A PAPER

ON

SURGERY OF THE HAND.

BY

E. T. EASLEY, A. M., M. D.

LITTLE ROCK, ARK.

FROM THE JULY NO. RICHMOND AND LOUISVILLE MEDICAL JOURNAL.

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The scope of the present paper is designed to include briefly the several propositions; 1. Some account of the anatomy of the part; 2. The mortality from operations and injuries; 3. Conservatism as applied to its surgery; and 4. Some suggestions as to operative procedures.

Man in his exalted station at the head of the *Mammalia* is classed in the distinct order *Bimana*, and is its solitary representative, for however the recent doctrine of evolution may have dignified the lower orders, the sincere physiologist must concede the truth of Sir Charles Bell's observation, that "we ought to define the hand as belonging exclusively to man." It is the exponent of his will, the interpreter of his thoughts, the indication of his capabilities. So high a place has been assigned the member in the economy that by common consent such figures, as "the labor of hands," "that which thy hand findeth to do," etc., have been accepted as properly denoting the working ability of the individual. Its admitted title to such high distinction is founded on its symmetry, the excellence of its mechanism, its perpetual employment, and the vast range of its usefulness. Additionally it claims consideration of the medical man on account of its constant exposure, its consequent liability to accidents and the grievous character and extent of its injuries. The prominent peculiarity of the human hand, which in itself, according to Cuvier, constitutes the hand properly so called, is its power of prehension, a faculty dependent on the size and strength of the thumb, and only perfectly exhibited in man. The human hand, far superior to the part in any other animal, grasps readily all objects within its compass, even to the most minute, and the thumb may be brought in apposition to the extremities of the fingers, singly or at once. It is not, therefore, asserting too much to say that man's commanding eminence in the scale of existence is largely due to the com-

pleteness with which the hand responds to the suggestions of his mind. It follows necessarily that the organ claims a high interest in surgery and surgical anatomy. The practitioner who would undertake any serious operative procedure in a part so perfectly organized and important, ought not only to fortify his judgment with a knowledge of broad facts and principles, but he ought also to command a very accurate acquaintance with the structures involved. For this purpose, in the first place, nothing can supply the thorough work of the dissecting-room, and for the physician remote from the medical centres, the many splendid plates of regional anatomy are available; those of Maclise (17, 18 and 19) have perhaps never been excelled.

Anatomically the metacarpo-phalangeal and phalangeal joints are all perfect examples of ginglymoid articulations, admitting only the two motions, flexion and extension. Two lateral ligaments of great firmness, an anterior ligament less so, and the extensor tendon behind compose the ligamentous apparatus of each joint. The articulation of the first and second phalanx is indicated as precisely opposite the fold of skin on its palmar surface, that of the second and third a little below the same guide. The capsular ligament of the metacarpo-phalangeal joint is loose, which permits the position of the articulation to be seen by drawing on the finger. It will be found in the adult about an inch above the interdigital commissure. The radio-carpal joint is located in the direction of a curved line from one styloid process to the other about four lines in height, estimating from the middle of an imaginary base line between the given points. Variations in the contour of the hand are to be expected, but the directions given will for the most part be serviceable. The wrist, according to Gray, is most correctly designated an arthrodial joint, "since it is incapable of rotation, one of the characteristic movements of enarthrodial articulations." On the palmar face the skin is normally thick, and the subcutaneous cellular tissue, through which the arteries and nerves run, very abundant. From this surface, as we shall see further on, it is best when practicable to secure flaps for stumps in amputation. Underneath this dense structure, the synovial membrane everywhere invests

and is reduplicated upon the tendons and ligaments, and its inflammation, to which it is subject, even on trivial provocation, becomes, owing to its extensive area, a matter of grave import. It may be as well to say something now of the nature and destructive effects of this inflammation. Any effusion under the dense skin and connective tissue of the palm is prone to pass into suppuration hastily, and quickly imperils the integrity of the parts. The morbid action however limited, its nidus readily invades the contiguous structures, the confined pus penetrates, literally burrows in all directions, until molecular death at some infirm point makes for it an outlet. Should the drainage now be sufficient, the inflammation may be regarded as having spent its force, and the processes of repair, ever on the alert, will set themselves to the task of casting off effete material and building up the waste places. Fortunately, in this enumeration of disasters what is true of phagædena in other localities may be stated here; the blood vessels hold out longest against its ravages, nevertheless they often give way, especially when antecedently diseased. It has been stated that a very slight cause may inaugurate such a course. My friend, Dr. Dibrell, has recently very kindly shown me a typical case of the sort. The trouble had been excited by the puncture of a small fish fin in one of the fingers, a mishap not uncommon on our Southern rivers. The inflammation becoming intense, the palm of the hand was rapidly disorganized, and the diseased action spreading around to the dorsal aspect, several of the phalangeal bones were left exposed by the separating sloughs. When such inflammation of the part has once fairly begun, and the integument becomes hot and tense, there is no time to temporize; immediate relief must be afforded. The most obvious and rational thing to do is to obtain free drainage by adequate incisions. If the cutting has been too long delayed, stimulating poultices may be required to promote the separation of tissue already dead. In the deeper forms of paronychia the morbid action is inclined to follow the course above described, and any expedient less decisive than an early and bold use of the knife is hardly palliative, and apt to result in destruction or permanent crippling of the phalanges implicated. Before splitting

