away, which it would have done, if it had possessed the force that it originally had, on leaving the mouth of the cannon.

This is, I believe, what he wishes to be understood by the following paragraph concerning the shot :

“ Lequel, en suivant sa ligne parabolique contourna d'avant en arriere tout le moignon de l'épaule ; mais comme le mouvement curviligne anticipait sur le rectiligne, il parcourut cette surface arrondie en roulant sur son axe ; en sorte que la peau, très elastique, ceda a son impulsion, et ne se rompit que sur la saillie de l'humerus.”

I can safely support M. Larrey in his denial of the injury having arisen, as it is frequently supposed, from the wind of the ball ; for, from the great number of injuries I have seen, in which one part of the body has been torn away, without that in its immediate vicinity being hurt, and the clothes even being torn off with little or no detriment to the skin, I am satisfied this kind of injury arises from the ball striking the parts in a particular manner, and the explication of M. Larrey appears to me more satisfactory than any I have yet seen.

He gives another instance of a wound of the

same nature, cured in about the same time, but in which an artificial joint was formed, allowing some slight movement in every direction; and it is remarkable that this man had less strength in his hand and arm, than where the anchylosis had taken place. His other cases differed little from the three preceding, and are not related.

In the British army I have seen several cases of the same kind, which were all unfortunate, except one in a drummer at Salamanca, wounded during the siege of the fort, whilst at play at the gate of the hospital; in which the head of the humerus, scapula, and clavicle, were fractured, and were taken away in part, and the rest exfoliated, but the arm was of little use, and the suffering protracted and extreme. In these cases, nothing more can be done than to remove the pieces of bone.

It is in military surgery that an operation of this kind has the fairest chance of success, from the surrounding parts being in a state of health previous to the injury received from the ball. I recommend, however, excision of the head of the humerus in the British army only under the following circumstances. Where the head of the bone is destroyed by a musket-ball, with one or two small openings, the ball having passed fairly through; or, that it remains sticking in the head of the bone; but I conceive it essential to the success of the operation, that the body of the humerus should not be splintered, or even have one or more fissures extending

in its length; for, under these circumstances, the cure would be extremely tedious, the exfoliation might be considerable, necrosis would probably affect the bone, and if a recovery should take place at last, which is not likely, the inconvenience and frequent pain attending it, would induce many to wish the arm had been at first removed.

I do not consider a perfect fracture of the humerus an inch below its head, although there be evident separation to demand even this operation, as I have known them do well, treated as other compound fractures, save that the motion of the joint was nearly lost. A case of separation of the bone, immediately at the tuberosities, opening into the capsular ligament, without splintering the bone, or which breaks it short off, is a fair case for the operation; but these kind of injuries are seldom met with. The most common case that occurs is where a ball either lodges in the head of the humerus, or passes through without separating it from the body of the bone, and then, where the injury is great, it ought to be turned out, and sawed off, and this kind of wound is the most favourable; for, as the head of the bone is much softer than the cylindrical part, the cancelli being more numerous, the bony part thinner, and the capsular ligament firmly attached round it, the splinters do not generally extend, and the body of the bone remains sound; but even under these circumstances, the fol-

lowing cases will shew it not to be at all times necessary.

Robert Masters, of the 40th Regiment, was wounded by a musket ball, on the 12th of April 1814, at the battle of Toulouse, in the right shoulder, at its anterior part, nearly where the cephalic vein passes between the deltoid and pectoral muscles. The ball did not pass out : the head of the bone was observed to be injured, but the ball was not discovered. The man being of a patient, determined disposition, bore it without much complaint ; and the surgeon in consequence paid less attention to it than it deserved. It was shewn to me a few days after the accident with other wounds of the joints, as a case that required operation, there was high inflammation, and considerable pain, particularly on the slightest motion, attended with fever, and much uneasiness. I directed venesection, cathartics, leeches, with a constant change of cold and wet applications, and the lowest diet. I considered it a fair case for excision of the head of the humerus, whenever the inflammatory symptoms should have diminished, and requested the man might be constantly under observation for that purpose. Under this treatment for some time, the joint gradually diminished in size, the pain became less, the patient more quiet, and there appeared no immediate necessity for the operation. Six weeks after the accident, the suppuration becoming good, and some small pieces of bone discernible, an

incision was made in the course of the original wound, and the ball, with a large piece of the head of the humerus, containing nearly one-fourth of its articulating surface, and a tolerably thick portion of the cancelli of the bone, were extracted without much inconvenience to the patient. About ten weeks after the accident, the man was walking about in good health, the arm being nearly immoveable and giving little uneasiness, a small sore only remaining. In the beginning of July, three months from the receipt of the injury, the man was sent to Bourdeaux on his way to England, free from pain, and with no other inconvenience, than the loss of motion in the shoulder, which was perfectly stiff, ankylosis having most probably taken place between the head of the humerus and the glenoid cavity of the scapula, the cartilages having been absorbed or destroyed. This man has of course the use of the fore arm, and a limited use of the upper arm, by moving the shoulder on the trunk.

Private Oxley, of the 23d Regiment, was wounded on the 12th of April, at Toulouse, by a musket-ball, which entered on the anterior part of the shoulder, and passed out behind, striking the fore part of the head of the humerus on its passage; the deficiency of which was clearly to be perceived on a slight examination. It gave him, however, little pain or uneasiness, and was dressed for some days as a simple flesh wound. It was shewn to me with the other wounds near the joints in the charge of the gentleman who had dressed the slight cases, and

the man was subsequently treated as the nature of his wound demanded in the usual antiphlogistic manner, as I conceived this would also turn out a fair case for removing the head of the bone: no bad symptoms supervened; the man carried his arm in a sling, complained much of the restraint imposed upon him, and the want of food. He never had any bad symptoms. Some few very small pieces of bone came away with the dressings, which were the simplest possible; and in the beginning of July he accompanied me to Bourdeaux on his way to England, his arm quite healed, and free from pain, but stiff at the shoulder, of which joint he had quite lost the motion. The lower arm he used as before the accident.

These cases may both be considered fortunate; but I have seen others in which part of the head of the humerus came away, and the arm has been preserved.

The rule of practice in general, where the ball passes out with little injury to the bone, is, I think, to enlarge the wound in the first instance, to allow of moderate examination by the point of the finger, if it cannot be done by the openings already formed. The most energetic antiphlogistic regimen is to be enforced, until suppuration is established; a clear depending opening is to be formed, if it do not exist, for the matter to be discharged, and any pieces of bone that appear loose are to be gently removed. The joint is not to be wantonly opened into at first,

to see how much bone may be injured, but it is to be cut into, if necessary, to allow any piece of bone to be removed that may become loose, and cannot be easily extracted. The principal point to attend to, is the prevention of sinuses round the joint, as they would ultimately prove fatal. If the injury be so great as to require the removal of the head of the bone, by the operation to be described, it must not be forgotten that it is the affection of the capsular ligament and synovial membrane that principally keeps up the constitutional irritation, and in the end proves fatal; so that it is not sufficient to make a simple incision through the deltoid muscle into the capsular ligament, by which the bones may be taken away, and the broken extremity of the humerus be sawed off; but it is necessary that a considerable part of the capsular ligament be removed, or disease will most probably continue in the joint, and be kept up by the end of the humerus, until the constitutional irritation shall destroy the patient, if not relieved by the amputation of the whole.

When the operation of excision of the head of the humerus is determined upon, the patient should be placed upon a low chair properly supported, the tourniquet recommended in the operation at the shoulder being ready for application if necessary. As it is impossible the state of the bone below the fracture can be exactly ascertained until examined, it is advisable that the incision made for its extraction be in such a situation, as to permit

the operation of amputation to be performed with advantage. If, upon examining the head of the bone, the body of the humerus be found uninjured, the arm being kept close to the side an incision is to be made directly downwards from a little below the acromion, for three or four inches, or as circumstances may require; as it allows a dependant opening for the discharge of matter, and does not interfere with the operation of amputation in the manner recommended: or, if the nature of the gunshot wound render it advisable, the flap may be preserved, as recommended page 273, in the operation of amputation. In either case, the flap being separated by the finger of an assistant, and of the operator's left hand, or the deltoid flap being raised up, the joint is brought into view: searching for the tuberosities of the humerus, the long tendon of the biceps flexor cubiti is to be cut as it enters the joint running between them, by which the head of the bone is a little relieved from its connexion with the scapula, sinks downwards, when the blunt bistoury in a firm handle readily cuts on the outside the attachment of the supra spinatus, infra spinatus, and teres minor. The bistoury is then to be brought towards the inside of the arm; the fingers of the left hand are to be placed in the axilla, so as to press the head of the bone outwards and forwards, this motion being assisted by the rotation of the arm, when the attachment of the subscapularis, with the rest of the fore and lateral part of the capsular

ligament can be divided. The bone is then only attached to the glenoid cavity by the capsular ligament on the back part, which may be readily got at and divided, always taking care to keep the cutting edge of the instrument next the bone, and the back towards the artery. The bone may then be carefully sawed off, any bleeding vessels tied, as much as possible of the capsular ligament removed, and the humerus a little raised towards the scapula; the edges of the wound are to be approximated by adhesive plasters, and retained by a bandage constantly wetted with cold water, until the inflammatory symptoms are restrained within due bounds. Where the single incision is used no vessel of any consequence will bleed.

If, however, in dividing the attachment of the teres minor on the outside, care be not taken to keep the knife close to the head of the bone, the posterior circumflex artery may be divided as it rises up round the bone between the insertion of the teres minor and the teres major, having the long head of the triceps on its outside:—if this should be divided, it is not of any consequence, save that compression must be made upon the subclavian artery until it be secured. If the anterior circumflex be divided on the inside it must also be tied, but this vessel is generally of less importance. If by any accident the operator should wound the axillary artery, he must secure it with a ligature, and proceed to amputate the limb.

After the inflammatory symptoms are over, the body of the humerus must be brought in contact with the glenoid cavity of the scapula, and retained in that situation until the wound be healed; it is obvious the greatest attention must be paid in dressing it, to prevent collections of matter of any kind, and to give free vent to them if formed; an exfoliation from the sawed end of the humerus is to be expected, and if very particular care be not taken to repress and allay symptoms as they arise, the patient will become hectic, and die.

Neither this, or the preceding operation, should be attempted, until a due knowledge be obtained of the relative situation of the great vessels and parts surrounding the shoulder-joint.

Of Amputation of the Arm.

This operation, perhaps the simplest in the list of those usually considered of importance, has frequently been confined to the space between the elbow-joint and the insertion of the pectoralis major; and where the injury, affecting the bone, has extended higher than this point, amputation at the shoulder has been recommended in preference to cutting through this, and other muscular attachments, and sawing off the bone near to its tub-

rosities. M. Larrey,* who, in general, I consider as one of the first authorities in Military Surgery, says, "When the injury affecting the arm, extends very high up, instead of preserving a short stump formed by the upper end of the bone, it is better to amputate at the shoulder; for, if the section of the humerus cannot, at least be effected on a level with the tendinous insertion of the deltoid, the stump is retracted towards the arm-pit by the pectoralis major, and the latissimus dorsi. The ligatures on the vessels which must be made high in the axilla, irritate the brachial plexus of nerves, and increase the retraction, which is attended by pain and nervous twitchings extremely uncomfortable to the patient, and which frequently bring on tetanus; the stump always remains swelled, and at last the humerus anchyloses to the shoulder, so that this portion of the arm is altogether useless to the sufferer, and renders him liable to frequent accidents. I have seen many officers and soldiers of all ranks, who regretted from these causes, that they had not lost their arm at the shoulder."

When amputation by the circular incision, is attempted at the insertion of the pectoralis major, it is seldom that the bone will not protrude after a few dressings; and frequently a disagreeable and painful stump is the consequence. If a tourniquet be used, a great difficulty occurs in securing the ves-

* Larrey, Tome III., page 53—400.



sel, which will not bleed from having retracted into the axilla from the first moment of the incision, and having during the remainder of the operation been compressed at its divided end by the strap of the tourniquet; a needle is then resorted to, and much mischief committed. I was called after the battle of Salamanca, to an officer operated upon, precisely under these circumstances, in whom a profuse hæmorrhage took place from the axillary artery, which in a few moments caused him to faint, and by this sudden and great loss of blood preserved his life. It was presumed the head of the bone must be extirpated, and the diseased parts removed, so as to render it a fresh incised wound, in which the vessel could be safely secured. The young gentleman was however, so nearly exhausted, that this plan did not appear feasible; and as the artery ceased to bleed, it was determined to wait until he gained a little more strength, or the recurrence of the hæmorrhage should render an operation necessary; due assistance to prevent accident, being always with him. The hæmorrhage never returned, the coagula and foul dressings were in three days removed, his strength gradually recovered, and in due time, allowing for the protruded end of bone to exfoliate, he was cured. I have been always of opinion, that the artery never was included in the ligature, as the surgeon himself was doubtful of it, and the operation had been performed in the dusk of the evening.

After the battle of Albuhera a similar circumstance would have occurred to myself, if I had not taken off the tourniquet, and even searched in the axilla by dissection for the artery, before it could be secured.

Since that period, I have abstained from performing amputation by the circular incision, when the bone cannot be sawed below the insertion of the pectoralis major; but I must dissent entirely from the opinion of M. Larrey and the French surgeons who recommend under these circumstances, amputation at the shoulder; for all the advantages of this operation may be gained, and any disadvantages attending it avoided, by sawing the bone from half an inch to an inch and a half below the tuberosities of the humerus, as the state of the injury may require. The artery is as easily and as safely secured as in amputation at the shoulder; the nerves are as readily separated from the vessels, and equally as free from irritation or inconvenience of every kind; the stump neither swells or becomes affected in any way differing from a common amputation; the bone is remarkably well covered; there is little or no fear of retraction of the integuments, the rotundity of the shoulder is preserved, and the deformity following amputation at the joint is in a great measure avoided.

