

Contributions of the Author.
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THE WOUNDED OF THE WOUNDED KNEE
BATTLEFIELD, WITH REMARKS ON WOUNDS
PRODUCED BY LARGE AND SMALL CALIBRE
BULLETS.¹

BY CHARLES B. EWING.

Captain and Assistant Surgeon, U. S. A.

THE Great Sioux Indian War of 1890 has been fought so often that I feel an apology is necessary for inflicting it upon you on this occasion, but, while much has been said of the combatants, little has been written of the casualties of which this paper will treat.

The causes which led to this sanguinary hostility are, in brief, "the failure of the government to fulfil its obligations," and the Messiah delusion, together with a determination of the hostile Sioux not to surrender their arms to the government; this latter more particularly led to the Wounded Knee affair.

The theatre of war was located in South Dakota, and especially that part known as the Pine Ridge Indian (Ogallala Sioux) Reservation, situated in the southern part of the State mentioned. I cannot do better than to quote from the annual report of that very gallant and able soldier, Major-General Nelson A. Miles, regarding his disposition of troops. He says: "Seven companies of the Seventh Infantry, under Colonel Merriam, were placed along the Cheyenne River to restrain the Indians of that reservation, and intercept those from Standing Rock. In the meantime, a force had been gathered at the Rosebud and Pine Ridge agencies. Those at the Rosebud, under the command of Lieutenant-Colonel Poland, were composed of two troops of the Ninth Cavalry and battalions of the

¹ Read before the Association of Military Surgeons of the National Guard, U. S., at St. Louis, April 19, 1892.



Eighth and Twenty-First Infantry; Colonel Shafter, with seven companies of the First Infantry controlled the country to the south and west of the Rosebud agency, with station at Fort Niobrara; those at Pine Ridge agency, under the immediate command of General Brooke, were eight troops of the Seventh Cavalry, under Colonel Forsyth; a battalion of the Ninth Cavalry, under Major Henry; a battery of the First Artillery, under Captain Capron; a company of the Eighth Infantry and eight companies of the Second Infantry under Colonel Wheaton. West from Pine Ridge agency was stationed a garrison of two companies under Colonel Tilford of the Ninth Cavalry; north of that, with headquarters at Oelrichs, was stationed Lieutenant-Colonel Sanford of the Ninth Cavalry, with three troops, one of each from the First, Second, and Ninth Cavalry; north of that, on the line of the railroad at Buffalo Gap, Captain Wells, with two troops of the Eighth and one troop of the Fifth Cavalry, was stationed; north of that, on the same railroad at Rapid City, Colonel Carr of the Sixth Cavalry, with six troops, was in command; along the south fork of the Cheyenne River, Lieutenant-Colonel Offley, and seven companies of the Seventeenth Infantry; and to the east of the latter command, Lieutenant-Colonel Sumner, with three troops of the Eighth Cavalry, two companies of the Third Infantry, and Lieutenant Robinson's company of scouts. Small garrisons were also stationed at Forts Meade, Bennett, and Sully. Most of the force was placed in position between the large hostile camp in the Bad Lands, which had gathered under Short Bull and Kicking Bear, and the scattered settlers endangered by their presence. As the line under Colonel Carr was considered the most liable to be brought in contact with the hostile force, the division commander established his temporary headquarters at Rapid City, S. D., where this force was in close com-

munication, and from which their movements could be directed with the least delay."



This map is drawn on a scale of 360 yards to the inch. The figure at the lower left-hand corner of the Cavalry Camp shows the location of one-half of A and I troops. The dotted line near the Council represents 12 or 15 soldiers at skirmish distance.

Everything indicated a peaceful settlement of affairs, when the well-laid plans of Major-General Miles looking to an early and amicable adjustment of trouble

were suddenly "frustrated" by the lamentable occurrence at Wounded Knee Creek on the morning of December 29th. The opposing forces were the following: the United States troops were eight troops; Seventh Cavalry; Light Battery E, First Artillery, and Company A, Indian Scouts, making a total of 470 fighting men, under the command of Colonel Forsyth, Seventh United States Cavalry. The Indian war party consisted of 106 warriors and 294 women and children, all of the Minneconjous Sioux, under Chief Big Foot.

So many descriptions of this unfortunate affair have been published that I shall limit myself simply to so much of an account as is to be found in the very brief and concise language of my report, made upon request, to the department commander, and in so doing, I ask pardon for using the personal pronoun to the extent that I do, but, inasmuch as a report of my personal services was desired, I was obliged to frame it in the following terms:

OFFICE OF ATTENDING SURGEON,
ST. LOUIS, MO., June 23, 1891.