the palm in the vicinity of the annular ligament the relations of the palmar arches and median nerve should be distinctly recalled; injury to the latter would result most likely in persistent pain and impairment of function, while wounding the vessels would give rise to bleeding troublesome to control. Physiologically considered, no arrangement could more perfectly subserve the purposes of sensibility and nutrition than that of the nerves and blood vessels in the forearm and hand. It can not be conceived that a piece of mechanism could more consummately realize the ends for which it was made. It is absolutely perfect. An exact knowledge of the relations of the very abundant vascular supply of the part is always essential. Operating in this fullness of knowledge, the surgeon is enabled not only to command hæmorrhages, but secures for his stumps in amputation sufficient nourishment. The principal blood vessels and nerves of the forearm descend upon the anterior aspect of the wrist, and are distributed mostly to the palm of the hand, as on this surface a larger number and variety of structures are to be found than on the dorsal. The radial and ulnar arteries occupy respectively the borders indicated by their names; they are comparatively superficial; the ulnar least so, until it reaches the palm, where it forms the superficial palmar arch, and gives off branches of communication with the deep palmar arch of the radial vessel. The dorsal arch is formed by a radial branch and the posterior interosseous artery. So free is the anastomosis of these important vessels that in the hand, practically speaking, they may almost be regarded as one. It is obvious that bleeding from any considerable vessel in the hand may not be arrested by ligation of either the radial, ulnar or interosseous, when they must all be tied, or it may be necessary to secure the humeral vessel. What effect obstruction of any current would have upon the bleeding may be ascertained by pressure on the vessels supposed to supply the wounded point. Although Dr. Joseph Pancoast and others have ligated all three of the vessels at the same time, the exceeding difficulty of so complete an operation, and the extensive violence it is likely to inflict are manifest. Ligation of one branch with compression of the other may serve a useful purpose. In a case of wound

of the radial between the metacarpal bones of the index finger and thumb, the hæmorrhage was permanently arrested by ligation of the vessel in the wrist and compression applied to the ulnar at a point opposite. Unquestionably the great and important rule distinctly laid down by John Bell, and so copiously illustrated by Guthrie, of enlarging the wound and ligating the vessel there, is not always appropriate or practicable in wounds of the palmar arches. The exceptions to this rule of practice are of course rare, for the plain reason that, however we may stop the direct current by tying the main trunk, such a measure does not interfere with the anastomosing circulation. So free are the inosculations between the anastomosing vessels that ligation of the brachial often fails to stop the loss of blood. A second great principle in the treatment of wounded arteries must be insisted on in this instance—the ligature is to be applied to both ends of the vessel. If a different course be adopted the bleeding will continue from the distal end uninterrupted by the ligature on the proximal side of the wound. The ends of the vessel may be so retracted or obscured by swelling and coagula as to make it exceedingly difficult to tie either or both ends. Should the effort fail, graduated sponge compresses may be tried before treatment of the artery in the wound is abandoned. Of course when all minor resources prove abortive nothing remains but to secure the brachial, which is a safer and surer, as it is a less difficult, procedure than to tie the main arteries of the wrist. If bleeding in the hand has ceased no interference is justifiable; a clot may effect permanent occlusion. The people have a fashion of wrapping an immense bundle of rags, with soot, cobwebs or other foreign substances about the part; these become saturated with blood, and the flow is undiminished. It is needless to say that such expedients are worse than futile. The wound should be cleansed, examined and more decisive measures taken, on the presumption that it is better to contend with an open than concealed enemy. It is to be remembered that the extreme flexion of the forearm upon the arm with compression at the point of injury is often entirely effective. While the superficial structures may be properly divided by exploratory incisions, it is a very questionable prac-

tice to extend them to the deeper parts of the palm. On the contrary, it seems wiser, especially if there be much infiltration, to resort to acupressure, or ligation at the wrist, or to proceed at once to the humeral vessel. The inosculations by which the circulation is maintained after obliteration of the brachial artery are those of the profundas and anastomotica. No anomalies are more common than those which occur in the distribution of the brachial; these irregularities should be well understood, and are said by Quain to occur as frequently as once in five cases. The older surgeons entertained great fears of preserving the integrity of the forearm after occlusion of the brachial, but more extended observation and statistics have proven their apprehensions unfounded. Reports from the Surgeon General's Office (part second Surgical Vol., p. 446*) record seventy-six ligations of the brachial for shot flesh wounds. Twenty-one or 27.6 per cent. of these terminated in death, a fearful mortality and one outside of all proportion to the magnitude of the procedure. The table is not to be regarded as representing the fatality of the operation in itself considered, but as indicating the gravity of its complications. It is worthy of note that the thirteen ligations for primary hæmorrhage were all successful, and that all of those, four in number, for bleeding from the palmar arches also terminated favorably. In the same work the death rate in ligations of the radial is laid down as one in five; of the ulnar as nearly one in three. There is one case of ligation of the superficial arch; recovery with anchylosis, and no instance in which the deep arch was tied. A number of examples are detailed of the spontaneous healing of arteries after shot injuries, and the fact reïterated that lacerated or shot wounds, if the artery is completely divided, effect almost perfect torsion. It is difficult to understand how the student of late military surgery can fail to see the advantages of torsion as a rational and physiological process.

* I am glad to refer to this truly great work, because it affords me the pleasure of again expressing my gratitude to the gentlemen engaged in it for kindnesses received, and my admiration of their devoted and successful labors. Certainly it is by far the most exhaustive collection of medical facts and deductions ever made, and it must endure a monument of zeal and learning in the interests of the Profession.

