



COLONEL JOHN T. THOMPSON ; U.S. ARMY INFANTRY

MAJOR LOUIS ANATOLE LaGARDE ; SURGEON MEDICAL CORPS

ANIMAL TESTS CONDUCTED AT NELSON MORRIS COMPANY UNION
STOCK YARDS, CHICAGO, ILLINOIS

CADAVER TESTS IN NEW YORK & PHILADELPHIA HOSPITALS

The Thompson-LaGarde Report to General William Crozier

March 18, 1904

Chicago, Illinois, March 18, 1904.

1. Board met at Springfield Armory, Massachusetts, October 16, 1903, Present, both members. Letter of instruction from the Chief of Ordnance, dated Washington, October 8, 1903, hereunto appended and marked "A" was then read and considered. The Board then prepared a program of the experiments and tests which it desired to make and of the visits considered necessary in the performance of its duty, see letter to the Chief of Ordnance, U. S. Army, dated Springfield Armory, October 17, 1903. This program was approved, see first endorsement dated office of the Chief of Ordnance, Washington, D. C., October 20, 1903.

The Board, both members present, or Major LaGarde only, met at various times at the Philadelphia Polyclinic Hospital, 1818 Lombard St., Philadelphia, Pennsylvania, and at the New York University Medical Department, corner 26th Street and First Avenue, New York City, New York, and made experiments upon cadavers. Upon completion of these tests, the Board proceeded to Chicago, Illinois, and made tests upon living animals.

2. DEFINITION OF SHOCK EFFECTS AND STOPPING POWER.

The Board sought to define for its guidance what constitutes shock effect or stopping power from projectiles. In the cadaver this effect was considered coincident with the disturbance observed when a suspended limb was hit. The amount of shock effect here was usually estimated by the degree of motion given to the limb by the force of impact. A study of the con-

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dition of the tissues in all instances demonstrated that the amount of shock effects measured by this standard was always proportional (1) to the degree of resistance on impact, and (2) to the amount of destruction of tissue. The greatest amount of resistance was, as a rule, observed in those shots directed against the hard bones, like the long bones of the limbs, and the harder the bone the greater was the amount of destruction wrought.

In attempting to define shock effects or stopping power in living animals, the Board's attention was directed to the immediate effects of projectiles when striking:

1. Vital parts.
2. Non-vital parts.
3. The anatomy concerned in locomotion.

As a rule, to which there were no exceptions, when an animal was hit in a vital part by any of the projectiles tested, the shock effects were immediate or nearly so in all cases. When the animal was purposely shot in non-vital parts, like the internal organs, -- the lung, liver, stomach, intestines, exclusive of large vessels, the Board found the shock effects to vary with the sectional density, form and caliber of the projectile.

Relating to the stopping power upon animals when hit in that part of the anatomy concerned in locomotion, the Board was guided by the behavior of the bullets when colliding against the bony tissues of the body, as shown in the accompanying skiagrams from the cadaver and the horse. In those instances

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where the bullet causes fracture of the long resistant bones, the efficacy as to stopping power was considered as positive. When a bullet traversed the joint end of a bone, making a clean cut perforation with no tendency to displacement of fragments, the efficacy as to stopping power was thought to be doubtful.

These next 3 sections are part of a single fold-out page tabulating the data and only make sense when read left to right.



3. Revolvers and Pistols used in the Experiments.

<u>MAKE.</u>	<u>MODEL</u>	<u>SHOTS IN MAGA-</u> <u>CALIBER ZINE OR CYL.</u>
Luger Automatic Pistol...	Medium barrel...	30128.....
Luger Automatic Pistol...	Short Barrel...	35438.....
Colt's Revolver.....	Army, 1903.....	386.....
Colt's Automatic Pistol..	Military 1902..	388.....
Colt's Automatic Pistol..	Military 1902..	388.....
Colt's Revolver.....	New Service....	456.....
Colt's Revolver.....	New Service....	456.....
Colt's Revolver.....	New Service....	4556.....
Colt's Revolver.....	New Service....	4766.....