To the Adjutant-General, Division of Missouri, Chicago, Ill.

SIR:— Understanding that a report of my services at the battle of Wounded Knee is desired, I have the honor to submit the following:

The battle began at 9.30 A. M., December 29, 1890, and the troops withdrew from the field about 2 P. M., and marched to Pine Ridge agency, reaching that point sometime between 9.30 and 10 o'clock that evening.

Lieutenant Kinzie, Second United States Infantry, Mr. James Asay, Indian trader at Pine Ridge agency, and myself, were seated in an open wagon within ten or fifteen feet of one end of the parallelogram of soldiers that surrounded the Minneconjous Sioux band under Big Foot.

Colonel Forsyth, Seventh United States Cavalry, was writing a communication which one of our party was to carry to General Brooke, commanding Department of the Platte, then at Pine Ridge agency, and while waiting for

communication, the firing commenced. A volley came in our direction, the bullets whistling unpleasantly about us; our horses took fright, and, becoming uncontrollable, ran right across the line of fire, but were turned, and finally stopped near Louis Mossoeu's store, about three hundred yards distant from the field of battle; we alighted, and I was then informed by Lieutenant Kinzie that he had been shot in the foot; after examination of the same, I immediately returned to the camp and busied myself in the care of the wounded.

I did not think it a time for ceremony, hence dispensed with the formality of reporting for duty, and at once went to work. The work consisted principally of what is known as first aid to the wounded. The only exception being an operation of a plastic nature, when I replaced and stitched the severed nose of Mr. Wells, the interpreter, belonging to Lieutenant Taylor's command of Indian scouts. This was the only operation, if my memory serves me, that was performed on the field.

This first aid consisted in stopping hæmorrhage; applying dressings to wounds; putting up fractures; giving stimulants; and allaying pain. Later it became necessary to redress many of the wounds, as is often the case, the first dressing being only temporary.

I accompanied Captain Ederly's troop to a point about three miles to the west, where Captain Jackson was reported to be surrounded by hostile Brulés. Truth forbids that I place this in the light of a medical service, and I freely confess that it was only after arriving at our destination that I was aware that I lacked everything in the way of dressings to render aid to the wounded in case of trouble; of course, much could have been done in that regard by using the clothing and equipment of the men. My only excuse is that I went very suddenly, so quickly in fact that there was no time for obtaining dressings. It was in this way: I was standing on the brow of the hill watching the firing of the Hotchkiss guns and the barricading of the ridge, when Captain Ederly's troop galloped past, and seeing a horse in the troop without a rider, I ran out and jumped in the saddle. I had provided myself with carbine and ammunition, hence was in good shape. It did not take us more than fifteen minutes to ride the three

miles, and we were just in time to see the Indians disappear in the direction of Pine Ridge agency. After remaining about fifteen or twenty minutes, I suddenly remembered that I had absolutely nothing in the way of dressings, hence returned to camp with Lieutenant Brewer for the purpose of obtaining some, but learning that the command was to return immediately, I found my services would not be needed, hence did not obtain dressings as I intended doing.

Now, to sum up: I was on the field from 9.30 A. M. to about 4 P. M., at which hour we began our march back to the agency. Of that six and one-half hours, I am quite sure I spent two and one-half to three hours at the dressing station, and the same length of time superintending the removal of a part of the wounded and at least three-fourths of the dead, to which must be added about three-quarters of an hour taken up in accompanying Captain Edgerly's command and returning as stated above.

We consumed about five and one-half hours on the march to the agency, which was of necessity slow. I rode a horse (kindly furnished me by a troop commander), as did also Assistant Surgeons Hoff and Glennan. I did not render any medical service on the march, and think it quite unlikely that such could have been rendered efficiently, as darkness came on quickly and lights were not permitted in the command. I was not called upon to render any aid by the surgeon officially in charge, and I fail to see, under the conditions, how the wounded could have been benefited further till arrival at division hospital. I would be failing in a proper appreciation of the work of my brother surgeons in this connection were I not to mention the very efficient and untiring services of Captain Van R. Hoff and Lieutenant Glennan, of the Medical Department, who labored unceasingly in ministering to the wounded. Upon arriving at Pine Ridge agency, the wounded were placed in that part of the divisional field hospital of which I was in charge. It was my duty to attend and redress some twenty of the wounded, which occupied my time till two o'clock the following morning.

Very respectfully, your obedient servant,

CHARLES B. EWING,

Captain and Assistant Surgeon, U. S. A.