The operation is performed as follows:

The patient is to be seated, and compression

made upon the subclavian artery in the same manner, and with the same instrument as in amputation at the shoulder, in preference to using a tourniquet with a pad in the axilla, which is a source of great inconvenience in every step of the operation: two incisions of a similar shape are to be commenced, one or two fingers breadth below the acromion, as the case may require, the point of the inner one, instead of ceasing, as in the operation of the shoulder, a little below the pectoral muscle, is to be carried directly across the under part to meet the point of the outer incision; so that the under part of the arm is cut by a circular incision, the upper in the same manner as in the operation at the shoulder: these incisions are only through the skin and cellular membrane, which has liberty to retract, but is not to be turned up. The deltoid and pectoralis major are then divided close to the inner incision, and the opposite portion of the deltoid, with the long head of the biceps on the outside, for the extent of the outer incision. A half circular cut on the under part, in the line of the skin down to the bone clears it underneath, and shews the artery retracting with its open mouth, which is at this moment advantageously pulled out by a tenaculum and secured. The flaps are turned outwards and inwards, and particularly the outer one until the bone is cleared to the spot of election for sawing, which is then readily effected from the outside, without danger of doing mischief

The tendon of the latissimus dorsi and the teres major, inserted on the under part, need not be cleared away too carefully, as they materially help to keep the bone steady under the motion of the saw, and effectually prevent its splintering. There are few, or no vessels to tie, the flaps are brought forwards and upwards, and perfectly cover the stump; one suture below the end of the bone, keeps the parts together, which form nearly a line from the acromion downwards. The wound over the bone heals generally by the first intention, the ligatures soon come away, and the cure is completed in as short a period as in other amputations.

Corporal M'Kenna, of the 36th Regiment, was wounded at the battle of Toulouse, by a musket-ball in the left arm, which fractured the bone at its lower half, and injured the joint of the elbow; four weeks after the accident, the arm to the insertion of the pectoralis major, being in a state of disease, and the man's general health seriously affected, the operation was performed as above stated, before the military surgeons on duty, and the French surgeons of the town; not an inch of bone being left, exclusive of the head of the humerus. Except slight pain the first twenty-four hours from the bandages being too tight, the man suffered little inconvenience: the bone was covered in nearly by the first intention, and the ligatures came away, leaving in three weeks, merely a line from the acromion downward; the man accompanied me to Bourdeaux

the beginning of July, on his way to England, in perfect health, having never after the first few days of the operation suffered any inconvenience in the stump.

Corporal Wm. Robinson of the 48th Regiment, was wounded at the battle of Toulouse, by the explosion of a shell, which rendered the immediate amputation of the right leg necessary; and fractured the bone of the arm of the same side, opening extensively into the elbow-joint. The amputated leg doing well, but the constitution becoming affected from the state of the arm, the integuments of which, were much injured and diseased, the removal of it was executed, as above described on the 1st of May, eighteen days after the receipt of the injury. The greater part of the incision, and particularly that over the bone, healed by the first intention, the lower part remaining after some days tolerably firm and compact; the ligatures came away regularly. At the end of the month there was merely a line of incision, at the lower part not quite cicatrized; when he perceived a little hardness at the under part of the wound, which gradually became a small swelling of the size of a marble, and in the beginning of June opened into the line of incision of the original wound, discharging about a tea-spoonful of pus, arising, as I conceive, from a small portion of the tendon of the pectoralis major, having sloughed, after being surrounded and cut off from the external wound, by the process of adhe-

sive inflammation. This discharge continued, but in small quantity, until the removal of the man to Bourdeaux, when it nearly disappeared, and he embarked for England. On his arrival at Plymouth, on the 28th of July, he walked about the streets, and was apparently well; this little abscess however, from inattention or injury, again collected the opening into the external wound having closed, and on the 2d. of August was opened with the point of a lancet; in the evening there was a trifling hæmorrhage which was hastily suppressed by compression, and the application of cold cloths. The following morning, on the removal of the dressings, the axillary artery bled furiously, and was scarcely restrained by the assistants, until the gentlemen in charge assembled; when the face of the stump was opened, and many attempts made to secure the artery, but in vain; owing, it is supposed, to the diseased state of the parts surrounding the extremity of the vessel. It was then resolved to take up the subclavian artery, which was secured with some difficulty immediately after passing the clavicle in the following manner by Assistant Staff Surgeon Dease, who had the care of the man from Toulouse to Plymouth, and who happened at this moment to be present; by him I am furnished with this part of the case. An incision commencing at the centre of the clavicle, was carried down to the inferior part of the axilla, where the abscess had pointed, the great pectoral muscle was then cut through,

the lesser pectoral and some fillets of the subclavian also. Then by a careful dissection and removal of cellular substance and fascia the artery was laid bare. During the dissection, one or two small branches sprang, which were secured; the great difficulty then existed in the want of an instrument adapted to the space where the artery lay, the projecting coracoid process of the scapula on one side, and the clavicle above, leaving it quite a deep and narrow space: this was effected with considerable difficulty, by giving to a probe a curve adapted to the space; the bare passing of which took at least one hour, so great was the difficulty, owing to its being too flexible, and the curve giving way. The ligature came away in a reasonable time, the man was discharged the hospital, cured, and is now at Chelsea.

On the embarkation of this man for England, I recommended a director to be passed in the course of the external wound, and the little abscess to be laid open; but Mr. Dease thought it unnecessary during the passage, the discharge being so small; and it appears to have been nearly sound on his arrival at Plymouth, when changing his medical attendant, and being during five days nearly at large, and drinking hard, the little abscess again formed. The artery must then have ulcerated in it, or it was wounded by the point of the lancet with which it was opened; whichever of these circumstances did really occur, and perhaps opinions

on this point may differ, neither affect the operation as it was originally performed; it having been, as allowed by all present, free from fault, and the artery fairly and clearly tied. The first abscess which I saw, arose, I believe, from the tendinous end of the pectoralis having sloughed, an accident likely to happen, both in this operation and at the shoulder; and in another case of this kind I would recommend its being fairly laid open by a scalpel and director; and if the artery give way from any cause, to cut down upon it in the direction of its course from the clavicle, instead of searching for it on the face of the stump, or attempting to secure it with the needle.

I first performed the operation at Salamanca, having seen the defects of the circular one at the battle of Albuhera, and the sieges of Ciudad Rodrigo and Badajos, and in consequence, I believe, of my recommendation of its general utility, it has since been performed in this manner in several cases with success, and particularly after the battle of Orthez, in which the operation at the joint would have otherwise been considered necessary; and when the operation is done in the way above described, and the parts united by the first intention, and I have seen several of them after the lapse of a year, it is not liable to any of the objections of M. Larrey, and certainly must be preferable to removing the arm at the shoulder.

Amputation of the arm by the common circular

incision, is to be practised only in the space between the lower edge of the insertion of the pectoralis major, and the elbow joint. More serious wounds may be inflicted in this space, however, and the arm preserved, than in any other part of the extremities; arising from the great command the surgeon has over it, from the bone being single, and its state capable of being distinguished with tolerable accuracy during the continuance of the complaint, from the muscles being few in number, and the interstices between them consequently less numerous, and from the great vessels being totally in our power. A wound in the arm is also less distressing to the patient, than a proportionate one in the thigh or leg, and in common much less affects his general health.

Considering the great frequency of wounds in this part of the arm attended with fracture, amputation, as a primary operation, is but seldom requisite; and a just delay to ascertain what nature, assisted by art can do, is prudent.

No common flesh wound, made either by cannon or musket shot, even including a division of the artery, absolutely demands the operation, the bone remaining sound, except the laceration attending it be extensive in every direction; as nature can, and will do much under these circumstances, when properly assisted; recourse is to be had to delay, until it be ascertained, that the fore-arm, or hand, cannot be supported below, or that the extensive contusion is

likely to bring on gangrene in the wound, when the operation is in time, and admissible. If, in addition, the bone be broken, or, if the bone be mashed with the muscles, by an oblique stroke of a round shot, or the fore-arm be destroyed, or carried away, it is required immediately.

The necessity for the operation after a wound from a cannon shot is generally obvious, or the reverse; it is far different, however, in regard to wounds from musket-balls; the practice has altered considerably in the late campaigns, and arms that would have been amputated in 1800 were preserved in 1814, from the knowledge acquired by experience, of the liberties that may be taken with impunity, with this extremity.

A musket ball passing through the centre of the os brachii with considerable splintering of bone, provided they do not reach as far as either of the joints does not require the primary operation, however, circumstances may ultimately call for the secondary; and this rule of practice is so general among military surgeons, that I believe no one of experience, or surgical knowledge, has ever proposed amputation in a case of the kind, during the peninsular war, without other particular reasons; and those practitioners in military surgery, whom Mr. C. Bell describes at p. 475, of his valuable *Dissertation on Gun-shot Wounds*, included in his *Operative Surgery*, as stating to him "that when the bone is fractured by the ball striking the bone, the arm is to be

saved ; but when the ball goes through the bone, and the finger introduced into the shot-hole, feels the broken pieces on all sides, and that the ball has passed through the cavity of the bone, it is a case for amputation," were stating to him not the practice of military surgeons in general, or of the army in the Peninsula ; but their own unconnected opinions, which are highly deserving of the censure he has passed upon them.

I cannot indeed conceive, that any thing could induce men of ability thus to depreciate their profession, and whatever situation these gentlemen might have held, I conclude it was ignorance of what was really done in the army, that made them state what they did ; and when I connect this with Mr. Bell's observation at p. 459, " Among the soldiers from Spain, I have seen some whose wounds were scored, as if in religious ceremony, but the cuts were healed, while the narrow wounds remained full of slough." I cannot help being perfectly satisfied that ignorance was conspicuously displayed to him ; for I solemnly assert that of 20,000 wounds I have seen from the first battle of Roliça, in 1808, to the last of Toulouse, in 1814, I never made an incision for the sake of simple dilatation ; and I never saw but one that I can recollect made by any person, without some further legitimate object in view for such operation.

On the 17th of August, 1808, a few days after the arrival of Sir A. Wellesley in Portugal, Captain, now

Major Hodge, of the 29th regiment was wounded on the heights of Roliça in the left arm, by a soldier whom he distinctly saw taking aim at him, at less than six yards distance. He came to me immediately afterwards at the foot of the hill, whilst still exposed to a severe fire of musketry. The ball had passed completely through the bone about its middle, and the lower part of the humerus and the fore-arm hung at a right angle with the upper extremity of the bone, when he was brought to me, as the surgeon of his regiment. I passed my finger between the bones at both shot-holes, removed all the small pieces that could be brought away, placed his arm in splints, and directed him to keep it constantly wet with cold water. This was done, suppuration came on in due time, an incision was made for the removal of a piece of bone that could not with propriety be brought away at first; and in two months, from the attentive care of the gentlemen at the Hospital at Caldas, he was enabled to remove to Lisbon with an arm perfectly firm, although not entirely healed. It is now no inconvenience or pain to him whatever; it is not quite so strong or so long as the other, but otherwise there is no defect. I relate this case of an officer, merely because he is more referrible to as to the fact than a soldier; and I could produce numbers, both officers and soldiers, under the same circumstances; indeed, I very lately met a soldier of the same regiment, wounded on

the same day, the 17th of August, 1808, but much higher up, the ball having passed through the pectoralis muscle before it broke the arm, who is now able to earn his livelihood as a labourer, having all the use of his arm below the level of his shoulder: it was, however, a year before the wound healed in this instance.

I hope it will be believed from these cases, that the gentlemen who gave Mr. Bell the information above stated, led him into error; and in vindicating the medical department of the army from the censure he has passed upon it, I acknowledge it would have been just and highly proper, under the circumstances he has stated, and I am satisfied it will be more grateful to him to know, that we are not guilty of this bad practice, than to be assured that his censure was just.

If the artery be wounded with an extensive fracture, the operation is then imperious; but if it be wounded with merely a splintering of the bone, without complete solution of its continuity, or even if it be broken short across with little or no splintering, the vessel should be secured above and below, and the event carefully watched. I have no case in support of the opinion, it is therefore more theoretical than practical, but I think it a case well deserving trial; for where the bone was not absolutely broken, but splintered, the arm would be saved, and where it was even fractured across, delay would be prudent, provided the surgeon is capable

of estimating symptoms, and has it in his power to pay his patient constant attention. If these advantages cannot be secured to him, amputation is to be preferred.

Here, as well as in every other case in which arteries are wounded, and continue to bleed, and in which I recommend an attempt to be made at saving the extremity, the state of the limb must be taken into consideration; if these vessels have thrown their blood directly out at the wound, without injecting the cellular membrane, the case is a good one, but if pressure has been inconsiderately made upon the wound, and the arm or leg be injected with blood, it is very disadvantageous, and in a case of injured bone, would determine for amputation; but where the artery or arteries only are wounded, it should not influence the practice to so great an extent, and if it be in the arm, or fore-arm, the vessels should be secured at each end, in parts unaffected by the motion of the ball, the extravasated blood pressed out by these wounds, or by others made through the skin and fascia, and the result, as before directed, awaited with attention. If the blood thrown out was in great quantity, and the hæmorrhage soon ceased, it is almost certain that the artery has been fairly cut through, and it may ~~be~~ give ^{no} more trouble; but if it continue to bleed and in less quantity, it is more than probable that it is only wounded.

A simple wound of the fore-arm, superadded

to a fracture of the humerus, is not a cause for operation ; although a severe one, attended with fracture of the radius or ulna, will in general be a sufficient reason for performing it.

A wound of the brachial artery by a musket-ball, accompanied by another in the fore-arm of a simple nature, or the loss of a finger or thumb, or even the ends of two or three fingers, is not sufficient reason for immediate amputation of the arm : the vessel is to be secured, the fingers amputated, and the results carefully attended to. Any wound, destroying a great part of the hand, or joint of the wrist, would render the attempt at preservation of the arm, not worth the risk attending it.

An incised wound into the elbow-joint, cutting off with it a part of the condyle of the humerus, or the head of the radius or ulna, requires the piece of bone only to be removed, and the flap laid down, when the cure will frequently be effected with a loss of motion of the arm, depending on the degree of injury. If the wound be large, and the ligaments much divided, it will be better to proceed at once to amputation, as the succeeding inflammation and its consequences, will in general destroy the patient, if it be not at last resorted to.