A consideration of this table shows as to:

- 1st: Caliber. The largest (0476) and the smallest (03012) calibers used in military pistols and revolvers, so far as known to the Board, were selected
- 2nd: Material. Lead, jacketed and metal patched (soft nose) bullets were used. The points of some of the jacketed bullets were filed so as to expose the lead. An explosive bullet was also tried.
- 3rd: Form of Bullet Point: These variations included the truncated cone, the ordinary spherical segment, the blunt-point, a hole in point, the cupped point and a hole in point filled with a copper shell, primed and charged.

B A L L I S T I C A L D A T A .

POWDER CHARGE		BULLET.		VELOCITY f. s. at			
Weight.	Kind.	Weight	Kind	Shape of	Muzzle	37-1/2 yds.	75 yds.
Gr.		Gr.		Point.			
6.2....	Smokeless	92.6..	Jacketed..	truncated cone	1420	1258	1133
5.2....	"	123.5..	" ..	" "	1048	985	930
3.3....	Bulls eye	148. ..	Lead.....	Sph.Seg.	763	727	690
6.6....	Smokeless	130. ..	Jacketed..	" "	1107	1022	953
6.5....	"	120. ..	Soft nose	" "	1048	980	920
4.8....	Bulls eye	250. ..	Lead	Blunt	720	692	688
4.8.....	"	220. ..	Lead	Hole in point	700	691	683
6.4....	Cordite	218.5..	Soft Lead	Cupped	801	704	616
18.0....	Black	288.1..	Lead	Sph.Seg.	729	686	646

4th: Bullet Weights. These varied from 92.6 grains to 288.1 grains.

5th: Initial Velocities. These varied from 700 f. s. to 1420 f. s.

6th: Muzzle Energies. These varied from 191 ft. lbs. to 415 ft. lbs.

7th: Combinations of Elements. A light weight, jacketed, small caliber bullet with high velocity, a heavy weight, large caliber, lead bullet with comparatively low velocity, a jacketed bullet of intermediate weight, caliber and velocity, and a lead bullet with intermediate weight and caliber, but with low velocity, were tried.

The revolvers and pistols used were selected on account of their giving the extensive range of ballistical elements mentioned above and not with a view of testing their mechanisms.

ENERGY ft. lbs.	SAMPLES.	REMARKS.
Muzzle.		
415	1	High charge.
301	2	Normal charge.
191	3	Service bullet.
354	4	U. M. C. Co's make.
293	3	Also known as the metal patched bullet.
288	6	U. M. C. Co's make.
239	7	U. M. C. Co's make.
288	8	S. A. Ball, Pistol Webley Cordite, Mark III, known as the "Man-stopper."
340	9	Government Mark III, solid brass, central fire, Eley Bros. Ltd., Manufacturers, London, England.

Revolvers and pistols being essentially short range weapons, 75 yards were fixed as the extreme range, 37-1/2 yards as the medium range and near the muzzle as close range, in all experiments.

Two samples of each bullet, Exhibits, A, B, C, D, E, F, G, H, and I are forwarded herewith.

The charges for long and medium range were reduced so as to give the required velocity at three feet from muzzle, in order to insure hitting proper point with bullet.

RESULTS OF SHOOTING IN CADAVERS; SKIAGRAPHIC
AND OTHER EVIDENCE.

4. The cadavers were suspended by the head so that the feet cleared the floor. For convenience in comparing the shock effects of the different projectiles employed, the maximum amount of oscillation in a suspended limb was rated at 100. The accompanying skiagrams were, as much as possible, selected to show the injuries at the short, medium and long ranges. The injury in the shaft parts about the wounds of entrance and exit was duly noted. The projectiles were stamped with a letter or number at their base and caught in a barrel of sawdust back of the cadaver. Each bullet when recovered was put in a small cardboard box with the notes of the injury which it caused.

(a) Bullet from Colt's Revolver, Caliber 0'38, Model of 1903, (the present service revolver).