Surgeons of great eminence have differed widely in their views on the interesting and important subject of the treatment of hæmorrhage from the palmar arches. The serious nature of the lesion and the fact that a fatal loss of blood has frequently occurred must justify the following citations of valuable opinions: The Surgeon General declares (op, cit. p. 437), "the subjects of such injuries are very unfortunate if they have not the services of a surgeon possessed of the requisite skill and courage to thoroughly explore the wound at the outset." Professors Gross and Agnew do not hesitate to advise that "the general rule for the treatment of wounded arteries should not be deviated from here, and that in recent punctured or incised wounds of the palmar arches, the wound should be enlarged and both ends of the bleeding vessel be tied;" the former of these distinguished authorities says (Surgery, vol. 2, p. 1017): "It is folly in such a case to tamper with the comfort and welfare of the patient by the use of compression." Lister lays down the same principle (Elements of Surgery, fourth edition, p. 400) in terms equally positive. "In the first instance," he says, "it is better to enlarge the wound, and tie the wounded vessel above and below the injured point." Mr. Erichsen (Sci. and Art. of Surgery, 1st American Edition, p. 181) and Sir William Fergusson (Practical Surgery, p. 221) urge that exploratory incisions should be very sparingly made, only in cases of very recent injury, and that every precaution should be taken not to inflict additional damage in the palm. Mr. Druitt (Modern Surgery, eighth edition, p. 623) says that ligation of the bleeding points is seldom practicable, that the propriety of enlarging the wound must depend on circumstances, "and can rarely be admissible about the centre of the palm." Mr. Bryant (Practice of Surgery, p. 213) allows the propriety of enlarging the wound in hæmorrhage from the superficial arch, but records an unqualified dissent from such a proceeding when the bleeding is from the deeper vessels. Swain (Surgical Emergencies, p. 47) says: "In incised wounds of the palmar arch, the vessels can generally be secured. In punctured wounds it is not advisable to enlarge the wound, in order to secure the vessel, but a compress must be applied to the wound,

and a hard ball being placed in the palm, the fingers must be firmly bandaged over it. This failing, extreme flexion of the forearm on the arm, with a pad at the head of the elbow, will effectually compress the brachial, and prevent further hæmorrhage." J. W. Hulke (Holme's System, edition 1870, volume 2, p. 759) observes, "a wound of the deep palmar arch, owing to its anatomical relations, can not be freely enlarged, therefore it is necessary to depart from the rule, almost universal elsewhere, of tying the vessel at the seat of injury, and to seek some other method of restraining the hæmorrhage." Professor Pancoast (Operative Surgery, p. 67) says the bleeding points are to be secured if it be possible by separating the lips of the wound, which he admits may be dilated only a little with the knife. Authorities of distinction may be quoted for the opinion that ligation should never be practiced for bleeding from the hand. C. D. Arnott ("Lancet," volume 2, p. 141) remarks, "under no circumstances in hæmorrhage from the palm is deligation of the arterial trunks on the cardiac aspect to be deemed necessary or attempted." Professor Von Pitha, to an account of a number of these cases, adds: "I was never forced to practice ligation, as the bleedings ceased on removal of coägula completely and permanently. The first thing to be done in such cases is to freely expose the bleeding vessel by enlarging the wound, and to boldly clear away all coägula." It may thus be seen that the discussion has attained considerable proportions, extreme views even having been entertained. Amid such contrariety of teaching and practice the student may well hesitate. The difficulty of formulating any precise rules for the conduct of such emergencies is apparent. Doubtless a due consideration should be given to the circumstances of each case. After a somewhat careful study of the subject, with proper allowance for the conditions of different cases, and conceding the general principle that each case should be treated on its indications, we may perhaps with some confidence venture to offer the following conclusions:

1. If bleeding from the palm has ceased spontaneously, the coägula should on no account be disturbed; the forearm should be flexed and partial compression of the brachial effected, in

the hope, generally well grounded, that natural hæmostasis is to perfect permanent occlusion of the vessel. 2. If the hæmorrhage continues, all clots should be removed at once, the bleeding points exposed, and ligatures passed if practicable, that is to say; 3. In division of the superficial arch the wound may be cautiously enlarged, but no cutting for that purpose is admissible in the deeper fascia of the palm. 4. If it is found impossible to secure the ends of the artery in the wound, flexion of the forearm and systematic compression is to be essayed before cutting down upon the vessels in the wrist. 5. If the parts have become much infiltrated and boggy, and especially if the redness and swelling have extended to the tissues of the wrist, no time should be lost in any minor recourse, but the brachial is to be immediately secured. The ligation of the humeral vessel under such circumstances not only insures against further loss of blood, but is to be regarded as a measure strictly conservative, and powerfully curative in its effect upon the rapidly spreading inflammation. In this connection it can not be out of place to refer to Professor H. F. Campbell's successful Hunterian ligation for the relief of destructive inflammation, and his able papers on the subject.* It is proper also to add that in all the appropriate cases in which it has been tested the procedure has proven eminently conservative. The application of the principle for our present purpose may be further illustrated. Given a wound in which either or both of the palmar arches are involved, from which blood still flows, in which the pain and engorgement are great, the tissues sodden, and the discharge foul, thin or ichorous, in such a case (not an infrequent one) the brachial artery should be immediately tied. Such a course, in this instance, not only relieves from the apprehension of hæmorrhage more surely than any other, but promises to prevent or limit the disorganization of the important structures concerned. 6. It remains to be said that if ligation in the wrist be determined upon, it should first be practiced on the vessel supposed to supply the most direct current to the bleeding point,

* Manual of Military Surgery, for the use of Confederate surgeons, Dr. S. P. Moore, Chapter III on the Arteries, Richmond, 1864. Richmond Medical Journal, April, 1866, Southern Journal Medical Sciences, August, 1866.

and that compression of the opposite artery should be attempted before it also is tied.