Now, to the consideration of the casualties, which I shall separate into the killed and wounded; of the former we had one officer and twenty-nine men, a total of thirty.

The great majority were killed outright, the very few surviving a variable time from a few minutes to a few hours after the reception of their injuries. Captain Wallace, besides the fatal gunshot wound of the lower abdomen, received two cuts with a tomahawk or hatchet; one across the forehead just above the superciliary ridges, and the other conforming to the anterior two-thirds of the sagittal suture. In neither case did these cuts fracture the skull.

This officer's death, coming as it did in the heyday of his career, was indeed a "tragedy." No words of mine can portray the love and admiration in which he was held by his family, friends and brothers-in-arms.

"His life was gentle; and the elements
So mixed in him, that Nature might stand up
And say to all the world, 'This was a man.'"

The greater portion of the dead I saw had received two or more wounds. In order that you may clearly appreciate the treatment of the cases to be presented, I shall premise by stating that my knowledge of them dates from the battlefield, on the morning of December 29, 1890, and ended, so far as three-fourths of them are concerned, upon their transfer to Fort Riley, Kan., January 4, 1891; remaining in charge of those whose condition could not permit of transfer at that time, till a day or two later, on which date I was placed in command of a company of the Hospital Corps.

The wounded consisted of two officers, twenty-nine enlisted men, and one civilian interpreter, attached to the scouts. I shall classify the above, broadly speaking, according to the part of the body injured, leaving out of detailed consideration twelve cases of gunshot

wounds, mostly of minor import, which did not come under my care.

In brief, then, we have gunshot wounds of the head, body, upper and lower extremities.

We will now consider the wounds as classified, taking up those of the Head, three in number :

CASE I. Private H. D., Troop A, Seventh Cavalry. Pistol-ball entered right side of face half an inch anterior to lower part of right meatus auditorius externus, passing transversely through bones of face and obtaining exit two and one-half inches anterior to lower part of lobule of left ear. Calibre of pistol not known, but from size of wound of entrance, think it about a 38. Discharge of blood from both ears, and persistent flow of saliva, the latter giving evidence of the wounding of Steno's duct. A violent cellulitis supervened, which finally subsided under treatment, and he was in excellent shape when transferred.

CASE II. Gunshot wound of inferior maxilla. Quartermaster-Sergeant C. C., Seventh Cavalry. Ball entered left inferior angle of chin, passing transversely through body of inferior maxilla, with inclination downward, gaining exit at right inferior angle of chin, crushing and comminuting bone in its passage. Treatment consisted of removing broken particles of bone, with corresponding teeth; stitching the lacerated integument of chin; applying antiseptic dressings; felt splints and bandages to support chin. This man was doing as well as he could under the circumstances when transferred. I understand that he has since had false teeth and plate made.

CASE III. Incised wound of nose. Mr. W., Indian interpreter attached to Company E, Indian Scouts, had all that part of nose anterior to nasal bones slashed off with a knife in the hands of an infuriated Indian of Big Foot's band. The severed part was hanging by a mere shred and bleeding profusely.

Fifteen minutes after reception of wound, I replaced nose, and held same in place with numerous silk stitches. This man immediately after the operation, took his Winchester and went at once to the skirmish line, and afterwards on our return to Pine Ridge agency, took his place in the advance with Lieutenant Taylor's Indian Scouts. I did not see Mr. W. for some days after operation, when I found good union, and removed stitches. This, if it can be so dignified, was the only operation performed on the field.

I now come to Gunshot Wounds of the Body. Under this heading we have five cases:

CASE I. Penetrating gunshot wound of chest. Private J. C., trumpeter Troop K, Seventh Cavalry. Ball entered two and one-half inches below and one inch from left nipple toward median line, passed transversely in straight line, gaining exit two and one-half inches below right nipple. No rise of temperature, and patient in good condition when transferred.

CASE II. Sergeant H. H., Troop A, Seventh Cavalry. Ball entered posterior surface of left chest, passed forward, coming out just internal to the left nipple. Besides the above, Sergeant H. suffered two additional gunshot wounds, one above and the other below left elbow. Pneumonitis supervened.

CASE III. Sergeant L., Troop I, Seventh Cavalry. Ball entered to right of sternum just below clavicle, passed backwards and outwards, obtaining exit at axillary line in the fifth intercostal space, where incision was made, and the ball removed, with pieces of blouse and fragments of undershirt. Pneumonitis followed.