The Shock Effects as noted by the standard laid down for cadavers, viz: the oscillation of the limb at the moment of impact was not perceptible when soft parts alone were traversed. If the joint end of a bone was hit, the motion noted amounted to a tremor of the member, and when the bullet was made to collide with a hard bone, like the shaft of one of the long bones, the amount of motion at close range was rated 50. The force of impact was noticed to throw the limb back in the direction of flight of the bullet, and in regaining its normally suspended position, the member was apt to sway back and forth several times.

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SOFT PARTS.-- The wounds of entrance and exit were, as a rule, the size of the caliber of the bullet. In cases of bone injury showing displacement of fragments, the wound of exit was generally larger than that of entrance. If the bullet caused only a perforation in the bone, as for instance in the joint end of one of the long bones, the wound of exit presented no characteristic features.

BONE.-- A study of the injury to bone, as demonstrated by the skiagrams, shows that the bullet has a tendency to perforate the joint ends of bones with little or no tendency to lateral displacement. The resistance offered by the soft spongy structure of bone near the joint ends is not sufficient, as a rule, to disintegrate the bullet, and lead fragments are seldom seen in these cases. The bullets which cause the injury to the joint ends are generally recovered practically undeformed. See skiagrams Nos. 1, 2 and 3.

The injury to the bones in their RESISTANT STRUCTURE, as for instance, in the shaft of the long bones, is very different to that just described. The bone in this part is hard; it offers enough resistance to break up the bullet into fragments. The force of impact is so great and the amount of energy which is liberated by the deforming bullet is so effective that extensive fracture of bone is noted. The pieces of bone are unusually large, and the fissures in the bone substance away from the point of impact are long, as much as two and three inches in some cases. The degree of deformation of the bullets varies as shown in the illustrations, from the deposition of small

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particles in some cases to larger ones in others. At times the whole of the bullet seems to have disintegrated and to have thus lodged at the seat of fracture. The bullets recovered in the barrel show all manner of deformation, and the majority have lost from one-third to two-thirds of their weight. See Skiagrams 4, 5 and 6.

(b) Blunt-pointed bullet from Colt's Revolver, Caliber 0745, New Service.

SHOCK EFFECTS.-- When the soft parts alone were traversed where was no shock effect perceptible. In the joint ends of bones it was more than was noted with the 0738 Caliber Colt's. The amount of shock effects in the middle of the shafts of the long bones was rated at 80.

SOFT PARTS.-- The wounds of entrance and exit, when soft parts alone were hit, corresponded in size to the caliber of the projectile. The wound of exit varied when hard bone was hit, as noticed with the 0738 Caliber Colt's, only to a greater degree. In some instances the wound of exit was multiple, either from pieces of lead or fragments of bone issuing through the skin.

BONE.-- The injury to the joint ends of bones with this bullet was characterized by a perforation or tendency to gutter or furrow the bone without complete fracture. The resistance usually offered here seldom caused more than detachment of the smallest fragments from the bullet. See Skiagrams Nos. 6-A, 6-B, 6-C and 6-D.

The injury to the shafts of the long bones accords with

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that of the 0738 Caliber Colt's, and as far as the amount of fragmentation of bone and of the bullet, a comparison of the skiagrams of these particular bones shows the injury to be about the same in both, although the larger caliber should of necessity give more exaggerated effects, yet as much as this may be true, they are not as striking as they might be in examining the illustrations side by side. The bullets recovered in the sawdust show deformation at their points, which increases with the resistance encountered in the body. See Skiagrams noted above, (6-A, 6-B, etc).

(c) Bullet from Colt's New Service Revolver, Caliber 07476.

SHOCK EFFECTS were perceptible only when bone was hit. In the case of the joint ends of bone, there was perceptibly more shock than with the preceding calibers. When, however, the shafts of the long bones were hit, the amount of shock was very much in excess of anything that was noticed with any of the bullets tested in these experiments. For instance, shooting through the hand from left to right or vice versa, the member was thrown back in the line of flight of the projectile with great violence. Again, when the tibia or shin bone was struck in about its middle third, the force of impact was exhibited by the foot being forcibly thrown forward so that the lower fragment of the tibia was made to describe an angle of about thirty-five degrees with the upper fragment. For the purposes of comparison, the amount of shock effect in the resistant bones has been placed at the maximum -- 100.