The death rate of amputation in the hand is indicated by the general rule that the mortality increases precisely in proportion to the size of the part removed, and hence augments in exact progression as the operation approaches the trunk. This proposition, laid down by Malgaigne and established by the statistics of the Crimean war, is corroborated by the records of our own civil war, and by the uniform experience of all modern military surgeons. The circumstances of any given set of amputations being equal the rule is without exception. Circular No. 6 from the Surgeon-General's office shows (and the statement is further elaborated in the last surgical volume) a percentage of mortality ranging from 1.60 to 85.71, as the operation proceeded upward toward the vital organs. The elementary and invaluable fact, the lesson taught is that every amputation should be done as far from the body as is consistent with a thorough removal of the injured or diseased structures, and that every additional inch sacrificed impairs by so much the character of a favorable prognosis. It is worthy of remark under this head that the size of the part amputated not only influences the general mortality, but also the particular cause of death. Now death following the loss of one of the smaller parts, a finger or toe for instance, will usually be caused by some unhealthy state of the constitution, example erysipelas, whilst in one of the larger limbs, a fatal termination will oftenest be brought on by shock, secondary hæmorrhage, or exhaustion from the abstraction of the amount of blood contained in the limb and that lost during the operation. In twenty-nine fatal cases of operations in the hand tabulated in the reports last mentioned, the causes of death were in four pyæmia, in four erysipelas, in two gangrene, in one tetanus, in eighteen different intercurrent maladies, as typhoid and camp fever and pleurisy. These records also show very conclusively the fallacy of the popular belief that the wounds in question are specially liable to induce tetanus. Of 11,369 shot injuries of the hand, only twenty-four cases of tetanus are reported, and four of these recovered. As contributing to the dead-list septicæmia ranks with erysipelas, gan-

grene furnished half as many victims and complicating diseases unconnected with the wounds, nearly twice as many as all the other causes combined. It may be as well here as elsewhere to reässert the observation of Romberg, founded on large clinical experience, that no remedy has been discovered to exert decided control over the acute forms of tetanus, and that a certain, though small, percentage of the milder cases recover under any plan not positively injudicious. The deduction from these statistics with which we have now to do is that death in a vast majority of fatal cases does not result from the wound or operation in itself considered, but from accidental complication or disease. Knowing then the source from which most danger is to be apprehended, it becomes an obvious duty not only to study carefully the patient's habit of life and constitution, but to eliminate as best we may all extraneous morbific or depressing influences. Other things being equal the provincial surgeon, with pure air and better subjects, is expected to furnish better results than can be obtained in the crowded wards of large hospitals. This mortality has been spoken of in general terms, and for ordinary purposes definitely enough, but for those who desire more precise information I have arranged from authentic sources a

TABLE OF MORTALITY OF OPERATIONS IN THE HAND.

AMPUTATIONS.	NO. OF	MORTALITY—PER CENTAGE.
Fingers and parts of hand	1,807	1.60
Digits only	6,870	2.
Digits and ends of metacarpal bones	413	3.2
Fingers and corresponding metacarpals	619	7.6
At the wrist	66	10.6
Forearm (average in all parts of)	1,734	13.9
Excision at wrist (partial and complete)	96	15.6

The last operation is included for the purpose of remarking that it contrasts unfavorably with amputation in the forearm, which has only furnished in 1,734 cases a mortality ratio of 13.9 per cent. Such a comparison, when the generally almost and sometimes quite useless character of the hand left after it is remembered, reduces the indications for the former procedure to still narrower limits. It is to be confessed, however, that the results achieved under Professor Lister's improved operation ("London Lancet," 1865, volume I, page 335) have done

much to modify the unfavorable impression entertained of the excision. A larger experience is yet required to justify the hopes of the great teacher in its behalf.

The general proposition so widely accepted that primary amputations are attended with least mortality in military practice is well illustrated in the surgery of the hand. This may be seen by a glance at the following memoranda of

RELATIVE FATALITY AS TO TIME OF OPERATION.

AMPUTATION.	PRIMARY.		INTERMEDIARY.		SECONDARY.	
	No.	Mortality. Per Cent.	No.	Mortality. Per Cent.	No.	Mortality. Per Cent.
Forearm	1,009	9.6	450	23.5	184	15.7
Wrist	55	9.2	7	14.3	5	15.
Fingers	Large.	1.4	Large.	3.7	Small.	4.

Hospital and private statistics, both in this country and in Europe, appear to establish the rule that secondary operations are to be regarded with most favor in civil practice. But the observations of Lidell, as suggested by Professor Hamilton, have rendered this doubtful. At any rate, the rule is subject to many exceptions, and ought not to be asserted dogmatically. It is likely that if only those amputations in civil life for traumatic causes were examined, the result would be ascertained to favor primary operations. However the question may be decided as to other parts, there can be little hesitation, I think, in the case under consideration. I am clearly of the opinion that if an amputation be determined upon in the hand, the sooner it is done the better. There can be no just reason assigned for delay. The patient is not supposed to suffer seriously from shock or exhaustion, and will be more comfortable and in better condition altogether with a neat and clean stump than with a painful, it may be ragged and bleeding, wound.