In considering the treatment of the cases coming under this particular heading of Penetrating Gunshot Wounds of the Chest, I should like to mention the cases of one officer and two enlisted men, who suffered gunshot wounds of like character in an affair with

Chiricahua Apaches at Chevelon's Forks, Ariz., July 17, 1882.

The treatment of all these cases was alike, with recoveries in all of them. It was as follows: thorough cleansing of wounds; application of corrosive sublimate solutions; iodoform powder dusted upon parts; antiseptic dressings just sufficient to cover each particular wound; then the application of collodion, sealing part "hermetically" or by what is known as primary occlusion; finally restraining the muscles of respiration by circular bandages of chest, and fixing arm of side affected. I do not wish to place myself on record as treating all penetrating gunshot wounds in this way, but simply present my experience to your consideration for what it is worth. I am quite of the opinion that I should modify my treatment by substituting the plaster-of-Paris bandage, with the flannel roller, for the circular cotton bandages, to restrain the muscles of respiration.

This treatment by primary occlusion may seem very radical indeed, when such an authority as Ashhurst says, "The vast majority of penetrating wounds of the chest are gunshot injuries, the exceptions incised or punctured wounds. Applying the ordinary principles of surgery, even to the exceptional group, nothing but absolute necessity would justify the complete closure of the wound." And again, "Surely the conditions of a wounded lung and thorax are unfitted for the experiment of closure." And further, "Nothing appears more repugnant to the principles of surgery than the attempt to close a bullet-track which, however it be placed, under its ordinary conditions must afford ample material to be discharged externally." I quote the above to present the other side of the question as well as my own. I think this kind of dressing for chest wounds would become very necessary, particularly where traumatic pneumonitis has been set up, which

would preclude the constant change of dressings and the consequent exposure of the chest at those times. The consensus of opinion among military writers is that the least fatal injuries are those in which the projectile has passed entirely through the chest, being less injurious than those in which the bullet has lodged. While my cases are few, the results are certainly very satisfactory, when we consider that during the last two years of the war, the death from penetrating wounds of the chest reached almost $33\frac{1}{2}$ per cent.

CASE IV. Gunshot wounds of vertebræ, upper and lower extremity. Private —, Troop B, Seventh Cavalry, suffered four distinct gunshot wounds: one passing transversely through lumbar vertebræ from left to right, crushing and comminuting vertebræ and severely injuring the cord and its membranes, and finally lodging in the muscles of the right lumbar region; penetrating gunshot wounds of right and left arms below elbow-joints; and the fourth passing through left leg just above ankle joint. It would not be economizing fact very much to say that this man was literally shot to pieces. The bullet which I now exhibit, weighing 385 grs., was removed from the right lumbar region by simple incision, without anæsthetic, immediately after his arrival in the divisional field hospital at Pine Ridge, and, as Nature had not moulded him to resist three ounces of lead in this form and method of distribution, he died shortly afterwards. The injuries of this soldier were so severe that it was hardly expected that he would survive the journey from the battlefield to the field hospital, sixteen miles distant.

CASE V. Gunshot wound in neighborhood of right inguinal region. Lieutenant H. H., Light Battery, Second Artillery, received gunshot wound (Winchester) of right side, ball entering just external to anterior superior spine of right ilium and passed down-

wards and inwards. This officer was in charge of a Hotchkiss gun some six hundred yards distant from a party of hostiles that had gained the shelter of a ravine, and who were beset upon two sides by the fire of carbines and upon the third by Hotchkiss guns. The gun in charge of this officer was moved from its original position upon an eminence to lower ground, so that better range could be obtained, rendering the fire more effective. This was so successful that the Indians sought to silence this particular piece, resulting in the shooting of Lieutenant H. The ball was deflected from its original course, seemingly a fatal one, by a watch worn at the time and which was completely destroyed. I saw Lieutenant H. when shot on the field; he fell under my care that evening at the field hospital; and the same night or the following morning I examined and dressed his wounds, at which time the course of the ball had not been fully determined. Having a great deal of work on my hands, I was glad when relieved of this case by another medical officer. I understand Lieutenant H. has so far recovered from his injury as to be able to perform duty.

Let us now consider Gunshot Wounds of the Upper Extremity.

Sergeant H. H., Troop I, Seventh Cavalry, was admitted to the field hospital, Pine Ridge agency, December 29th, from the field where I first saw him. Ball entered just external to coracoid process of scapula, passed through deltoid muscle, finally entering the head of humerus. Severe. This man was treated upon the expectant principle till his transfer to Fort Riley on January 6th, for the following reasons: no appreciable rise of temperature; complained very little of pain; was able to sit up and walk about to a certain extent. Treatment consisted of securing thorough drainage of wound; absolute rest by appropriate position and posterior splints of felt or plaster-of-Paris

(I have forgotten which); antiphlogistic regimen; hypodermic administration of morphia when necessary.