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SOFT PARTS: Wounds of entrance and exit were the size of the bullet, except when resistant bone was hit, and then they were larger, as in the case of the 0738 and 074 5 calibers previously noted.

The skiagrams show correspondingly large perforations in the joint ends of bones. In the case of the humerus, there is a slight tendency to fissuring. See Skiagrams Nos. 7, 8 and 9. In the case of the long bones, the skiagrams show that the bullet, in deforming, and fracturing the bone, acts variously. For instance, at close range, in Skiagram No. 10, the bullet made a regular impact on the femur, caused but little fragmentation at the point of impact, but left a long fissure in the upper fragment of the bone, and the whole of the bullet appears in two large fragments and a dozen or more smaller fragments close to the seat of injury. This bullet, for reasons which might be variously explained, at close range, sought to spend its energy in deformation instead of breaking up the bone, as is shown in Skiagrams Nos. 11 and 12. It may be noted also that the amount of fragmentation of the bone is even less than we find in Skiagram No. 13, at long range.

(d) Full jacketed bullet from Luger Pistol 9 M/M.

The SHOCK EFFECTS were not perceptible when soft parts alone were hit and scarcely perceptible when joint ends of bones were traversed. When the middle of the shaft of the long bones was struck, the shock effect was equal to that of the 0745 Colt's Revolver with blunt-pointed bullet, and is consequently rated at 80.

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SOFT PARTS: The wounds of entrance and exit corresponded in size to the caliber of the bullet when soft parts and joint ends of bones were hit. The wound of exit at times in the joint injuries was apt to be oblong in the longitudinal or transverse diameter of the limb, showing possibly a key-holing on the part of the bullet. The shape of the orifice of entrance of the bullet in the head of the barrel also indicated that it had lost its balance. When resistant bone was struck, the wound of exit was, as a rule, larger than the wound of entrance. The wound of entrance was never larger than the wound of exit, except in parts of the body where the overlying skin was stretched over subjacent bone; as, for instance, that covering the crest of the tibia.

The injury to the joint ends of bones, as shown by the skiagrams, shows uniform perforations, except when the bone has been struck near the edge, in which case a guttering appears. The injury to the resistant structures, on the other hand, demonstrates fragmentation of bone with more or less fissuring. The area of fracture is generally free from the lodgment of particles of the bullet and this feature serves often to identify the lesion or injury of the jacketed from the unjacketed bullets.

The bullets show denting of their pointed ends, when they perforate joints alone, and a tendency to set up at the conical end as far as the base of the cone when hard bones have been hit. In some cases resistant bone, like the femur, causes a slight dispersement of some of the lead core and envelope.

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See Skiagrams Nos. 15, 16, 17 and 18.

(e) Full jacketed bullet from Luger Pistol 7.65 M/M.

The SHOCK EFFECTS as noted against hard bone was greater than that of the 0.38 Caliber Service bullet, and it can be rated at 60. In the joint end of bone there was perceptible motion of the suspended limb; in the soft parts no motion occurred.

SOFT PARTS: The wounds of entrance and exit presented nothing characteristic except when a hard bone was struck, and then the wound of exit was apt to be larger and irregular, the irregularity taking the shape of the distorted bullet in the majority of cases.

BONE: The injury to the joint ends of bones partook of the nature of complete perforations and guttering, with little or no tendency to fissuring. See Skiagrams Nos. 19, 20 and 21.

In injuries of the shafts of the long bones, the Luger bullet causes fracture and lateral displacement of fragments with striking effect. The area of fracture is not distributed as much in the shaft of the bone as we have noticed with the 0.38 and 0.45 Caliber lead bullets. The foyer of fracture is more circumscribed, with a little of the substance of the bullet showing in the vicinity. See Skiagrams Nos. 22, 23 and 24.

The energy and destructive effects of this Luger bullet are strikingly shown when a cavity with semi-fluid contents having rigid walls, like the skull, has been struck. For an

illustration of this point, see photographs A, B and C. In this case the bullet perforated the skull entirely, making a wound of entrance the size of the projectile and a wound of exit about twice the size of the projectile. The bullet is dented at the point and flattened somewhat on one side more toward the base.