Wounds from musket-balls entering the joint of the elbow, and wounding only one of the bones, have seldom done well ; they have generally terminated in cases of secondary amputation, after the cartilages had been destroyed, and anchylosis had

failed to take place. From the failure of a great number of cases attempted to be preserved, I am satisfied that cures will seldom be effected in military practice. Amputation is not however demanded as a primary operation, except there be not only a scrophulous predisposition, but the appearances of scrophula existing in the system, when the operation is advisable.

If the artery in the bend of the arm be wounded, or the joint of the wrist, or the carpal bones be injured, in addition to the injury of the elbow, the operation is to be performed.

A musket-ball passing through the elbow-joint, injuring the articulating ends of the humerus, radius, and ulna, is a fair case for amputation above, as the joint cannot be saved by ankylosis, as has frequently been supposed; or if a case of this kind should occur, it is so infrequent, and gained with the loss of so many lives, as not to deserve consideration.

A wound from a cannon shot injuring the bones of the elbow joint, demands immediate amputation, as the neighbouring parts are also generally much injured.

The operation being necessary, the patient should be placed upon a chair, and properly supported: the tourniquet is then to be applied in the usual manner with a small pad in the axilla, with the screw above the acromion, it being advisable to have the strap acting as far distant as possible on the muscles, and skin to be divided, that free retraction may take

place, and no impediment be offered by the pressure of the tourniquet on the soft parts, whilst retracting them for sawing the bone. If the surgeon have the slightest confidence in himself, and the assistants are good, no tourniquet should be applied, but the artery be compressed against the bone, by the two fore fingers. For my own part, I never apply a tourniquet, and I believe if by any accident the assistant should fail, the operator can without difficulty compress the artery himself, so as to prevent any evil consequence, and not interrupt the operation; and in the first case in which I tried the flap operation on the arm, I had to compress the artery against the head of the humerus with the left hand, whilst I sawed the bone with the right.

The assistant who compresses the artery should retract with both hands the integuments upwards, and another assistant, if one be at hand, should put them on the stretch downwards towards the elbow joint, when they are cut more readily, and with greater ease to the patient.

A circular incision is to be made at one continued stroke, as quickly as possible, through the integuments down to the muscles, taking care that they be not cut, and that the artery on the inner and under part be especially avoided. The integuments thus cut, are not to be dissected back, as is usually done, but separated by touching the slip of membrane which may still adhere to the muscles with the knife; the assistant still steadily retracting it

as it recedes on being loosened. The knife being then placed close to the incised integuments, with the edge gently sloping inwards, the muscles and the vessels are to be divided, the incision commencing on the outside of the biceps which is to be cut through, and carried in one sweep completely round. A second incision close to the edge of the former, if necessary, cuts through any remaining muscles down to the bone. The amputating knife being changed for a strong scalpel, the muscles are to be cleared from the bone for an inch or a half, or two inches as the thinness, or wasting of the part, may require for the sake of covering, as no injury can arise from the bone being short, and conical stumps frequently occur, from its being too long.—The retractor is to be applied, and the periosteum to be divided by one circle drawn with the scalpel round the bone, and in the circle the saw is to work until the bone be divided. The retractor is to be removed, and the brachial artery drawn fairly out with a tenaculum, and tied. It will be found on the inner side of the arm. If it should have retracted out of sight, the finger on the vessel above it is to be raised, or the tourniquet is to be loosened, when it will shew itself, with perhaps two or three other vessels, which must be secured. The surface of the wound is to be washed clean with cold water, and the integuments dried with a cloth, and the stump dressed in the same manner as in amputation of the thigh.

I consider stump caps in military surgery, where other important articles cannot be conveyed as unnecessary: and they frequently do harm, from incautious application; in summer they are injurious, and in winter they can be dispensed with until the stump be healed, when they keep it comfortably warm.

Excision of the Elbow Joint.

I have already stated that the operations of sawing off the articulating ends of bones, or cutting out the whole of the joints themselves have not been practised in the British Army, although my own opinion now is, that many cases do occur in the upper extremity in which they may be resorted to with advantage; and I recommend the observations of Messrs. Park, Moreau and Jeffray, published by the latter, to the consideration of all military practitioners: premising, that the operations therein advised are only to be attempted by those who have a competent knowledge of the anatomy of the parts to be divided; whereas the more simple operations of amputation may be performed by any body, with little anatomical skill.

In the case of a musket-ball sticking in the condyle of the humerus, which from the softness of the bone at that part may easily occur, I would cut down upon it, and extract the ball with any splin-

ters to be found, by applying even the trephine, if it could not be done under more easy circumstances; and with a fair depending opening, wait the result.

In cases where the articulating surface of the condyles of the humerus are alone wounded, or the head of the radius and ulna are both destroyed, I would recommend the operation of sawing off the ends of the bones as proposed by Moreau and Dr. Jeffray, where due attention can be paid in preference to cutting off the arm. As there is no reason to doubt that the cases related are genuine, I am satisfied that accidents do occur in military surgery in which they are advisable, and frequently the accommodation and arrangement of hospitals, will permit of every attention and sufficient comfort being given to the patient: besides, the arm is so manageable, that if it fail, amputation will not be rendered impracticable. Before giving the methods proposed by these two gentlemen, I must caution military surgeons against performing them without they can isolate their patients and put them in healthy situations, free from the confined air of any large hospital however apparently healthy, or it is most probable the operation will fail, and be condemned from causes foreign to its nature.—An injury to the head of the radius or ulna alone, will not require so severe an operation in general; the pieces of bone should be removed, and the efforts of nature carefully awaited.

The following is Moreau's method as performed in a case of carious joint of the elbow in the year 1797.*

“ A Table, about four feet high, was placed opposite a light window ; on this a bed was spread, on which the patient was so placed upon his belly, that the diseased arm lay on the edge of the table, presenting to the operator, the inner and posterior side of the joint.

“ After having applied the tourniquet, on the upper part of the arm, to guard against the unnecessary loss of blood, as well as to deaden the sensibility of the parts to be operated upon, I entrusted it to an intelligent assistant. The arm being in a state of semiflexion, I plunged a dissecting scalpel in upon the sharp edge, or spine of the condyle of the os humeri, about two inches above its tuberosity ; and directed by the spine, I carried the incision down to the joint. I did the same on the other side. I then laid the two wounds into one by a transverse incision, which cut through the skin and the tendon of the triceps extensor cubiti, immediately above the olecranon.

“ By these means I got a rectangular flap, one end of which adhered to the flesh, on the posterior side

* See Park, Moreau and Jeffray, on Carious Joints, edited by the latter.

of the arm. This flap I raised from the bone, dissecting it from below upward; and I caused an assistant to hold it up, out of the way.

“The posterior surface of the os humeri being now bare, I washed it and wiped it with a sponge, in order to satisfy myself respecting the condition it was in.—It was enlarged and rough; the joint was filled with purulent matter, and contained a fungous substance that occupied the place of the cartilages, which had entirely disappeared. No doubt remained respecting the propriety of removing this part; but wishing to be certain whether the caries had penetrated into the whole of its substance, I pared a little of it away with a gouge. This trial fixed my resolution. I then separated the flesh which adhered to the anterior side of the bone above the condyles, taking the precaution to guide the point of my instrument, with the fore finger of my left hand; and after I could pass the handle of a scalpel, through between the flesh and the bone, I allowed the scalpel to remain there, and sawed the bone through upon it. I finished the removal of the piece, by raising and detaching it from all its adhesions. Perceiving that the bone was diseased higher up, I was obliged to take away six or eight lines more.

“The most difficult part of the operation yet remained, for, I had to remove the upper ends of both the bones of the fore arm.

“My first flap being no longer sufficient, it became

necessary to make another. I extended the lateral incision, at the outer side of the arm, carrying it downwards, along the external border of the upper part of the radius. I separated the head of the radius from the surrounding parts; I destroyed its connexion with the ulna; and I introduced a strap of linen between them, to draw back the flesh from being injured by the saw:—I cut the radius across, close by the attachment of the biceps, which I had the good fortune to preserve. Finding that some medullary cells, filled with pus remained, I removed them with a gouge, without injuring the solid bone, by which they were surrounded.*

“ I next laid the ulna bare, by continuing the lateral incision of the inner side of the arm; which, with that I had made, gave me a rectangular flap, that adhered by its base, to the flesh on the back part of the fore arm. I detached it from that part of the bone, which I wished to remove. I separated the bone from every thing that adhered to it; and having put a strap of linen around it, to protect the

* The bones of the fore arm must be cut with a small saw. The flesh comes too much in the way of a large saw. The small one is difficult to manage; but what better can we do? And when you add to this, the risque of cutting the vessels, which at this place, pass through the interosseous ligament, you will see how difficult this operation must be.

flesh, I sawed off about an inch and a half of bone, measuring from the tip of the olecranon downwards. The rest of the bone being sound, a few medullary cells excepted; I took them away, in the same manner as I had done those of the radius.

“It may easily be conceived that the wound produced by this operation was enormous. It will be seen in the sequel, that it healed as soon as if it had been only a common wound. It was washed; the tourniquet was slackened; two or three small vessels sprang, which I secured by ligature. I brought the two flaps together, and secured them by two stitches of the interrupted suture. I put in two more, into each of the longitudinal wounds; one into the flap of the arm, and another into the flap of the fore arm, on each side. That done, my patient was carried to bed; where a cushion of chaff, covered with several folds of cloth, and an eighteen-tailed bandage, were placed. On this the arm was laid, in a half bent posture; and I covered the wounds with pledgets, dipped in a mixture of olive oil and yolks of eggs, in order to prevent the caddis from adhering, which renders the first dressing so painful. Over these pledgets, caddis was laid; and the whole was secured by compresses and a bandage. The weight of the bed clothes was borne up by a hoop.

“The wound went on favourably; in fifteen days the arm was put in a sling, and the man walked about where he pleased. The wound healed, but the arm was at first powerless, by degrees it gained

strength. In 1801, four years after the operation, the arm was less than the other, and three inches shorter. The bones of the fore arm had grown together, but were not in contact with the humerus. The little finger had no feeling, from the ulnar nerve having been divided, but the man had the use of his arm so completely, as to be able to use it in thrashing in a barn, holding the plough, &c.*

Dr. Jeffray of Glasgow, struck by the difficulty of sawing off the ends of the bone in this, and other operations related by the same writer, invented a flexible saw, jointed on the principle of the chain of a watch, which certainly not only gives greater facility to this operation, but would be highly useful in other cases of military surgery, where the ends, or pieces of bone are to be cut off. He describes its operation as follows.

“ Having brought the bone that is to be cut fairly into view, by an incision, the flesh is to be separated from it all round, and by the finger if possible. The needle, which it is scarcely necessary to say, should be blunt at the point as well as on the edges, at the same time that it should be elastic, and adapted in curvature and size, to the depth of the wound and the diameter of the bone, should then be taken in the right hand; and its point being brought to touch the surface of the bone on the right side, should be passed behind, and in contact with the bone, till, sweeping a half circle, it be felt or seen

* See page 109 of Park Moreau and Jeffray on Carious Joints.

in contact with the bone at the other side, where it now may be laid hold of and drawn through.

“ While the surgeon is thus employed in passing the needle behind the bone, his assistant should attend to the saw, by letting it through between his finger and thumb, so that its cutting edge shall be towards the bone. The saw being brought through, the needle is to be removed, and the handles hooked on. The surgeon should now place himself in a position, to have the full use of all the muscles of his arms ; and, having tried the saw gently, to see that its side is not to the bone, he should draw one end of it towards him smartly with one hand, and then the other with the other, till it cut the bone through ; during which operation, the assistant should hold one end only of the bone fixed, for, if they press upon both, they will lock the saw, and retard the operation. The execution of the saw will be found to exceed expectation ; for, as it is applied round one half of the bone, its cut is extensive. When however, the bone is sawed nearly through, the surgeon should either keep his hands farther separated from one another, than he found it necessary to do at the beginning ; or he should give one handle of the instrument to an assistant, and retain the other himself, that they may stretch out the saw, and thereby make it more like a straight saw, as it approaches the anterior surface of the bone, lest, being then bent too sharp, it break ; of which, however, if the force exerted be not unnecessarily great, I can say there will be very little

danger, having now used, and sometimes roughly, the same saw for these fifteen years past, without either sharpening or mending."

Moreau in his operation above described, divided the triceps extensor of the arm immediately above the olecranon, from which circumstance the extension of the arm was in a great measure lost; to obviate this inconvenience, Dr. Jeffray thinks his chain saw peculiarly applicable. He says, p. 190, "recollect then the relative situation of the different parts about the joint; and you will find, that, by making two longitudinal incisions only, one on each side, and of sufficient length, as practised by Moreau, the chain saw can be entered at the wound on one side, and be conducted by the needle, across and in contact with the upper side of the bone, to the wound on the other; and from whence it can be brought back, under the bone with equal safety and ease. You have seen the saw applied in this way, to the bones below the joint, as well as to those above: and though the swelling of the parts must render every step of the operation more difficult in real practice, than on the sound limb of a dead subject; yet I persuade myself you are convinced, from what you have seen, that however necessary it may be to lay the two lateral incisions into one, by a transverse cut, before the straight saw can be applied, few cases will occur requiring a transverse

* See Dr, Jeffray, page 176, 178.

incision, if the chain saw be used." To avoid the division of the ulnar nerve, he recommends the external lateral incision being made exactly in the course of the nerve, which is then to be dissected from its attachments, and drawn to one side or the other, as may be most convenient.*

In recommending this operation occasionally to be performed, I wish it again to be understood, as requiring considerable precaution and attention, more so than the excision of the head of the humerus; as injuries of the joint of the elbow less frequently do well after gun-shot wounds than of the shoulder; and if every precaution cannot be taken, it is better to amputate at first, than after a severe operation, and considerable suffering, to be obliged to execute it, to great disadvantage.

Amputation of the Fore-Arm.