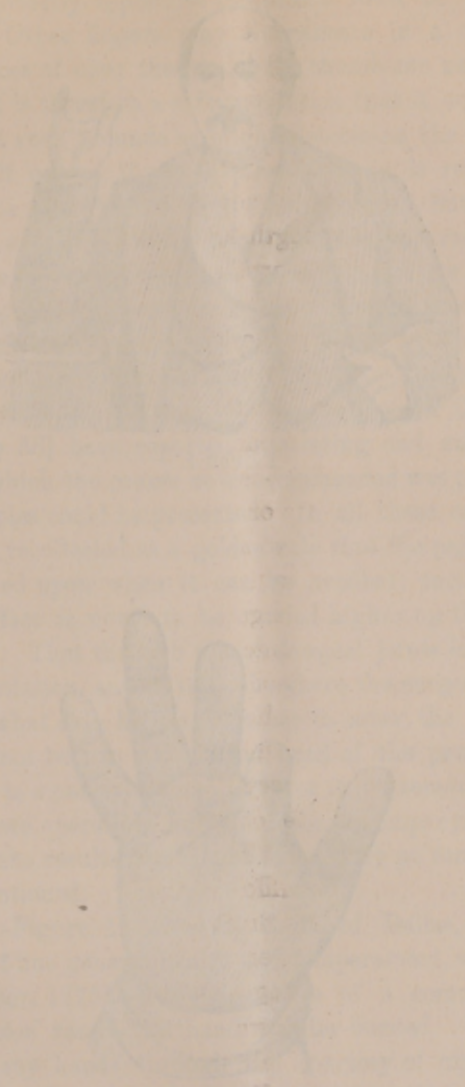
It has already been mentioned that an enlightened conservation of parts should be constantly practiced as tending to diminish the fatality of all amputations. While all recent surgical records incline to encourage a rational conservatism, they with equal emphasis condemn the weakness and indecision that would save limbs and sacrifice lives. To save life is the first, to save tissue the second duty of the surgeon. A proper apprehension

of these facts elevates surgery to the dignity of a science; a departure from them degrades it to the level of a trade. No needless mutilation or retrenchment of structure is ever to be advised; the ablation must comprehend only what is indispensable for safety. The beauty of a stump, however desirable, is still a snare which should never betray the operator into losing sight of his main object, his first duty. If a part be condemned on sound principles, life should not be imperiled in any effort to save it because extraordinary and accidental recoveries under like circumstances have been reported. These cures, as they are sometimes called, are paraded as triumphs of skill, yet they are in truth anything else; the attendants have in reality nothing to boast of, and can take no credit for their sagacity. They are to be considered rare exceptions, and he who on the basis of an exception habitually deviates from the rule will soon find himself inextricably involved in difficulties and mistakes. It is nevertheless a welcome reflection that, while surgery encroaches upon new fields with original and modified procedures, its domain is enlarged and its freshest laurels won in the interests of a rational conservatism. Its path in this direction is disclosed alike by the authority of the ablest teachers and the most intrepid operators, precept and example. It may be said that the tourniquet, the application of the ligature, and the discovery of chloroform were chiefly instrumental in systematizing amputations. A rigid adherence to the great principle of the least sacrifice of parts is of still more recent date. Many of our predecessors certainly gave up too much of the body to the knife, and were too strongly biased by the idea of points of election in making their incisions. The fact is this phraseology is unfortunate as applied to ablation in the extremities; the point of election should be that of necessity, and the work of the knife scrupulously limited to the removal of structures hopelessly disorganized. The operation that does no more than this, that provides sufficient integument to cover the stump, and insures that the cicatrix is well located, is under all circumstances to be approved. That which does more imperils so much the chances of recovery and inclines to the nature of an experiment. As has been stated, it

is within a comparatively recent period that severe fidelity to this doctrine has been observed. Mr. Lister, great and practical as he was, said in 1846: "Operation near the ankle is inadmissible; sufficiency of soft parts for the protection of the stump can not be procured lower than the calf." And again: "I have long since come to the conclusion that the femur in amputation should not be sawn lower than its middle." We have advanced so far beyond the knowledge of this clear-headed surgeon that such dicta would now meet only the most deserved and unmeasured opprobrium. The teacher who ventured to lay down such precepts could not retain the respect of his associates. We have now learned that the loss of an amount of tissue apparently quite insignificant may turn the wavering balance of probabilities against the sufferer. All of the recent operations (in the foot for example) have been devised and practiced to this end; that is to say, with the view of saving the largest portion possible of that valuable member. Hence when Hey's amputation will answer the purpose, Chopart's is not to be undertaken; when the latter can be made available, any major procedure is not to be entertained. Pirogoff's method in the hands of Hewson and others has given results in every way superior to those obtained by more extensive or higher mutilation. Operations and their modifications in the foot have multiplied in the interests of the highest conservatism, always with the object of securing stumps as far removed from the trunk as practicable. If it be admitted that the principle is essential as relating to amputation in the lower extremity, that its claims are even more imperative in the surgery of the hand is a proposition that does not admit of debate. A single finger, a part of one or even the most deformed digit is better than none, while if the thumb can be saved it will always be found of great service. No apparatus has ever been devised that would even tolerably compensate for the loss of phalanges. In a doubtful case, if the thumb alone is preserved, the surgeon is to be congratulated; if a finger be saved with it a great deal has been accomplished. If the retrenchment must include all the phalanges still the metacarpus is to be sedulously cared for, and a strong, firm palm (always of great value) secured if possible. In some