(f) Full jacketed bullet from Colt's Automatic Pistol, Caliber 0.38, Military Model 1902.

The SHOCK EFFECTS of this bullet was estimated at 65 when hitting against resistant bone. It was practically nil when traversing soft parts only and it imparted very little motion to the limb when the joint ends were hit.

SOFT PARTS: The wounds of exit and entrance in the soft parts were the same in size as the sectional area of the bullet except when bone injury occurred, and then the wound of exit was nearly always larger.

BONE: The tendency to perforation of the joint ends is noticed in the case of this jacketed bullet. There is, in accordance with the skiagrams presented, a slight tendency to fissuring. See Skiagrams Nos. 25 and 26. In the middle of the shaft the area of fracture is not so widely distributed as in the case of the 0.38 Caliber Service bullet, and in this particular the injury more nearly approaches what we find in the case of the Luger 7.65 M/M. Against very resistant bone, the jacket of this bullet shows a tendency to rupture. See Skiagrams Nos. 27, 28 and 29.

For the destructive effects of this bullet upon the skull, see Photographs G, H and I. The wound of entrance in

the scalp was the size of the projectile while the wound of exit was lacerated and four times the size of the bullet. The bullet shows a slight indentation at its conical end.

(g) Marred bullet from Luger pistol 7.65 M/M. Jacket of bullet marred by filing the point transversely, sufficient to expose the lead core.

The SHOCK EFFECTS were the same as noted in the experiments with the full jacketed Luger bullet of this caliber. In the resistant bones, when the bullet was broken up by the force of impact and became lodged in the tissues, the shock was greater than was seen in the case of the full jacketed bullet. The latter seldom disintegrates entirely against the more resistant structures in the body, so that part of its energy usually escapes with the bullet or its fragments that pass outside the body.

SOFT PARTS: The wounds of entrance and exit, when the soft parts and joint ends of bones were hit, were similar to those noted in the case of the full jacket. These structures -- soft parts and joint ends -- offered no resistance sufficient to break up the bullet, although it was marred, as stated, to invite deformation.

BONE: The joint ends of bones, in the strictly spongy structure, present perforations alone in the way of injury, similar to those made by the unimpaired jacket and already noted under (d). The injury to the hard bones was, however, very different. In the large majority of such hits the marred bullet generally parted with its jacket and caused destruction

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of tissue not unlike the dum dum or soft nose bullet. The wounds of entrance were usually round and the same size as the bullet, but the wounds of exit often exhibited tears and lacerations many times larger than the bullet itself. The amount of breaking up of the bullet and the bone substance are shown in the skiagrams better than it can be described. It will be seen that the area of fracture is limited and that the bone is pretty well broken up. See Skiagrams Nos. 30 and 31. The effect of firing a marred bullet against the head is shown in Skiagram No. 32, and Photographs D, E and F.

(h) Marred bullet from Colt's Automatic Pistol, Caliber 0.38, Military Model 1902. Jacket of bullet marred by filing the point transversely, enough to expose the lead core.

The SHOCK EFFECTS were similar to those noted under (f), with the full jacket, except that they were greater when the resistant bones were hit by the marred bullet.

SOFT PARTS: The wounds of entrance and exit were similar to those of the full jacketed bullet when the soft parts of joint ends of bones were hit. As in the case of the marred jacket of the Luger bullet 7.65 M/M, these tissues have not resistance enough to cause a separation of the marred jacket from the lead or to cause deformation except the slightest amount of denting of the envelope now and then. The wound of exit, when a resistant bone was hit, was generally lacerated, showing protruding flesh at times, and as noted in some cases, as much as four inches in length.

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BONE: The joint ends of bones are perforated without fracture, as was demonstrated in the case of the full jacketed bullet. See Skiagrams Nos. 33, 34 and 35.

The destruction of the hard bones from the use of the marred jacket in this test of experiments is very striking. The area of fracture is not so circumscribed as in the case of the preceding experiments with the marred Luger 7.65 M/M. The bullets often break up at the seat of fracture and lodge. See Skiagrams Nos. 36, 37 and 38.