Wounds of this part are frequently more serious in their results than their appearance at first gives reason to suspect; and the operation of amputation becomes in general a secondary, rather than a primary operation, from the subsequent evils demanding it; and the principal one arises from the constitution becoming affected, so as in time to endanger life. For although the fore-arm is liable to more complicated injuries than the upper arm, still it is quite

* See Dr. Jeffray, page 206.

under our management. The two bones can be more easily got at, and pieces extracted with ease; the arteries, particularly the radial and ulnar, can be cut down upon, and except at the upper part, secured without any difficulty. The interosseal, ulnar, and radial arteries can and ought to be fairly tied whenever they bleed at any sacrifice of muscular parts; and the fascia may be divided freely in every direction, as it may be found to impede the discharge of matter, or cause other inconvenience to the patient. An advantage arises also from the number of the arteries supplying the lower part of the limb, for if one be wounded, yet another, and perhaps two, remain to support and nourish the parts beneath, which, from the free communication of the palmar arches is readily effected; mortification of the fingers therefore seldom or never takes place, from wounds of the fore arm.

These observations will shew that amputation is considered seldom necessary after wounds from musket balls. A fracture of both bones of the arm, with a division of the arteries is, perhaps, the only case from a wound by a musket ball, in which it may be legitimately performed as a primary operation; a wound of one artery with fracture of both bones is not sufficient, as the artery should be fairly tied at both extremities as soon as the injury be ascertained, and which perhaps may even be only suspected from the want of pulsation at the wrist.

If both the radial and ulnar arteries be wounded

by a raking musket shot, it may, under certain circumstances of great extent of injury, as a ball passing from the wrist to the inside of the elbow joint, be necessary to amputate; I would recommend in most cases in the first instance, both vessels being secured at each end, by regular incisions for the purpose, and the arm only removed when gangrene was commencing. The stuffing of the fore arm with blood, in consequence of the wound of the vessels without fracture, would not induce me to amputate until I had given the arm a fair trial.

Cannon shot seldom strike the fore-arm without doing such injury as demands amputation, if they do not carry it away; arising, I conceive, from the two bones being so near the outline of the arm for two thirds of its length, and allowing of no recession or elasticity of parts before the impulse of the ball. From the firmness with which the parts are bound together, there is, in general, a greater laceration, which with fracture even of one bone may render the operation advisable. If the muscles composing the thick part of the arm only be carried away, even with division of one or more vessels, the operation is not imperiously called for, nor until circumstances may arise demanding it, such as gangrene in the part itself, the effect of contusion, or in the hand from deficient support.

When the hand is carried away below, or at the joint of the wrist, the operation is required instead of

attempting to cover the end of the radius and ulna, or preserving one range of carpal bones.

A wound of the carpal end of the ulna opening into the joint of the wrist does not demand amputation, for the ulna enters so little into this joint that with due care it may be expected to do well with some little loss of motion. The destruction of the radius is of more consequence, and if the joint of the carpus be opened, and the radius, the scaphoides, and lunare, also destroyed, the operation is generally requisite. If the ulna and radius be both injured, in the same manner, it is necessary as a primary operation.

Wounds, by musket shot, of the lower range of bones of the carpus, do not require amputation. I have seen numbers of them do well and recover, with some little loss of motion of the wrist, and of the fingers to which the tendons that may be divided were going, but even this is in some measure removed in time, by the connexion there is between all the flexor and extensor tendons of the hand.

The operation being determined upon, a question has arisen where it should be performed, and here the practice of some of the English and French surgeons differs materially.

There are two places of general election, one near the joint of the wrist, in the lower third; the other near the elbow, in the upper third of the arm.

The one performed in fleshy, the other in tendinous parts : and this difference of substance causes the difference of opinion in question.

It has been already stated, when treating of "Amputation," that many, indeed a great part, of the French surgeons do not endeavour to effect union by the first intention, but gradually cause the parts to approach each other by means of bandaging ; they then place some lint on the incised muscles and integuments, and wait for supuration, granulation, and the subsequent approximation and adherence of the wound.

The British surgeons on the contrary, lay down the parts after every amputation, and endeavour to unite them.

The French surgeons, and particularly Baron Larrey, declare, that amputation at the lower part of the wrist does not succeed ; and recommend the operation being performed in the fleshy part above ; and this not only when the injury has been inflicted by cannon, but by musket or grape shot, and without reference to the apparent soundness of the part. They support their opinion by the result of their practice, which they state to be unfavourable to the lower operation, and generally attended with disease of the bone, formations of matter, and other evils that frequently render another operation advisable, or at least leave the stump in many instances, painful and useless. The reason for this, is supposed, by them, to arise from the aponeuroses

of the muscles, the fascia binding down the tendons, and the periosteum of the bone being torn up to a greater distance, than is generally conceived, in consequence of which, matter is formed amongst the tendons, or caries of the bone takes place to a considerable extent, or there are large exfoliations with a tedious cure ; all of which they say they avoid by cutting higher up in the thick part of the fore-arm.

I allow an accident of this kind may happen occasionally, but the surgeon can in general judge with sufficient certainty whether it has occurred or not ; and no one would perform the operation from choice, if he considered the periosteum to be separated, or even slit up from the bone, above where he intended to saw it off, or the fascia torn to any extent. But I cannot coincide in the opinion of these accidents occurring frequently ; or if they do occur, of their being so detrimental under proper treatment ; as my own experience, and that of the medical department of the British army, is in direct opposition to that of the French surgeons. As the nature of wounds must be the same in both armies, the difference of success must be looked for in the mode of treatment, and here I think it will be found. The British surgeons bring the flaps together, cover the bones and ends of the divided tendons, and endeavour to obtain as much union as possible by the first intention. The French, on the contrary, do not lay the parts down in contact ; they

are merely approximated by drawing the integuments and muscles forward, and suppuration is awaited. This I conceive to be the error; for however valuable this mode of proceeding may be under certain circumstances, it is here very detrimental. There is but little muscle to granulate; the greater part is tendon and cellular substance: tendons will unite to each other, or to fresh incised parts, but they will not granulate, and in the attempt to attain it, the bone becomes uncovered, the periosteum recedes from its edge, and it will then exfoliate: if abscesses form near it from the disease of the tendons or periosteum, caries may ensue for a considerable distance, and the train of evils usually attendant on the flat stumps of the more ancient surgeons. This I consider to be the real cause of the ill success of the French surgeons, and whenever they will lay down the flaps in apposition in fair cases for the operation, I am confident they will succeed in the same manner as we have done in the British army.

I must dissent from the opinion that a short stump is as good as a long one, as I have seen the most decided utility from the latter; and perhaps the relation of the following cases will best exemplify the value of the operation, both as to its safety and use.

Two private soldiers in America, supposing they would be discharged the service, within a short period of each other placed their left hands on the

muzzle of their firelocks, and destroyed the joint of the wrist, fracturing both the articulating extremities of the radius and ulna. I took off the arm at its lower third, by the flap operation, hereafter to be described, and in three weeks they were both well, and able to do the duty of necessary cleaners to the whole regiment, which they were ordered to perform as a mark of ignominious punishment. On the landing of the British army in Portugal, in 1808, their usual duty having of course ceased, these two fellows were attached to me as *bât-men*, to load and take care of the public mule, with the medicines and instruments committed to the charge of the surgeon: this they did extremely well, lifting with a hook fastened to the cuff of the coat of the left arm very great weights, supporting them also above their heads on the face of the naked stump, whilst they tied the ropes that retained them with the right hand. They would even press the girth forcibly against the belly of the mule with the stump, whilst they buckled the saddle with their remaining hand, a proof that the stump was as sound and as well covered as it was possible any thing could be, by the art of surgery. In fine, I can with truth assert, I never saw the operation fail when executed in the following manner.

The arm being placed in the intermediate position between pronation and supination, with the thumb if it remain, uppermost, so that the radius and ulna are in one line, and firmly held by an assistant; a catlin (two inches longer than the usual

size, if it can be procured) is to be entered close to the inner edge of the radius, and brought out perpendicularly below, at the inner edge of the ulna: the knife is to be carried forwards on a parallel line with the bones for half an inch, and then cut its way out with a gentle inclination, so as to leave a semicircular flap. The catlin is to be again introduced on the outside, at the same wound, and pushed out below in the same manner, the end of the knife being brought out at the wound made by the first incision, which is easily accomplished, as the point of it passes the ulna by turning the arm a little inwards. These two flaps are to be turned back equally to the point of entrance of the knife, where the interosseal ligament and any muscles or tendons not cut by the incisions for the flaps are to be divided; the bones are then to be cleared, the retractor run between them, the flaps kept back, and the two bones sawed across at the same time. The radial and ulnar arteries will be found on the inner flap, and as by the inclined cut of the flap they may be wounded by the edge of the knife higher than where they are absolutely divided, it is advisable to tie them high, and cut off with the scissars any long portion that may be below the ligature. The tourniquet may now be loosened or taken off, when the interosseal artery will shew itself between the bones on the inside, and perhaps another on the outside. If the tendons hang long, they are to be cut off with the scissars. The wound being thoroughly cleaned with cold water, the two flaps

are to be placed exactly in contact, each ligature being brought straight out, or at the corners by a single end : some straps of adhesive plaster, a slight compress, and a few turns of a roller, retain them in their situation, and in a very short time, frequently a fortnight, the cure is accomplished.

When the operation is to be performed above the middle of the arm, it is best done by the circular incision as follows.

The arm being placed with the thumb uppermost, an assistant must retract the integuments as much as possible, whilst the operator makes one circular incision through the integuments, which must be then fairly pulled up or separated from the fascia below for near an inch. The edge of the knife being inclined inwards, the muscles on the inside of the arm should be divided at one slanting cut down to the bones; the same on the outside and upper part. The bone is then to be cleared by separating the muscles from it, until it is obvious they will meet over it when sawed. The interosseal ligament is next to be divided with the catlin, and the retractor passed between the bones, by which the integuments and muscles are to be well kept back, and the bones then sawed through at once, and the stump dressed as usual; or the operation may be performed nearly after the manner in which it was done lower down, save that the catlin is not used to make the semicircular flaps, but the lesser amputating knife cutting obliquely from without inwards,

until the flaps shall be sufficiently large to meet with a thick cushion over the ends of the bones when sawed off; this method also makes a good stump, but I think the other preferable for young operators as it will better cover any defects, or avoid the appearance of irregularity on the face of the stump.

Amputation of the metacarpus and fingers.

Gun shot wounds of the hand are particularly disagreeable, in consequence of the tendency they have to bring on trismus or locked-jaw; and to avoid this, in many instances the hand has been removed, when it might otherwise have been in part saved. The difficulty attendant on the removal of the heads of the metacarpal bones from the joint of the carpus, or of sawing off the bones with the metacarpal saw, have been another cause of the frequency of the operation above the wrist.

The advantage of two or three fingers, or of the thumb and two fingers, or even the fore finger is so great, that much ought to be attempted and hazarded to save them; and it is generally allowed that few wounds from musket balls occur, in which amputation of the hand is necessary.

The tendency to tetanus or trismus, is to be obviated in some measure by freely cutting up the palmar aponeurosis, removing all spiculæ of bone, and by keeping the wound open preventing the collec-

tion of any matter under the fascia, or expansion of the tendons. The fear of wounding the arteries ought not to be indulged; it is truly advisable to avoid them if possible, but this immunity should not be acquired at the hazard of causing a greater evil; for they are secured if injured, with tolerable ease, and if the incisions be made in the direction of the bones, and flexor tendons on the inside of the hand when they are required on that side, there will not much hæmorrhage ensue, that cannot readily be commanded by the ligature, or a small graduated compress.

A musket-ball passing fairly through the hand, generally fractures two of the metacarpal bones; it sometimes merely fractures them by passing between them, and I have seen a ball pass through between two bones without breaking either of them. Two are generally injured, one more than the other; but it is not necessary to amputate as a primary operation for this cause alone whatever circumstances may render it necessary afterwards; on the contrary, the wounds should be enlarged, the broken pieces of bone removed, and the most vigorous antiphlogistic measures adopted.

When cannon shot, splinters of shells, or grape shot strike the hand, it is generally the reverse; amputation of one kind or other is necessary, but seldom of the whole hand. Either the thumb and forefinger, with its metacarpal bone, or the two outermost fingers, or the two center ones are destroyed,

and require amputation : or, both the flexor and extensor tendons are cut across, and hanging out of the wound, the joint of the wrist is opened into, and the skin of the hand much torn ; there is also in general considerable hæmorrhage, which continues to ooze, although the blood is not thrown out *per saltum* : The bones are found totally destroyed, and as the hand is frequently bent or closed, the fingers are often also wounded. Amputation is in this case, to be performed as soon as possible, for the sooner the wound becomes a clean incised one, the better. When the metacarpal bones of the three outermost fingers are destroyed, the thumb and fore-finger are worth preserving.

The little finger is occasionally to be kept, when the two middle ones are sawed off, and in taking away the two outermost fingers, the next metacarpal bone is not to be removed if it even be a little injured ; the tearing up of the integuments is not of so much consequence as is believed, and in performing the operation of removing any two bones, flaps may frequently be procured partly on one side, partly on the other, when a whole one can be obtained from neither. The opening into the joint of the carpus, will do well in most instances, if skin can be procured to cover the joint injured : in fact, the hand is so valuable, and is so much under the command of the surgeon, if attention be paid to it at first, that much ought to be hazarded to save it. The removal of the hand is also a last resource, when every attempt has failed.

The metacarpal bones and fingers may be removed in two ways, by sawing the bones across, or dislocating them from their articulation at the carpus. Both these operations have frequently been found extremely difficult and tedious ; and it was in consequence of this, and the anguish suffered by the patient, that the removal of the whole has been occasionally practised in bad wounds of the hand.

The metacarpal saw in the military case of instruments, is the only instrument given to military surgeons for the purpose of sawing these bones, and in consequence of the small size of the teeth, and the unsteadiness of the bone, it becomes a most unpleasant operation. I have seen a surgeon work for twenty minutes, at two metacarpal bones with this instrument, to the unspeakable torment of the patient, and his own serious annoyance.