avocations, as that of bakers, a strong smooth palm with flexible wrist, although the rest of the hand be lost, is exceedingly useful. Resection of phalangeal bones, except the last in continuity, has rarely proven satisfactory; the portion of the finger below the excision usually being a useless appendage. As a rule it is better to abridge the finger by a phalanx than to attempt resection. When the indispensable importance of the thumb in prehension is considered, it is at once apparent that in any amputation the integument should be brought over the stump at the lowest possible point. The surgeon is on no account to be deluded into making higher flaps under the impression that they will afford more shapely or attractive workmanship. In shot or machinery wounds of the digits, it frequently happens that very little cutting is requisite to fashion the stumps, and in such cases the rough points of bone are to be trimmed with forceps, and the flaps formed with the least expense of sound skin. At times, unless the surgeon chooses to descend to a feeble effort at doing a "nice job," the procedure consists simply of making the bone smooth and adjusting the soft parts over it. It is a common and wise practice to saw splintered bone at a point high enough to include its entire circumference, but the phalangeal and metacarpal bones appear to afford exceptions to the rule. Yet the exception is not to be stated too broadly, and ought to be subject to some reservation. If the patient be young, favorably conditioned, and the processes of repair likely to be active, it is almost certain that a smoothing down of the broken bone will be sufficient, and a useful amount of support for the soft tissues be saved. If, on the contrary, the subject is old, of bad or uncertain history, no chances are to be taken, but the division of the bone should embrace its entire dimensions. In figure 1 of the illustrations, the third and fourth metacarpals, although split nearly to the os magnum and unciform, only lost by the forceps a few lines of their points; had they been separated at the articulations, it is evident that so good a palm could not have been secured. In figure 2 a similar course was pursued, and left the man over one-half of a very useful phalanx. The same plan has been observed in other instances, and found to succeed admirably

In such cases as little additional violence as possible ought to be inflicted, and if the periosteum be carefully preserved, the healing will seldom if ever disappoint the surgeon's expectations. Many of the precepts laid down for the removal of uninjured heads of bones are obnoxious to severe criticism. Too much trimming in the hand, with a view to giving it a more seemly shape, has been taught and practiced. It is doubtful in these operations of expediency if the part gains in symmetry so much as it loses in strength and usefulness. It is admitted that the heads of the metacarpals of the index and small fingers may be taken off or beveled to advantage, but there can be no valid reason for so treating those of the ring and medius, when the necessities of the case do not demand it. That the metacarpal bone of the thumb should be spared any such needless ablation is sufficiently obvious. The rule which obtains in reference to the foot, that the toes are not to be amputated at the phalangeal articulations or in continuity, does not apply to, but is rather to be considered as reversed in the surgery of, the hand. A recent and distinguished systematic writer has said that, excepting the index finger, amputation should never be performed at the first phalangeal articulation. With this opinion I can by no means coïncide. Every phalanx, or piece of one that can be preserved, should be, and no fraction of the finger thus saved will be found inconvenient or useless. The distal phalanges, although very liable to injury, and perhaps to a greater extent than the others subject to disease, really seldom require amputation. The removal of crushed portions of bone will ordinarily be sufficient, and in cases of necrosis from whitlow or the allied inflammations, exfoliation will usually leave a useful end to the finger. In regard to these destructive inflammations of the phalanges, it can not be too well remembered that early incision down to and through the periosteum is the most conservative of all measures, and saves both bone and soft structures from the disastrous effects of infiltration and pressure. If excision of diseased metacarpals becomes necessary, it is probably sound surgery to take away also the corresponding digits, for under such circumstances these organs could be of little service, and being weak and deprived of sup-



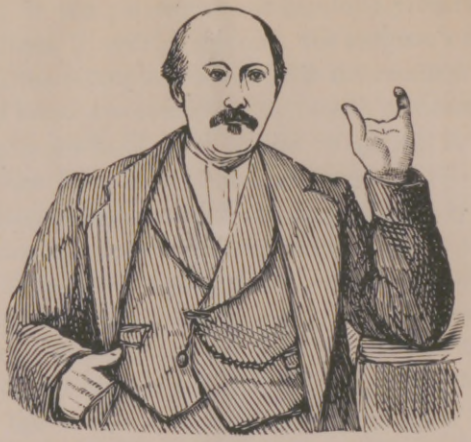


FIGURE 1.

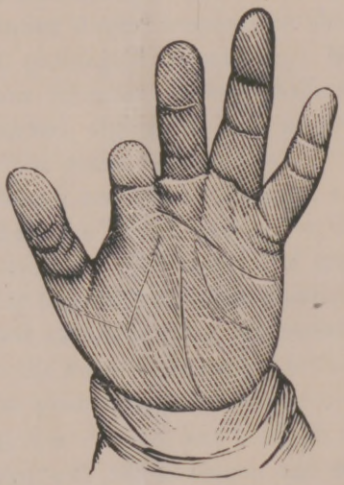


FIGURE 2.

port might interfere seriously with those remaining. But the rule as customarily applied to the thumb must be of doubtful propriety. Other fingers may compensate in a considerable degree the loss of one; the loss of the thumb can never be supplied, and it is therefore a safe suggestion that it ought not to be cut off on such grounds as might determine the removal of a finger. Of course, if the metacarpal bone is removed, the utility of the thumb will be much diminished, but still it will be of more advantage to the hand than any apparatus hitherto made. It is insisted then that extractions of its metacarpal bone does not always necessitate amputation of the thumb. If the flexor and extensor tendons still retain a certain amount of influence, the part will be of great service. Besides, both Sir Wm. Fergusson and Mr. Syme ("Observations in Clinical Surgery," page 38) have reported interesting and successful instances in which the course now recommended was pursued, and other examples could be presented. In all these operations it ought to be recollected as a golden rule that the palm is not to be encroached upon when it can be avoided; incision in the palmar surface is never to be carried higher up than the fold of the joint. That through the phalangeal joints is a good and simple amputation, and in it as elsewhere the surgeon is to be guided by what skin he has to utilize to cover the stump. As a rule it is not best to take off the head of the proximal bone, but if there is a paucity of flap to cover it, its removal is advisable. The two operations, of which the accompanying illustrations show the results, confirm so far as they go some principles already mentioned.