I find myself well supported in the above treatment by Billroth, who declares against operative procedures, under like conditions, as follows: "As in cases of resections, you can have no control as regards the prospective functions of the arm, especially when a large portion of bone is to be excised, it is always better for the patient to escape with an anchylosed joint, without resection, than to have a dangling joint after resection."

Von Langenbeck says: "If it be true that anchylosis of the shoulder-joint enhances the usefulness of the rest of the extremity, and especially of the hand, we would be obliged, in shot-injuries of the shoulder-joint, to constantly strive for the accomplishment of ankylosis. The presumption that ankylosis would bring about greater usefulness of the arm than could be had with a shoulder-joint even with limited motion, rests upon a fallacy, occasioned by neglect to take into consideration the various degrees of severity of shot-wounds of the shoulder-joint." The same author cites nine successful cases of shot-wounds of the shoulder-joint treated on the expectant plan, the patient in every case recovering "completely with conservation of good motion of the arm." He further says: "It is certain that the results of the cases of conservative treatment of shot-wounds of the shoulder-joint above cited challenge greater attention to the side of conservative surgery."

Two of the cases under this heading were gunshot injuries in the neighborhood of the shoulder-joint, one of them made by a Winchester 38, and the other by a gun of larger calibre. Both cases were given complete rest by means of splints and position; drainage of wounds; antiphlogistic regimen, and opium in cases of pain, which complaint was rare.

No symptoms up to the time of transfer to warrant operative interference. I am quite of the opinion, however, that if the temperature, pain, etc., had so indicated, I should at once have made an exploratory incision, and an exsection or amputation, according to the conditions in each particular case; but up to the time of transfer to Fort Riley, there occurred nothing to warrant such procedure.

Gunshot Wound of Upper Extremity.

Lieutenant G., Troop G, Seventh Cavalry, received a shot which entered olecranon process of right ulna, comminuting that part, passing forwards through shaft, and gained exit at the posterior surface of arm, at junction of inferior with middle third. Treatment consisted of removing portions of bone; applying antiseptic dressings, and supporting arm. This case was turned over to another surgeon the day following his arrival at the field hospital. I have since learned that this officer has rejoined his regiment.

Gunshot Wound of the Right Hand.

Private F. L., Troop B, Seventh Cavalry. Ball entered internal border of wrist, and passing through comminuted bones of same, coming out on palmar surface at base of thumb. Wounds cleansed, dressed antiseptically, and given rest by application of splints. This man was transferred in good condition.

Gunshot Wounds of Lower Extremity, consisting of two of thigh, one of knee and two of leg.

CASE I. Private Wm. H. G., Troop C, Seventh Cavalry, while mounted, received a gunshot wound which entered middle of posterior surface of left thigh, at junction of middle with upper third, ranging slightly downward (missed femur), passed forward and inward, obtaining exit at about middle of internal surface. Wounds were cleansed, dressed antiseptically, and when transferred patient was about well.

CASE II. Private E. S., Troop C, Seventh Cavalry.

Gunshot wounds of right and left thighs. Ball entered inferior surface of left thigh, ranged upward in front of femur, passing out at internal border of anterior surface at junction of middle with upper third; this ball continuing its course entered internal border of posterior surface of right thigh, and ranging transversely behind femur, passed out at middle of upper third of external border of posterior surface. Treatment consisted of thoroughly cleansing wounds, using bichloride of mercury solutions and dressing antiseptically. This man had about recovered when transferred.

CASE IV. Private G. E., Troop K, Seventh Cavalry. Gunshot wound of right leg, middle third. This was a very severe compound comminuted fracture of both tibia and fibula, with much destruction of the soft parts, including a division of both anterior tibial and peroneal arteries. Am of the opinion that this was a case of primary infection. Thirty-six hours after entrance into field hospital it was decided to amputate limb. I performed the operation, assisted by Surgeons Hartsuff and Spencer, United States Army, under rather unfavorable auspices. A Sibley tent with the earth for a floor served as an operating-room, which is very unsatisfactory, inasmuch as your light passes to you through a mere "chink" of a door, and the tripod which supports the central upright pole of the tent permits very little room for the operating table, assistants and tables for antiseptic fluids. Then again, you may sprinkle your floor assiduously with water, yet those moving about run great risk of stirring up clouds of dust. Patient was placed under chloroform and a lateral flap amputation was performed, four inches below knee-joint, under antiseptic conditions so far as they could be obtained. Leg was found as described above; flaps were brought together, permitting of the best drainage. Treatment

then consisted in supporting patient, and using persistent antiseptic irrigation of the stump, but despite all our efforts, the products of the staphylococcus pyogenes were formed abundantly, and the patient succumbed to pyæmia resulting from a primary infection upon the battlefield.