This part of the operation may in some instances be materially shortened, and rendered less painful, by the adoption of one of Mr. Hey's convex saws, or of the crown of the trephine instead of a saw ; and if one be chosen for the purpose, as recommended by Mr. C. Bell in his *Operative Surgery*, and by Mr. Wardrop in the 4th Vol. of the *Medico Chirurgical Transactions*, it will answer much better. The instrument is prepared by cutting away two thirds of the head of a small trephine, so that the remaining third may form a saw, which, when the centre pin is fixed in the middle of the bone, will cut it through nearly in a straight line. When the bone is much shattered by the shot, and destroyed

near to the joint of the carpus, it will often be impossible to find a part of the bone on which the pin can be fixed, so as to allow the saw to work : and the removal of the head of the bone will not be less difficult, if it be of a middle finger, and in a case of this kind, Mr. Hey's saw will be very useful. When the thumb is destroyed in this manner, it is much the easiest way to remove it at the joint of the first phalanx, corresponding to the metacarpal bones of the fingers with the wrist; the same with the little finger, or when the two outermost or even three outermost fingers are to be removed.—The metacarpal bone of the fore-finger should always be sawed off as long as possible when the thumb remains—and it is always advisable to do so with a middle finger, as it is very difficult to dislocate one bone between two others, whereas commencing from the outside, it is done with less trouble. The preserving the articulation inviolate especially supports the remaining fingers, and leaving a part of the metacarpal bone of the fore-finger is of great utility, in giving strength, and a freer motion to the thumb.

As there is always a laceration in gun-shot wounds of the hand, even from musket-balls, but more particularly from shells or shot, the incisions will not be very direct, or according to rule; and the skin torn up, must be considered as inclined to adhere when laid down, if it be not much bruised.

The first phalanx of the thumb requiring to be removed, an incision must be made on the back of the hand on the inside of the bone, commencing between the thumb and the finger, carried down to the joint of the carpus, and brought over with a gentle slope to the outside. A similar incision in the palm of the hand joins the point of this slope, and the muscles are to be divided close to the bone. The flap over the joint of the thumb formed by the slope of the integuments, is to be pulled a little back, the external lateral ligament cut into, and the thumb bent and pressed a little inwards, when it will readily be separated by cutting through the capsular ligament, and any adherent ligamentous or muscular fibres; the compression on the brachial artery is to be taken off, the vessels tied with single threads, and the parts brought together with adhesive plaster and bandage.

In the removal of the two center metacarpal bones near their middle, two transverse incisions are to be made on the back and palm of the hand, a little nearer the fingers than where they are to be sawed through, and these incisions are to be exactly the width of the two bones; the skin is to be dissected back to the place where the bones are to be sawed, and a longitudinal incision is then to be made on each side of the two bones to be taken away, between the fingers and into the palm of the hand, so as to join the transverse cut inside. Care is now to be taken that the tendons running to the

fore and little fingers are not injured, as the soft parts belonging to the fingers to be removed are cut through; the saw or trephine is now to be applied and the bones cut across. The little flap saved on the upper and under part will cover the sawed bones, and the skin saved at the sides will leave enough to cover the bones remaining with the help of a strap of adhesive plaster, so as to leave only a line of incision every where.—If the nature of the wound will not allow the flaps to be made from every side in this way, each flap may be taken from above or below, as circumstances will permit.

Removing the middle metacarpal bone alone, must be done nearly in the same manner, but with more care, so that the articulation of the adjacent fingers be as little injured as possible. It must be recollected that there is a wound through the hand, and that skin cannot be saved at will, it must, therefore, be kept either from the back part or inside, as will be most convenient, which, in almost every case in the hand, will somewhat vary the first incision.

If there were no wound through the hand, the best manner of removing the diseased bone would be as recommended by Mr. C. Bell; by a circular incision round the root of the finger, and continued down the back of the hand, when the diseased bone is to be dissected out.

If the articulating heads must come out, a strong, but thin scalpel is to be used, and pushed in between

the bones, the ligaments being cut clear above, below, and at the sides; care should be taken in the efforts to get out the heads of these bones, not to dislocate the other fingers, or to injure them as little as possible, and the cavity of the joint of the carpus should be covered by a flap or flaps, if they can be obtained.

The outer fingers are easily removed at the joint commencing from the outside, and when the ligaments on the inside are cut, dislocating them outwards.

The most satisfactory case I ever had of the hand, was of this kind at the battle of Salamanca. The man had been struck by a grape-shot, which shattered the metacarpal bones of the little and ring finger, grazed the middle finger, and tore up the integuments on the palm and back of the hand. He was in great pain, and it was intended to remove the hand, when I conceived there was a probability of saving the two fingers and the thumb, although no regular flaps could be made to cover in the wound. By cutting some parts on the inside, others on the outside, I managed to cover in the joint of the carpus, replace the torn integuments on the back of the hand, and waited for granulations to cover the uncovered part of the metacarpal bone of the middle finger. At the end of two months, he was cured, with the use of the thumb and fore finger, and considerable motion of the middle finger, and was very grateful for the attention paid to him.

The joints of the first phalanx of the fingers with the metacarpal bones, may be removed by making a flap, on the upper or under part; in either case, making the edge of the flap the depending part, by the position of the hand.

When the flap is made from the back part of the finger, the bend of the joint should be ascertained; from this point an incision is to be made along each side of the finger, for about an inch, in a semilunar form, and the angle of these two joined by a tranverse incision underneath, when a flap can be raised of sufficient size to cover the wound when the bone is removed. This flap being turned back, the extensor tendon divided, and the joint laid bare, a half circular incision is to be made on the under part, so as to divide every thing down to the bone. The joint should now be a little bent, to shew its exact position; the ligamentous attachment between the bones, on each side connecting it to its fellow, cut through; and the lateral ligament divided when the joint will be easily dislocated. Two small vessels will often require a single thread, sometimes even a pinch from the forceps will be sufficient to stop the hemorrhage. The flap is to be brought down, or raised up, according as it is formed from the fore, or back part of the finger, and retained by adhesive plaster.

If skin to form the flap in this way cannot be saved, the operation may be done by a circular incision, or by two semilunar flaps on each side, but the

former method is preferable.—I have never found it necessary to remove the cartilage, and it renders the operation more painful.

If the flap unite by the first intention, it will not adhere to the cartilage, but slide over it for some time, a little fluid being interposed, which will gradually be absorbed, and the integuments become firm.

The other joints of the fingers are to be removed in the same manner, taking particular care to cut into the joint on the side, through the lateral ligament, by which it is firmly connected, when it may be readily dislocated, by moving it in an opposite direction.

It is generally best to remove these bones at the joints; it is occasionally necessary where the injury just includes the joint, and no more, to saw them off below it: this operation may be done by a circular incision and the trephine, or the straight metacarpal saw may be used; both are troublesome and disagreeable, but the metacarpal, or the fine straight saw, is the best, as there is room to steady the bone, and space for its motion. These operations, although apparently trifling require as much practice on the dead body, and as much attention on the living, to perform them well, as others of far greater importance.

FINIS.



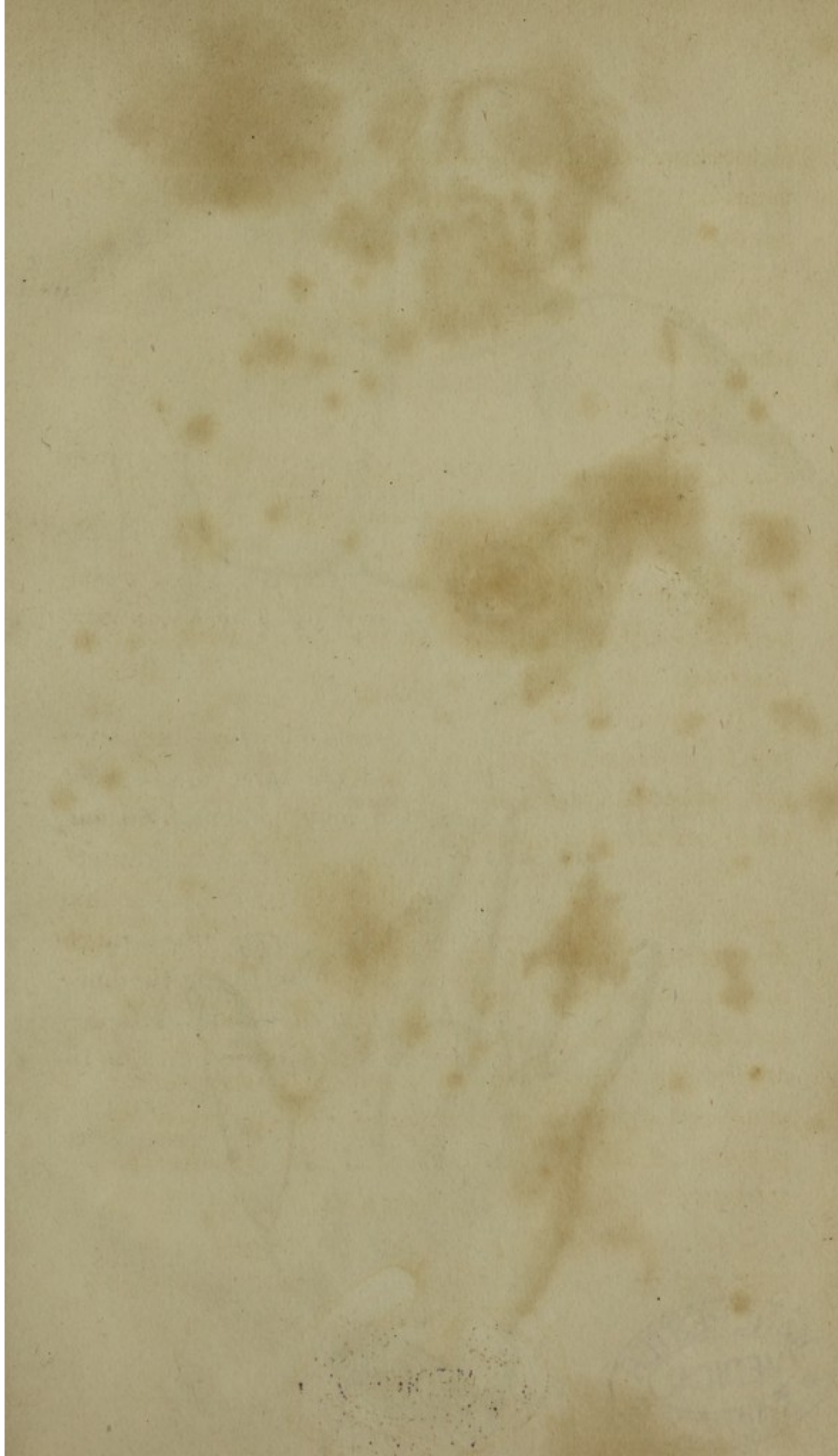




Fig 2.



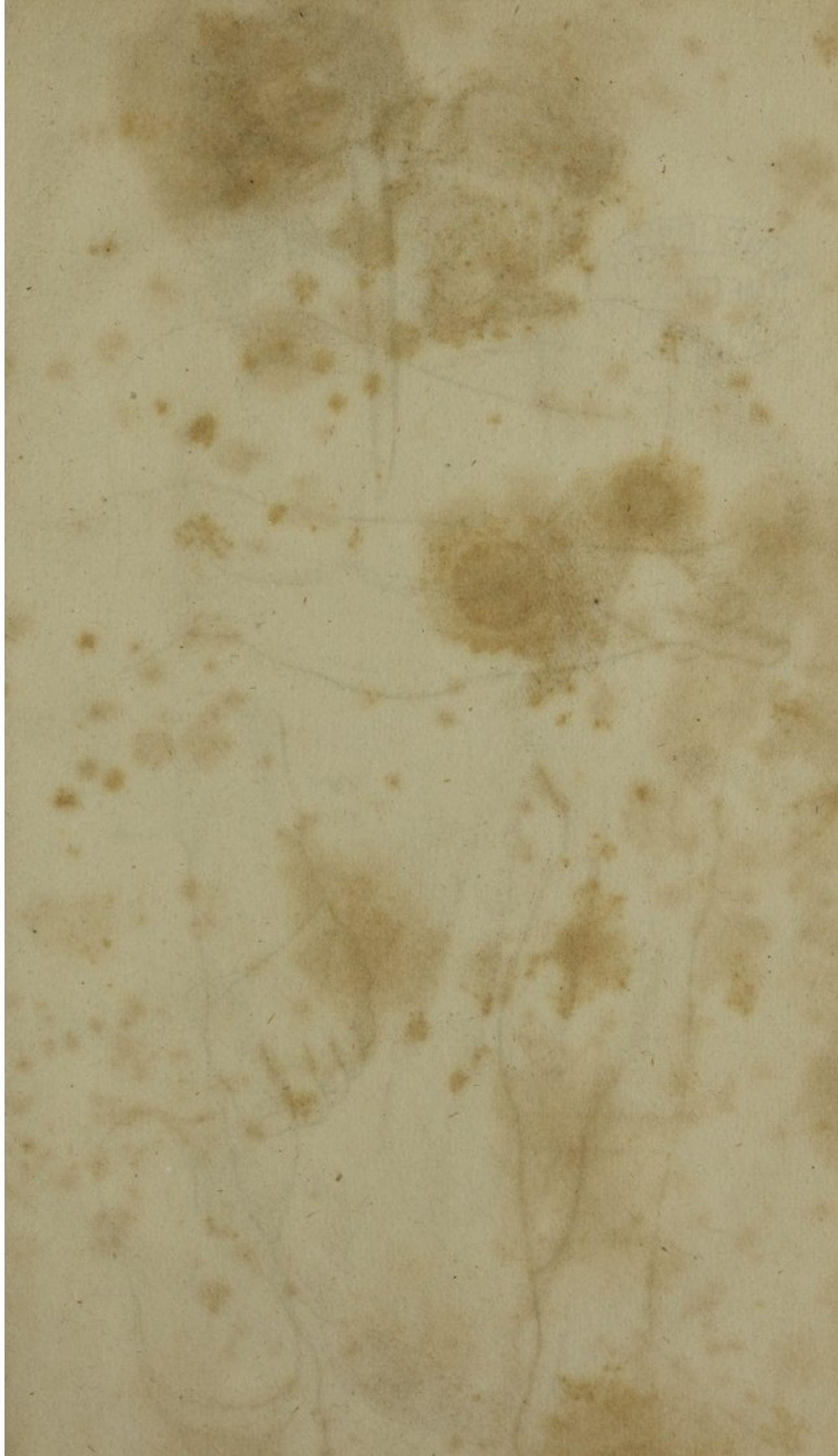


Fig. 1.