Case I.—Figure 1. General B. L., of Dallas, Texas, aged forty-five, of fine general health and temperament, was wounded in September, 1875, by the discharge of a common fowling piece at close range, the hand powder-burned. The patient came into my hands through the courtesy of my friend Dr. Sutton. The charge of small shot, entering the dorsal aspect of the hand toward its ulnar border, had shattered the heads and part of the shafts of the third and fourth metacarpals, when taking a direction obliquely upward it had torn up the soft tissue and bones of the index, medius and ring fingers. The operation consisted in the arrest of hæmorrhage, removal of spiculæ

of bone, cutting off tendons smoothly with the bottom of the wound, and adjusting the flaps. The head of the second metacarpal was sawn off only because its presence increased the tension of the flap. The splintered shafts of the third and fourth metacarpals were simply trimmed down to a point at which they would give a useful amount of support, instead of being exarticulated at the os magnum and unciform. The appearance of the member is pretty well represented in the figure, its utility and flexibility are all that could be expected or desired. In these material points it contrasts very strikingly with the cast of the result of a similar operation in the second surgical volume of the History of the War, page 1022. The stump has never been painful, and healed quickly and smoothly. As will be seen the scar is altogether upon the dorsal aspect, the palmar surface being left to its accustomed use of opposing substances brought in contact with it, without distress or inconvenience. This wound suppurated but little, and was treated on a strictly antiseptic plan, to the judicious management of which by Dr. Sutton the rapid recovery is largely to be credited.

Case II.—Figure 2 is that of Mr. John H., of Little Rock, thirty-seven years old, a man of good habits and health. The wound, a lacerated one, was sustained while the patient was engaged in working a shingle machine, and involved both soft parts and bone. The wound of the medius, beginning about the middle of its second phalanx, on the radial border, passed upward to the head of the bone, at which point the finger was completely divided. The same course in the main was pursued in this instance as with the hand of General L. A portion of the splintered shaft of the bone was dissected away from its periosteum, and removed nearly as low down as the insertion of the dorsal interossei muscles. The sharpened eminence of bone still left was cut off smoothly with the pliers, and after cleansing the wound the redundant integument on the ulnar border of the finger was brought over to meet the short flap on the opposite side. The cicatrix extends from the radial around to the dorsal aspect, as may be seen in the picture.* Healing took

* For this and other like favors I am much indebted to the skill and patience of Mr. George E. Shaeffer, Photographer of Little Rock.

place kindly and rapidly. The attachment of the flexor sublimis tendon was only partially separated, and hence there is a considerable degree of motion in the stumps below the joint. The patient feels sure that he could write if the right were the maimed hand. The cicatrix of the index finger is placed well over on the dorsal surface, and the little stump affords a most useful opposition to the prehensile power of the thumb.

In many wounds of the hands, particularly lacerated or shot injuries, where so much depends upon the amount of structure to be utilized and so much upon the ingenuity of the surgeon, it is not easy to indicate precise methods. If the operator is disposed to be an economist, his procedure may with advantage be varied to suit almost every case. The palmar surface of the hand, with its soft cushion of adipose and areolar tissue and its rich vascular and nervous supply, furnishes an ideal structure for fashioning the covering of stumps. It ought whenever practicable to be used for this purpose. Beside healing quickly, this skin has the additional advantage on the face of a stump of being less tender and liable to injury than that upon the other side, its normal situation and organization adapting it to the contact of all external objects. The different forms of amputation in the hand, as in other parts, are but modifications of the leading general methods, flap and circular. If a mixed procedure be practiced, especially in disarticulation, the least important flap should be made first, and that containing the vessels or designed for the chief covering of the stumps be formed after the separation of the bones is completed. Of course when it can be done, healthy tissues should be selected for the formation of flaps; nevertheless they may be made from inflamed or infiltrated parts, as under drainage and suppuration the swelling will diminish, with little danger of gangrene, or interruption to the reparative process. Both McLeod and Mr. Bryant have expressed themselves decidedly on this point, and the latter has not scrupled to assert that he has often had "brawny" flaps unite at least as rapidly and well as others not so affected. In the phalanges Ledran's amputation by two lateral flaps, as well as that by dorsal and palmar flaps of equal size, has been adandoned. If the conditions of the wound admit it, there can