Now, to sum up, we have reviewed: Gunshot wounds of the head, three cases; of the body, eight, including the three cases quoted; of the upper extremities, six; and of the lower, four; making a total of twenty-one cases.

The difficulties of the situation, as they appeared to the medical director of the department, Colonel Bache, can be learned by a reference to his own language when he says: "Had that regiment (the Seventh) been operating at a distance from support or organized assistance instead of having a receiving hospital within easy reach, it is not hard to cast the sum of its suffering." In comparison with the difficulties met with in this instance, in which there were three (although the medical director says two) medical officers, and four hundred and ten men to care for, thirty-one wounded, I would like to place for a moment those met with and successfully overcome, in an affair in which I played a part some years since upon another field.

My memory recalls the battle of Chevelon's Forks, Ariz., the 17th of July, 1882, where the fighting strength of the Chiricahua Apaches was about the same as that of the actual Indian combatants in this affair under consideration; the opposing forces being two troops of the Third and one of the Sixth Cavalry, under Major Evans and that brilliant cavalryman, Captain Chaffee, respectively. These Indians were the most warlike in the entire Southern country, and among them were the renegade scouts that had turned against General Carr's command at Cibicu Creek, Ariz., the year before. The engagement was a sanguinary one,

the Indian foe holding a very inaccessible point in the mountains some five or six hundred feet high, with precipitous sides except upon the south, which, while permitting the approach of our forces, was so strongly fortified and the Indians so well armed and such good marksmen, that this line of approach was exceedingly dangerous. The casualties were two officers and twelve men wounded and two men killed. The Indians lost fifteen killed (left upon the field), and a number of wounded carried off under cover of darkness. The Indian camp was captured, and with it two Indian squaws and two children; one of these squaws suffered a very severe gunshot wound of the right leg, which made amputation necessary. I performed this operation at once, upon the field, using as an operating-table a box placed upon the ground, which was at that time covered with three to four inches of hail, having plenty of spectators in the shape of soldiers. This case with seven others, we carried by hand on rude litters fashioned from the branches of the pine tree, for a distance of fifteen miles, such was the roughness of the country. Upon gaining the table-land of the Mogollon Mountains, where a comparatively smooth country was found, mule litters were made, upon which the more serious cases were placed, and carried ninety miles to Whipple Barracks. The lamented Crawford was detailed with two troops of cavalry to help me out of the mountains with the wounded, and his men acted as litter-bearers, relays being necessary every two or three hundred yards. This task, from the roughness of the country and the rudeness of the litters, was found not a very agreeable one. Our base of supply in this instance was fifty miles distant, whereas in the affair under consideration it was only sixteen. The difficulties were really not great, and I can only recall one case in which I thought the operation of amputation of the limb should have taken place on the battle-

field rather than at the field hospital twenty-four to forty-eight hours later.

This unfortunate battle provoked another hostility upon the following day, in the shape of the White Clay Creek affair. Such, however, was the masterly manner in which that gallant soldier, General Miles, controlled the situation, both by his comprehensive knowledge of the art of war as indicated by the disposition of troops and his clear insight into the Indian character, that he prevented what at one time threatened to become a serious Indian war. Peace as well as safety was again assured the settlers of that sparsely populated country, a month after the arrest of Sitting Bull, by the surrendering of nearly 4,000 Sioux Indians at Pine Ridge agency, February 15, 1891. The entire sentiment of the country is well voiced by no less a personage than the President of the United States, in his last annual message, when, in speaking of General Miles, he says, "*He is entitled to the credit of having given thorough protection to the settlers and of bringing the hostiles into subjection with the least possible loss of life.*"

It is not surprising that the casualties of the foe, as well as ourselves were great, when we remember that the fire-arms used were those of largest calibre at close range. The Sioux were armed with three different kinds of guns, namely, Winchester of pattern 1866 and calibre 45; Winchester, calibre 38; and the Springfield carbine, calibre 45. The principal weapon was the Winchester, calibre 38, together with very few of the other patterns mentioned.