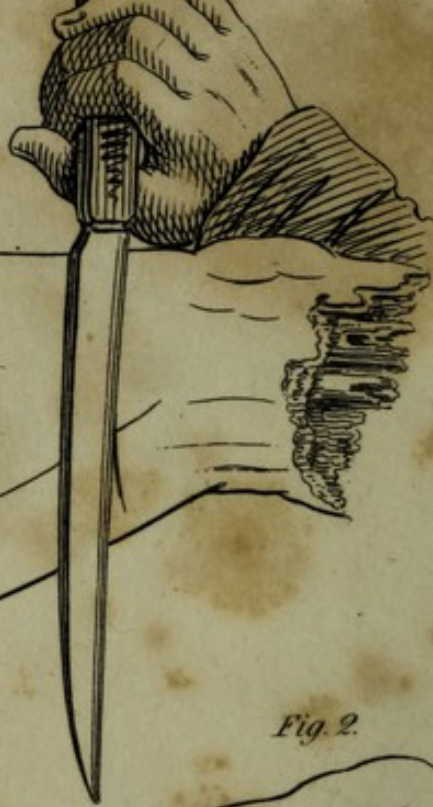


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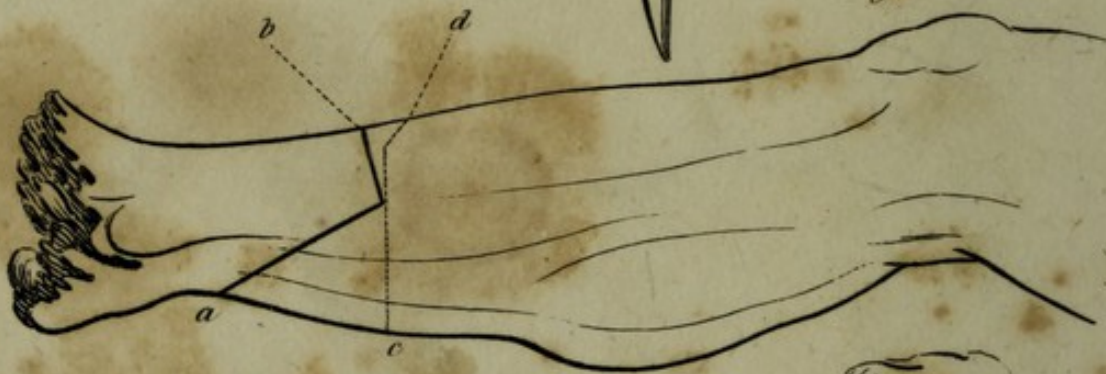


Fig. 3.



Fig. 4.



Fig. 5.



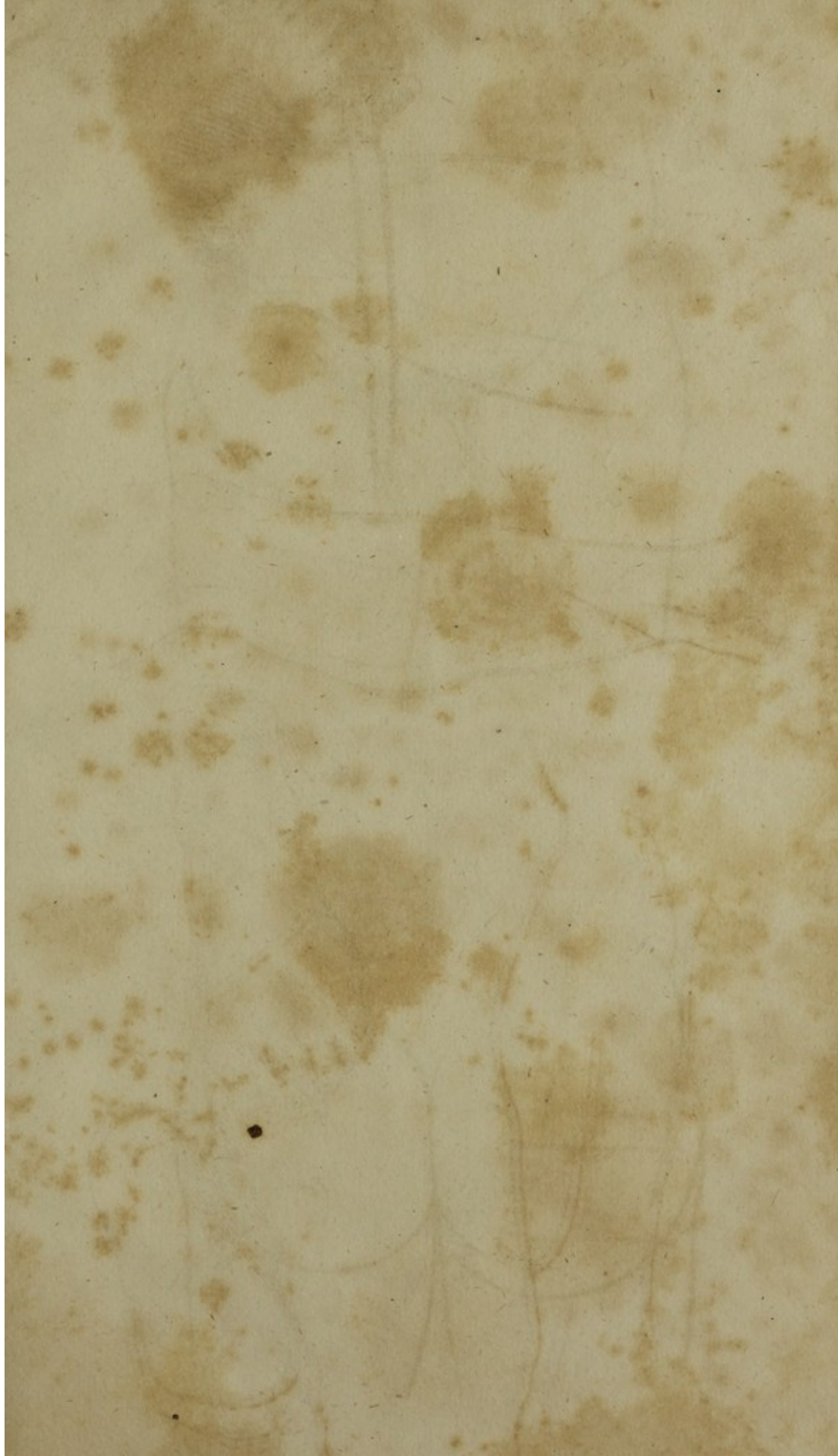


Fig. 1.

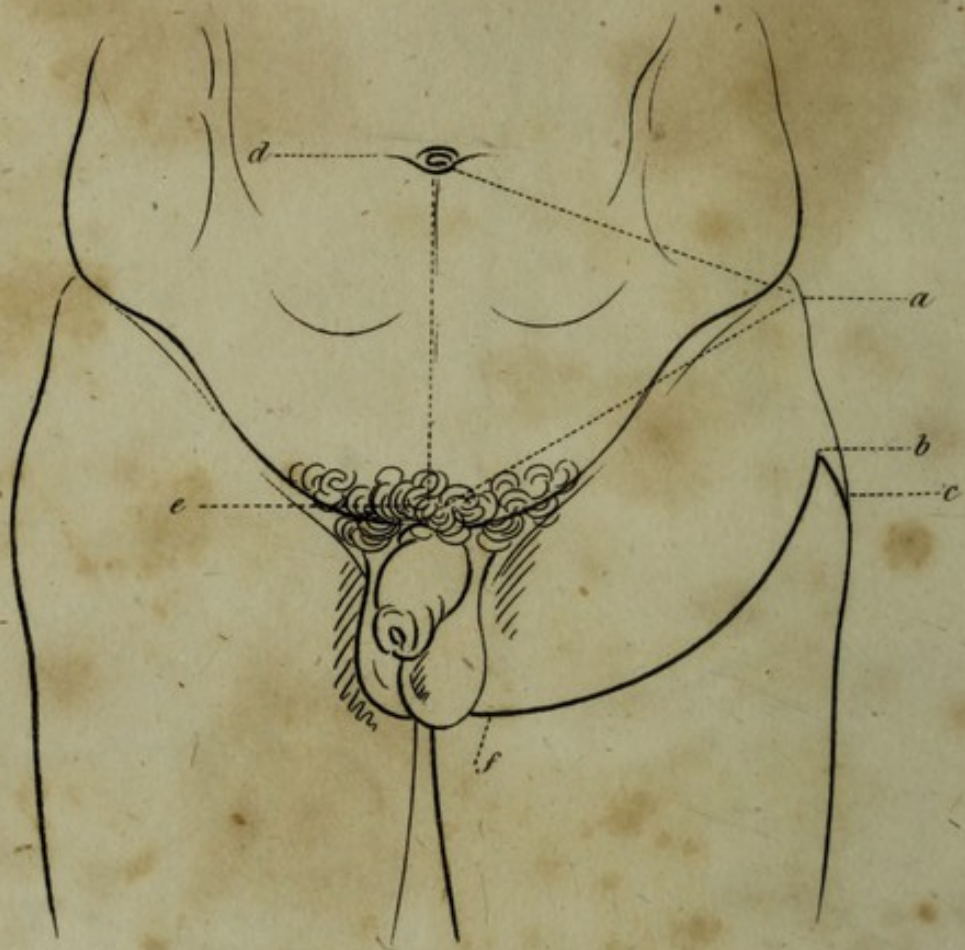
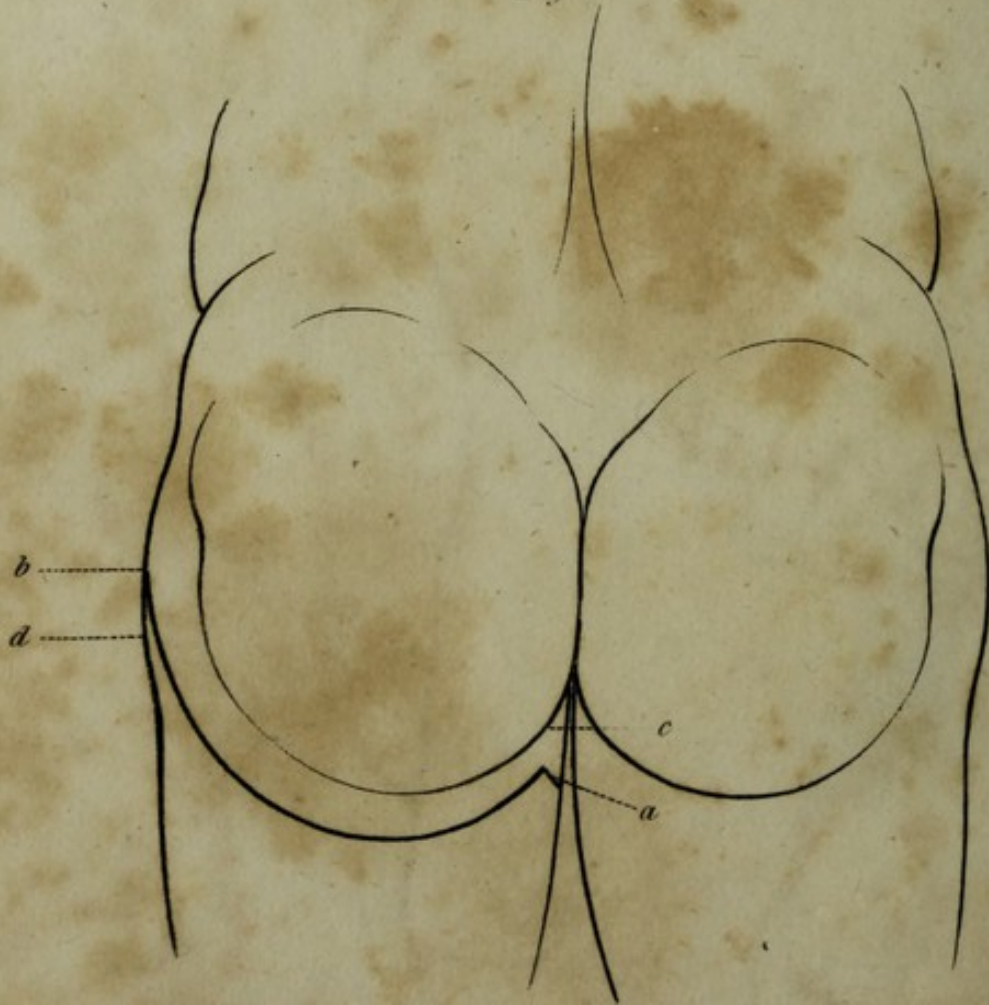


Fig. 2.