be no better procedure than that known as Lisfranc's first method, the single flap operation. A curvilinear incision with its convexity looking downward is made over the joint (if the amputation be at a joint), disarticulation accomplished from the dorsal, and the principal flap cut from the palmar surface of the digit. Lisfranc's second method does not differ from this, except that the palmar flap is first fashioned by transfixion and disarticulation made from that surface. Amputation of all four fingers at once at the metacarpo-phalangeal joint, or amputation at the carpo-metacarpal junction may be done by a modification of the process for the removal of a single finger by Lisfranc's first method. The amputation through the radio-carpal articulation on the same principle, by single flap (method of Denouvillier), is a good one. The first incision is across the dorsal surface, between the styloid processes, its convexity looking downward, the joint is then opened, when a sufficient palmar covering for the stump may readily be secured. This latter, in its best shape, is really the mixed method first practiced by Mr. Carden in 1846 (described in "British Medical Journal," April, 1864), and so applicable to the leg and forearm. It is doubtless best to remove the projecting styloid processes, but it is not essential, for it has been shown by the recent modifications of Pirogoff's operations in the foot that sawn bone as well as muscular and skin flaps grow firmly on incrustations of cartilage. While amputation at the elbow has for a good while constantly grown in favor, that at the wrist has received a late and hesitating encouragement. It is alleged that its statistics in comparison with those of operation in the forearm are bad, that in 146 cases tabulated by S. W. Gross the mortality was 46 per cent., and that the Crimean surgeons lost nearly half their cases. These comparative estimates of the death rates are not borne out by the latest records. In Circular No. 6 from the Surgeon-General's office, of thirty-six cases of wrist amputation, at that time determined, the mortality was put down at 5.55 per cent., evidently much too low an estimate. In the extensive series of cases presented in the second surgical volume the fatality is given, as already mentioned in this paper, at 10.6. If we contrast with this result the ablation in the forearm it is found that

the aggregate percentage of death was of 491 in the upper third 13.4, of 676 in the middle third 11.1, of 452 in lower third 12.4, and of 128 at points not specified 37.8. Such figures as these appear to decide the question definitely in favor of the less extensive mutilation. The more conservative measure recommends itself on general principles, and if the articular ends of the radius and ulnar are unharmed and a sufficiency of integument exists to cover them, any higher amputation is unjustifiable.

So far as I can ascertain no excision of the entire carpus has ever given a satisfactory result, nor is it likely to do so. Yet it has often happened that a partial removal of these bones for caries, necrosis or injury was a highly advantageous expedient. The removal of diseased or injured metacarpal is sound practice, and particularly in the thumb, as previously stated, does not absolutely necessitate amputation of the corresponding phalanges. In such cases as little violence to contiguous structure is to be inflicted as is compatible with a thorough operation, and especially should the sheaths of the flexor and extensor tendons be guarded from harm.

The surgeon is sometimes called upon to decide between amputation and excision at the wrist. The question of precedence as to the two procedures is an interesting and important one. It may be said that the results of exsection have not been by any means gratifying, and hence many surgeons prefer amputation in the first place to the pain, inconvenience and uncertainty of the former measure. Anything like a proper notice of the subject would require more space than is now at the command of the writer.

We pass from a consideration of the principles upon which certain operations in the hand should be conducted to some observations of a general character in relation to the treatment of its wounds. There are four great indications to be observed in the local management of incised and punctured wounds, and they are as applicable to those of the hand as to any others. Briefly they are: 1. The arrest of hæmorrhage; 2. Removal of all foreign substances; 3. Coaptation of opposing surfaces; and 4. The treatment and dressing should be antiseptic and in-

stituted with a view to limit inflammation. Under the last head I declare my belief in an inflammation necessary for healing in contradistinction to one that falls short of what is requisite in that process, or that overreaches its demands. No refinement of modern pathology can do away with the essential facts of a reparative inflammation as laid down by John Hunter; it stands out a towering landmark, and if his fertile genius had done no more, it alone confers immortality. Beside the general and specific treatment designed to limit inflammation or prevent the exhaustion and tissue waste of profuse suppuration, the local measures to be adopted readily suggest themselves, and are for the most part effective. If strangulation from tension be imminent, the swollen structures are to be drained. For wasting suppuration, the remedies with which the materia medica is now so full are at hand, and I must beg to refer my reader to what I have already said (Transactions American Medical Association, 1876, p. 569) on that subject. The benefits derived from the antiseptic treatment of wounds are now so universally acknowledged that something should be done in that way, although we may not be prepared to carry out the plan perfectly. The common cotton wool, when carbolized, is an excellent, convenient and protective substance for dressing the hand. The ship caulker's oakum is an exceedingly useful material for the same purpose, absorbing foul discharges rapidly, and acting as a potent disinfectant. I believe Dr. J. C. Nott, of Mobile, first brought it prominently into notice in the South, and I have heard his pupil, the late Dr. Gilmore, often speak of his partiality for it and commend its use. From its abundant lymphatic and blood supply it is manifest that septic infection may readily be propagated from disorganized discharges in the hand. Under circumstances of uncleanliness and neglect, absorption of putrid material is prone to occur, all the fluids are depraved, the nervous system deranged, in a word we are called on to encounter the dread culmination, constitutional toxæmia. We need not recount the events of its course; with its appalling history we are only too familiar. It is enough to say that every stage of that history teaches plainer than any language can teach that the prophylaxis is of the first importance.

Few conditions are more disfiguring and intractable than the unyielding cicatrices in the palm from scalds, burns and other causes, and none perhaps tax more the ingenuity of the surgeon. Permanent contraction and deformity are not infrequent. If the tendons are involved, tenotomy is a very questionable procedure, and ought in most cases to be condemned. If, however, the injury is found to implicate only the skin and aponeuroses the knife may be used with much prospect of success. The inodular tissue may be divided at several points transversely, or the shortening of the palmar aponeurosis may be relieved by subcutaneous division. If the scar be cut, the object of course is to keep the hand fixed in a corrected position till healing takes place by granulation. But skin-grafting is the most rational, as it has proven itself the most successful means for the relief of the deformity. I have done the operation to good purpose; Dr. Truehart, of Galveston, and others have lately reported successful cases, and on the whole the little procedure is before the Profession well endorsed. The points in the operation are that the entire cicatrix should be dissected out, and the transplantation effected on the principles indicated in the Italian method.

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