The United States troops were armed with Springfield carbines, calibre 45; weight of bullet 400 grs., composed of lead and projected by 55 grs. of powder. The wounds resulting from the above were sinous and irregular, with lacerated edges; and the apertures of exit were frequently much larger than those of en-

trance. Fragments of clothing, splinters and pieces of lead were at times left in the wounds by the bullets, which, when permitted to remain, frequently led to long and obstinate suppurations (as instanced in the Indian wounded), often rendering secondary operations necessary. These bullets, by reason of the malleability of the metal (lead) of which they are made, are expansive; they easily lose their regular form and "mushroom," readily bursting into fragments upon contact with a hard body. By reason of the above, wounds of blood-vessels are more frequent, and attended with laceration, and the gravest of all dangers to the wounded on the battlefield, hæmorrhage. These wounds are further complicated by the splintering and not infrequently the complete shattering of bones.

I am of the opinion that three-fourths of the casualties of the opposing forces were received in what may be termed the "explosive zone" of the projectiles' trajectories.

If, then, for the sake of illustration, we divide the trajectory of a small-arms projectile into three zones of action, indicative of the effects of its penetrating power on the human body, we should designate them as: (1) a "zone of explosion"; (2) a "zone of penetration"; (3) a "zone of contusion."

With record of the remaining velocity of the projectile, at successive stages of its trajectory, which it is perfectly possible to have with fair accuracy; and with an assumed value of the work of penetrating the average human body, which assumption could be made within reasonable limits of error; and with an assumed value of the remaining velocity after penetration, the projectile reappearing to leave a wound of the explosive type, which would be a very vague assumption,—accurate calculations of the zones could be made, but the result could be no better than the assumed data of the problem. Looking to experience, for the zones

of the Springfield rifle, the wounds at the Wounded Knee fight, mostly within 100 yards range, were distinctly of the explosive type. The wound of Lieutenant Hawthorne, delivered at 300 to 400 yards, just failed of this type. I have seen, at target practice at known range, the body of a man perforated by the Springfield bullet at 1,000 yards, and my memory retains no note of the wound of exit being of remarkable character; from which I infer that this range is well within the zone of penetration. I shall therefore estimate these zones, for effective range of 2,400 yards, to be as follows: explosion, up to 250 yards; penetration, thence to 1,200 yards; contusion, thereafter.

The discussion of the zones of "explosion," of "penetration," and of "contusion," is a mixed one, involving both mechanics and physiology. Its mechanical features are essentially as follows: a very rapidly moving projectile practically shatters and destroys the material opposed to it, and makes a clean hole, as a pistol-bullet through a pane of glass, or as the entering bullet in the familiar type of gunshot wounds. A projectile of less velocity tears or breaks the material opposed to it, as a bullet thrown from the hand against a pane of glass, or as the issuing bullet in the ordinary gunshot wound.

The "zone of explosion" for any given piece is that part of its range in which the projectile has so great velocity that its loss of speed by penetrating the body of a man still leaves such velocity as to make the wound of exit similar in character to that of entrance; the loss of velocity by the work of penetration is so great that this zone is very narrow except for pieces of great power.

The "zone of penetration" for any piece is that part of its range in which the velocity of its projectile is such that it perforates the human body, but the loss of velocity in doing so leaves the projectile unable to

make the wound of exit similar to that of entrance. This zone makes up the important effective range of most fire-arms.

The "zone of contusion" covers the whole range from the last to the harmless "spent ball." Much of it is still effective range.

The penetrating power of the projectile varies directly with its weight, directly with the square of its velocity. The resistance of the human body may probably be taken to be proportionate to the area struck, that is, to the square of the calibre.

In comparing the more modern arms with the Springfield rifle, the higher velocity and the less area of resistance more than counterbalances the less weight of projectile, and the "zone of explosion" confined to a very short range in our arm, is with them a considerable part of their effective range. We are neither keeping pace with the humanity of nations nor increasing the effectiveness of our army, by still holding on to the antique, single-loading Springfield rifle, calibre 45.

This old-fashioned gun cannot be compared to that of France, the weapon of Germany or that of Austria; and while our arm possesses a larger calibre than that, I think, of any other civilized nation at this time, it cannot be classified with such old calibres as those of 68 and 72 (the latter known as the Minnie carbine), carrying projectiles that weighed as much as 740 grs. We find, however, a gradual change for the better, as in the last Franco-Prussian war the Germans were using an arm with projectile weighing 478 grs.; twenty-two grains less than our own. The French, upon the other hand, were armed with the Chassepot, calibre 43, carrying a bullet weighing 385 grs. The Gras, which superseded the Chassepot in 1874, did not reduce the calibre or weight of bullet. The real advance was made, however, in the direction of in-

creased velocity and reduced calibre, when the Lebel was adopted. Germany kept pace with France in substituting the Mauser model (1888) for that of 1871-84; and Austria followed suit by arming her troops with the Mannlicher.