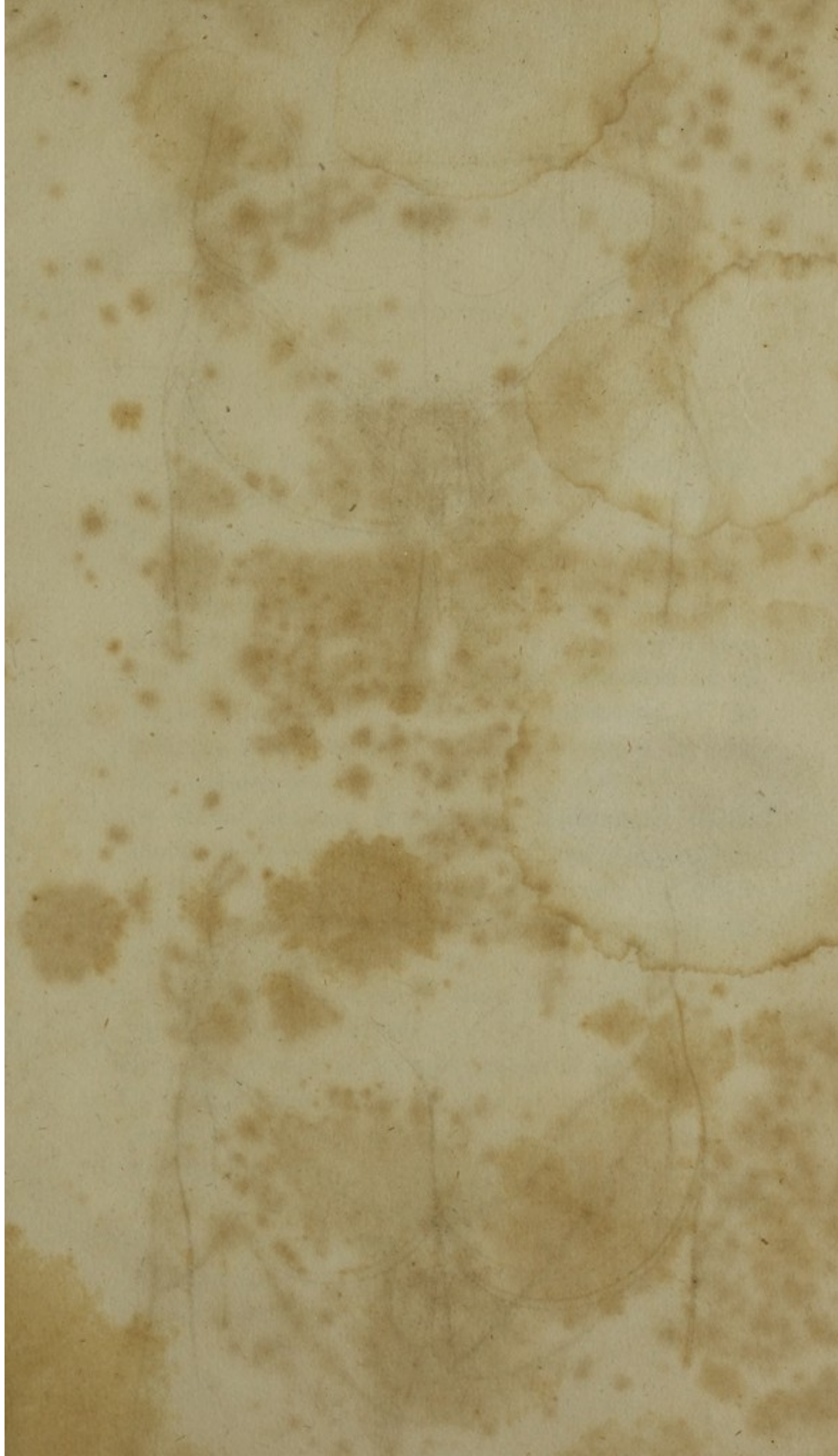


Fig. 1.

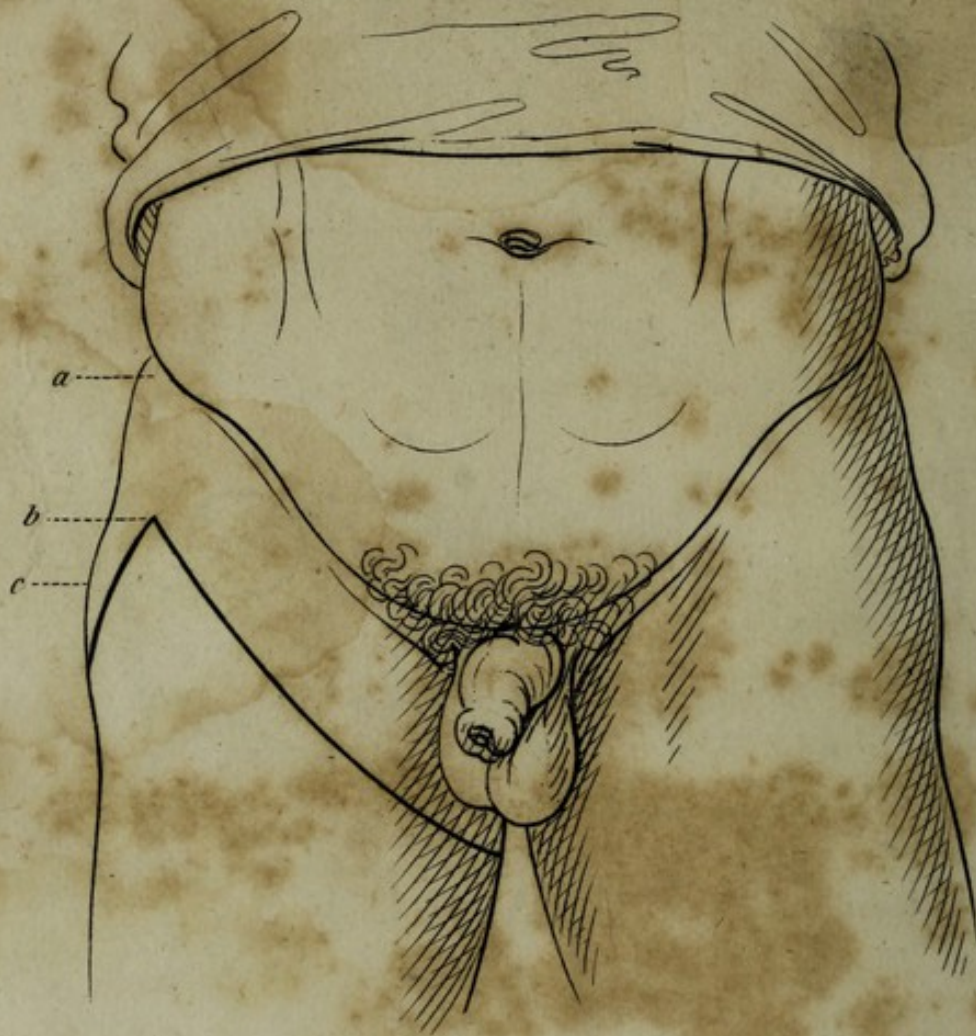


Fig. 2.

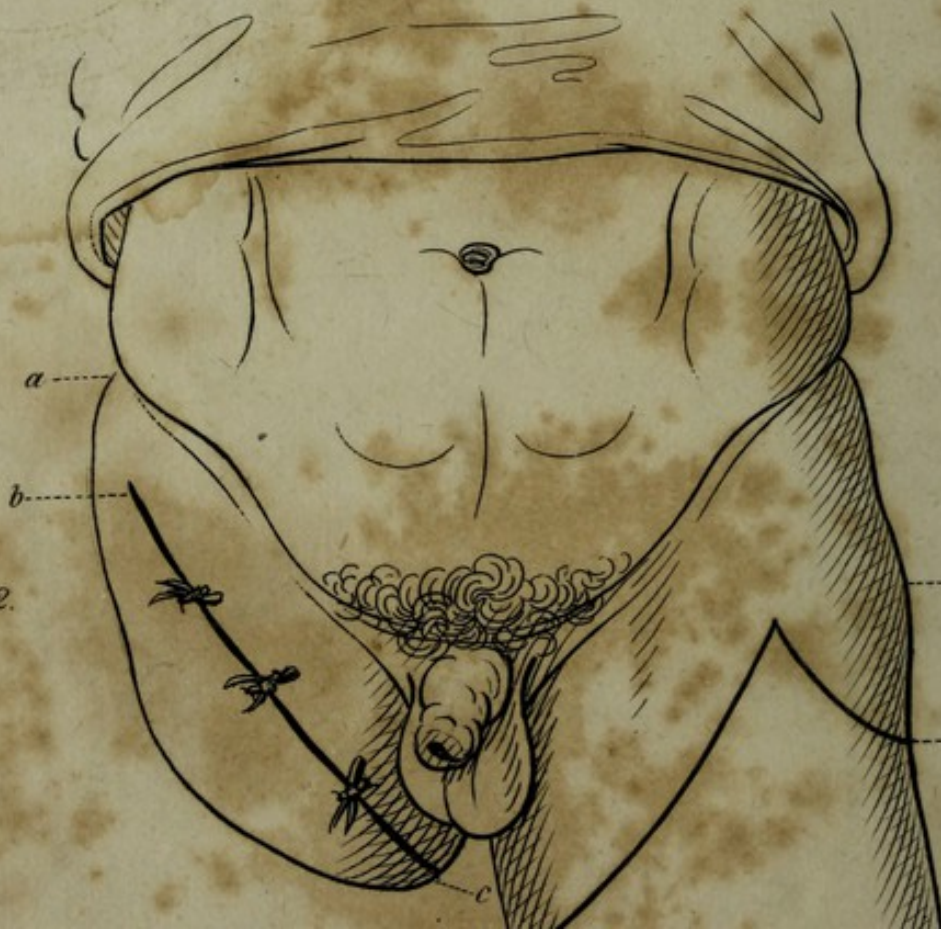
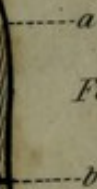


Fig. 3.



EXPLANATION OF THE PLATES.

PLATE I.

Figure I, Shews the line of incision recommended in the amputation at the hip-joint, described at page 178.

- a.* The anterior superior spinous process of the ilium.
- b.* The first incision commencing about four finger's breadth, and in a direct line below the anterior superior spinous process of the ilium in a well sized man, and continued round in a slanting direction at an almost equal distance from the tuberosity of the ischium, nearly opposite to the place where the incision commenced.
- c.* The second incision commencing underneath where the former ended, and united by a gently curved line to it at the place of its commencement, by which means the outer incision is not more than one-third of the size of the internal one.

Figure II, The wound made after the removal of the bone united by sutures.

- a.* The anterior superior spinous process of the ilium.
- b.* The commencement of the line of incision running down to *c*, which is the tuberosity of the ischium.

Figure III, Shews the line of incision recommended in the flap operation high in the thigh, described at page 200.

- a.* The trochanter major.
- b.* The outer incision.
- c.* The inner incision.

EXPLANATION OF THE PLATES

PLATE I.

Figure 1. Shows the line of incision recommended in the
amputation at the hip, as described at page 178.

a. The anterior superior iliac spine of the ilium.
b. The line of incision, extending from the anterior
breast, and passing through the iliac spine, and
the spine of the ilium, and ending in a well mixed man,
and continuing through the iliac spine, and ending at an
almost equal distance from the tuberosity of the
ischium, nearly opposite to the point where the inci-
sion commenced.

c. The second incision commencing underneath where
the former ended, and ending in a nearly curved line
to it at the point of its commencement, by which
means the part removed is less than one-third
of the size of the whole.

Figure 2. Shows the line of incision after the removal of the
bone, and the extent of the wound.

a. The anterior superior iliac spine of the ilium.
b. The second incision, of the line of incision remaining
down to the point of the iliac spine.

Figure 3. Shows the line of incision recommended in the
amputation at the hip, as described at page 200.

a. The anterior superior iliac spine of the ilium.
b. The line of incision.
c. The second incision.

PLATE II.

Figure I, Shews the line of incision in the operation, performed by Mr. Emery, described at page 146.

- a.* The anterior superior spinous process of the ilium.
- b.* The commencement of the incisions.
- c.* The trochanter major.
- d.* The umbilicus.
- e.* The pubes.
- f.* The inner incision.

Figure II, A posterior view of the same operation.

- a.* Termination of the first or anterior incision.
- b.* The second or posterior incision joining the first.
- c.* The tuberosity of the ischium.
- d.* The trochanter major.

PLATE II.

Figure 1. Shows the line of incision in the operation, performed by Mr. Amey, described at page 146.

- a. The anterior superior spinous process of the ilium.
- b. The commencement of the incision.
- c. The trochanter major.
- d. The umbilicus.

Figure 2. A posterior view of the same operation.

- a. Termination of the first or anterior incision.
- b. The second or posterior incision joining the first.
- c. The tuberosity of the ischium.
- d. The trochanter major.

PLATE III.

Figure I, Shews the position of the amputating knife on commencing the first circular incision as described, page 204.

Figure II, Will give an idea of the flap operation as described, page 232.

- a.* The commencement of the first incision for the formation of the flap.
- b.* The half circular incision joining the two angles of the flap.
- c.* Intended to represent the place where the bones are to be sawed through.
- d.* The sharp spine of the tibia sawed off.

Figure III, Mr. Hey's operation as described, page 228.

- a. a.* The highest circular line, where the bones are to be sawed through.
- d.* The course the catlin is to take in the formation of the flap, which in the plate is rather too long.
- e. e.* The circular line a little below which the catlin is to be brought out.
- b. c.* A circular line made one inch below the superior one, where the integuments are to be divided.
- b. to d.* Marks the course of the incision through the skin on the anterior part of the leg.

Figure IV, Intended to represent the anterior view of the operation described at page 238, in which an incision is made from half to three quarters of an inch across the foot in the direction of the joints of the tarsus, but nearer the toes.

Figure V, Shews the flap formed upon the sole of the foot, which is raised up to cover the tarsus, when the metatarsal bones and the toes are removed.

PLATE III.

Figure I. Shows the position of the rotating knife on commencing the first circular incision as described.

page 204

Figure II. Will give an idea of the flap operation as described.

page 205

a. The commencement of the first incision for the formation of the flap.

line of the flap.

b. The half circular incision joining the two angles of the flap.

flap.

c. Intended to represent the place where the bones are to be sawed through.

to be sawed through.

d. The sharp spine of the flap as it is turned off.

Figure III. Shows the flap operation as described.

a. The highest circular line, where the bones are to be sawed through.

sawed through.

b. The course the spine is to take in the formation of the flap, which is the plate is rather too long.

flap, which is the plate is rather too long.

c. The circular line a little below which the spine is to be brought out.

be brought out.

d. A circular line made one inch below the superior one, where the integuments are to be divided.

where the integuments are to be divided.

e. To show the course of the incision through the skin on the anterior part of the leg.

on the anterior part of the leg.

Figure IV. Intended to represent the anterior view of the operation described at page 205, in which an incision is made from half to three quarters of an inch across the foot in the middle of the joint of the tarsus, but never passing the tarsus.

operation described at page 205, in which an incision is made from half to three quarters of an inch across the foot in the middle of the joint of the tarsus, but never passing the tarsus.

Figure V. Shows the foot, which is raised up to cover the tarsus, when the metatarsal bones and the foot are removed.

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PLATE IV.

Figure I, Shews the position of the patient in the operation at the shoulder-joint, recommended at page 273, with the tourniquet of the capital case of instruments prepared for compressing the subclavian artery, and held in the hand of an assistant from behind.

- a. The inner incision commencing a little below the point of the acromion.
- b. The outer incision.

Figure II, Intended for the operation, described page 380.

- a. The first incision on the inside of the thumb on the back of the hand, which is carried down to the joint with the carpus, and brought over with a gentle slope to the outside.
- b. A similar incision on the inner side of the hand joining two ends of the first incision.

2d and 3d, Two ways of removing the first phalanx of the fingers, as mentioned at page 383.

4th, Of the second phalanx, nearly in the same manner.



PLATE IV.

Figure 1. Shows the position of the patient in the operation at the shoulder-joint, recommended at page 273, with the tourniquet of the capital case of instruments prepared for compressing the subclavian artery, and held in the hand of an assistant from behind.

a. The inner incision commencing a little below the point of the acromion.

b. The outer incision. c. An Artery exposed.

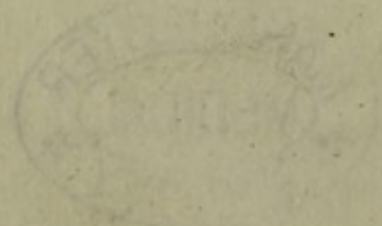
Figure 2. Intended for the operation described page 280.

a. The first incision on the inside of the thumb on the back of the hand, which is carried down to the joint with the thumb, and brought over with a gentle slope to the outside.

b. A similar incision on the inner side of the hand joining two ends of the first incision.

2d and 3d. Two ways of removing the first phalanx of the fingers, as mentioned at page 283.

4th. Of the second phalanx, nearly in the same manner.



ERRATA.

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— 37, — 21, *after* consequences *dele* .
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— 79, — 25, *for* circoïd *read* cricoïd.
— 82, — 19, *for* porticus *read* posticus.
— 87, — 20, *for* began *read* begun.
— 128, — 4, *after* operation *read* on its.
— *ib.* — 23, *for* brim of the pelvis *read* os pubis.
— 138, — 13, *for* sartorious *read* sartorius.
— 178, — 28, *for* ileum *read* ilium.
— 198, — 30, *for* anchyloe *read* anchylose.
— 260, — 6, *for* its *read* their.
— 262, — 1, *after* as *read* its.
— 272, — 17, *after* prefers *dele* of.
— 351, — 26, *read*, and it may give no.

Shortly will be published, by the same Author,

A

TREATISE

ON

GUN-SHOT WOUNDS

OF

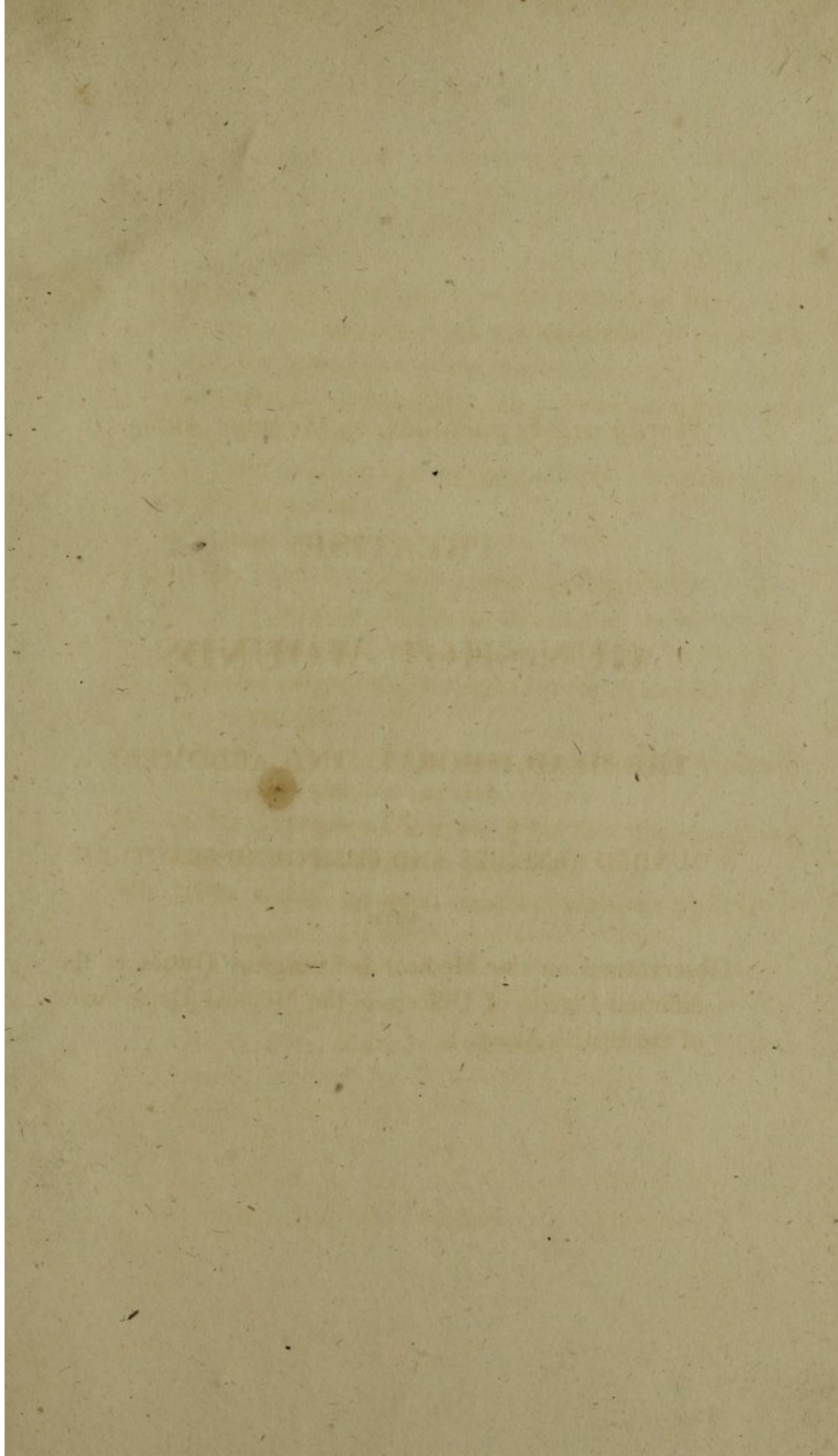
THE HEAD, THORAX, AND ABDOMEN,

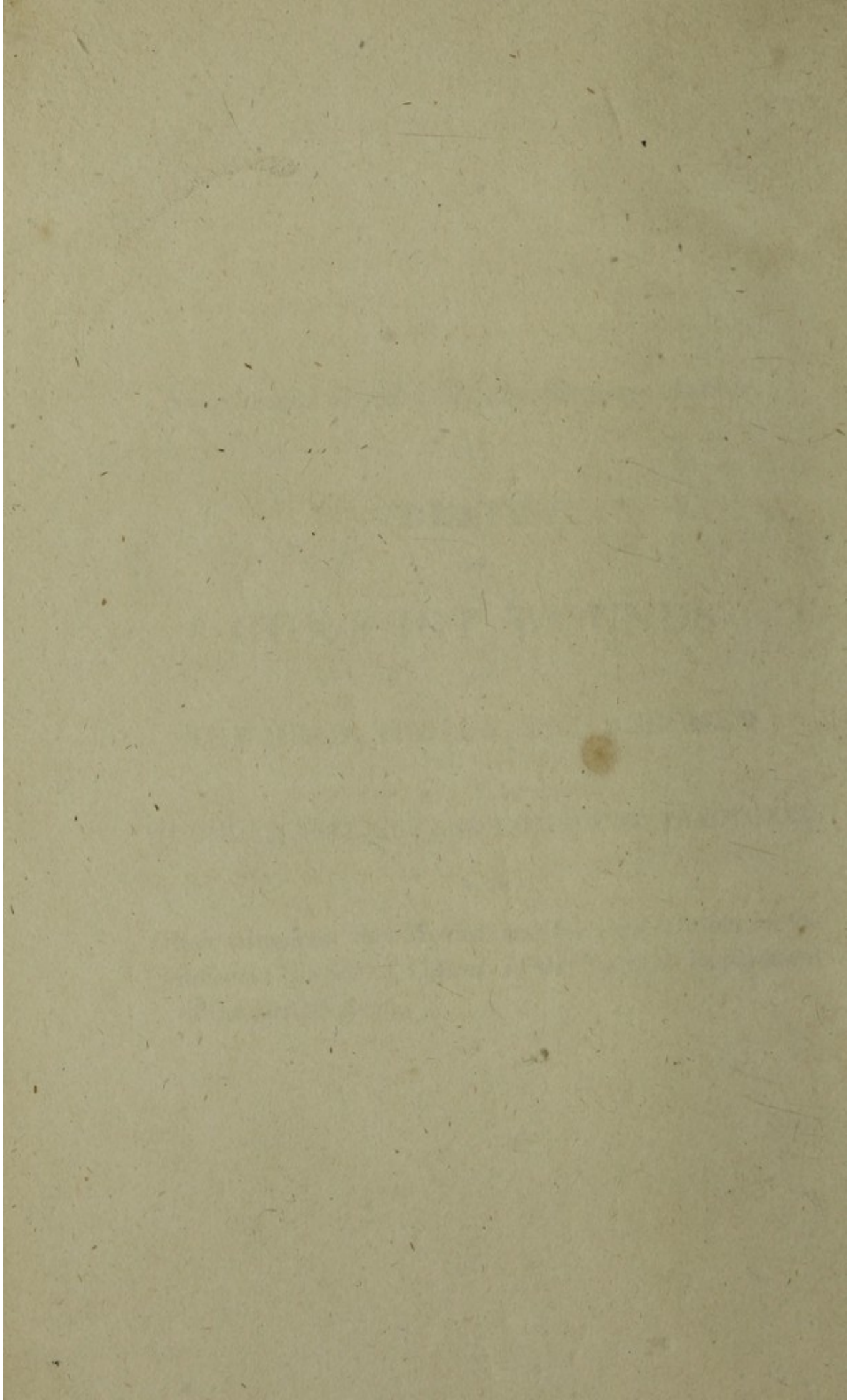
ON

WOUNDED ARTERIES AND COMPOUND FRACTURES;

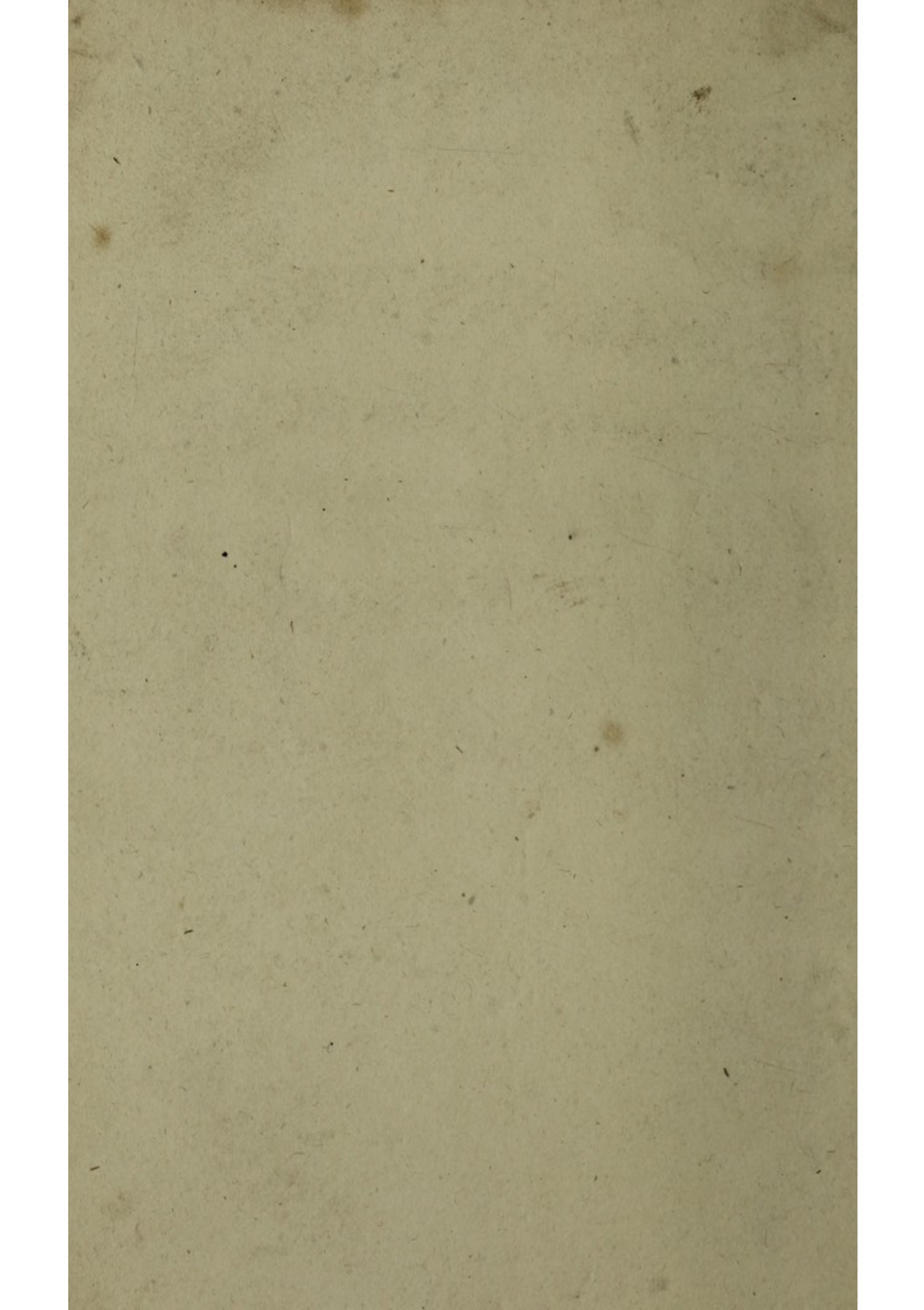
WITH

**Observations on the Medical and Surgical Duties of the
different Classes of Officers of the Medical Department
of the British Army.**









4 plates at end.