Now, to sum up, from the standpoint of ballistics, the modern arms mentioned are superior to ours by reason of possessing (1) greater initial velocity, (2) flatter trajectory, (3) greater accuracy, (4) greater penetration, (5) greater range.

Added to these qualities, we find the quantity of powder lessened, the weight of projectile decreased, and from a financial view less cost of the arm as a whole. The most interesting phase is presented, however, when we consider this matter from a surgical aspect. Chavasse and Delorme are of the opinion that all wounds received in the space between three hundred and nine hundred yards, are equally dangerous, but this is not concurred in by Chauvel, who contends that the explosive effects are as frequent in arms of small calibre. Dr. Noel, in the *Medical Bulletin* of February and March, 1891, says, "The disorganization of the soft parts is so extensive and the loss of tissue so considerable, that in general all reparation is impossible and a considerable sacrifice, is rendered unavoidable." "The zone of penetration," however, presents a more marked difference; here the bullet, as a rule, maintains its shape; the wounds of entrance and exit are more equal; the fluids of the body are not thrown violently toward the periphery, as in the case of balls of large calibre, and the edges of the wounds are not bruised or lacerated, but look as if the integument had been "punched out." As we have stated, the bullet does not change its form, except in very rare cases, so that fragments of clothing and foreign bodies are not usually left in the track of the wound; hence consequent suppuration is not to be

feared. It is said that union is, as a rule, to be expected by first intention; the period of recovery will be shortened; paralysis or extensive shock rare; gangrene less grave and infrequent. Bones will not suffer fracture to the extent heretofore known, as they will be pierced in their entirety, and the fissuring and splintering will not be so extensive. Blood-vessels and nerves will run less risk of being struck proportionate to the reduced diameter of the projectile, consequently hæmorrhage will not be so frequent, and the wounded in better position to await first aid. In the "zone of contusion" we will find either simple contusions or contused wounds, their gravity diminishing as the bullet reaches the end of its trajectory, thereby losing its force. Periostitis, abscesses and exfoliations will ensue at times where bones have been struck, but these form the most serious cases, for generally we will find mere extravasations of blood into the connective tissue. The optimistic picture just drawn portrays what is thought by some of the French and German writers upon the subject of their respective arms; but this is not shared in by Billroth, who recently spoke to a question relating to the reorganization of the army medical corps of the Austrian army. He is of the opinion that the modern small arm will aggravate suffering and slaughter in the battle of the future, and informs us that as eighty per cent. of all wounds result from rifle-balls, fifteen per cent. from heavy guns, and five per cent. from cavalry weapons, surgical attention must be devoted principally to the infantry projectile. Accurate statistics of the war of 1870-71 show that comparatively few were killed by artillery.

Speaking of the manœuvring at a distance which the long range of the modern arm will lead to, he says: "A collision must come sometime, and then what will the effect of the new rifle be? Bullets

that formerly stopped at the bone will pierce it, and perhaps two or three other bones; the number of the severely wounded will be rapidly increased, and the armies will dwindle rapidly.

“In consequence of the greater length of range, the wounded must be treated at a longer distance from the enemy, say four hundred paces further than heretofore. Moreover, with the quicker movements of the troops comes the necessity for the quicker moving of the field hospitals. The number of porters for the wounded, already too small in the Austrian army, will have to be largely increased; in fact, many wagons must be drawn up immediately behind the line of battle to carry off the injured.”

After dwelling upon the increase of the mortality to result from the use of smokeless powder, Professor Billroth continued to speak very disparagingly of the stretcher service in these words: “At Gravelotte St. Privat there were 5,000 dead and 15,000 wounded. Two-thirds of the latter were only slightly wounded, and were carried off by railway. For the severely wounded, when we calculate that two porters with one stretcher made the trip of 500, 600 and 700 paces ten times during the eight hours of battle, we find that for the Germans alone 500 stretchers and 1,000 porters were necessary. We have left out of all consideration the French, for whose severely wounded the Germans, as victors, had to care. This at least doubled the requirements, so that 2,000 porters and 1,000 stretchers were needed. This shows how entirely impossible the whole stretcher service is.”