(i) Metal patched (soft nose) bullet from Colt's Automatic Pistol, Caliber O'38, Military Model 1902.

The SHOCK EFFECTS were very similar to those noted under (f), with the same caliber weapon. When the bullet happened to strike a very resistant bone, like the femur, the amount of motion was very well marked and it exceeded in those instances the shock effects noted with the full jacketed bullet. The amount of shock effect for the close range jacketed bullet was placed at 60, and the shock effects for the metal patched might be placed at 70.

SOFT PARTS: The wound of entrance was, as a rule, the size of the bullet. The wound of exit, when resistant bone was hit, was much larger and showed a great deal of laceration. When soft parts and joint ends of bones alone were hit the wounds of entrance and exit were practically the same, namely, the size of the projectile.

BONE: The injury in the joint ends of bones was marked

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by a perforation, as a rule, with very little more tendency to displacement of fragments than we have found with the full jacketed bullet. See Skiagrams Nos. 39 and 40. The amount and character of injury in the hard part of bone is very striking. The fragmentation of the bone at the point of fracture is circumscribed, with little tendency to fissuring in the shaft. The area of fracture is marked by the presence of pieces of the lead and jacket of the bullet. The bullet seems to undergo more or less complete rupture upon colliding with the shafts of the long bones. See Skiagrams Nos. 41, 42, 43 and 44.

In recovering the deformed bullets in the barrel, in the large majority of cases the pieces of lead and jacket were separated and as the marks for identification were placed on the envelope at the base, the latter could always be identified with the particular injury that it had inflicted, but it was impossible to find the particular core of lead that went with each particular envelope, so that in describing the deformation of the bullets it will be seen that the description pertains mostly to a description of the envelopes found. We recovered nine lead cores and some fragments of lead. The former were set up at the conical end for the most part, the cylindrical part being normal in shape.

(j) Bullet with hole in point from Colt's Revolver, Caliber O'45, New Service.

The SHOCK EFFECTS were thought to be greater at times than that determined for the Colt's Revolver Caliber O'45 bullet, already noted. This appears to be especially so when

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the resistant bones were hit and the bullet lodged. The shock effects for the Colt's Revolver, Caliber O'45, with the blunt-pointed bullet, under "b," was rated at 80, and this might be rated at 85.

SOFT PARTS: The wounds of entrance and exit cannot be well described inasmuch as the notes pertaining thereto are in Washington.

BONE: With reference to the injuries in the joint ends of bones, the skiagrams show that the action of this bullet does not materially differ from the blunt-pointed bullet. There is a tendency to perforation with no special disposition to displacement of fragments. See Skiagrams Nos. 45 and 46. In the hard bones the projectile ruptures readily and causes fracturing not unlike that noted in the soft nose bullet. See Skiagrams Nos. 47 and 48.

The bullets emerging from joint ends of bones, which were recovered, showed no special tendency to deformation.

(k) Cupped (so-called "Man-stopper") bullet from Colt's Revolver, Caliber O'455, New Service.

SHOCK EFFECTS: The shock effects in the soft parts were small. In the joint ends of bone the shock effects were greater than were exhibited by any other bullet with which we have experimented. In the resistant structures, in shots for close range only, the shock effects should be rated between the O'45 and the O'476 Caliber Colt's Revolvers, and it might be placed at 87.

SOFT PARTS: In the soft parts the wound of entrance

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was usually the caliber of the bullet. The edges of the wound were sharp cut. The wounds of exit cannot be described on account of the notes not being available.

BONE: The injury to the joint ends of bones from close shots is exhibited in Skiagram No. 49. It will be seen that the projectile deformed and left part of its substance around the area of fracture, which is not the case with ordinary lead bullets when striking joint ends of bone. The bullet, as will be noted, made no perforation but broke up the spongy structure in the same way that the shafts of the long bones are broken up by these lead bullets. For the long ranges, the bullet has not sufficient energy to penetrate the bone. The energy seems to spend itself in deformation of the bullet, as shown in Skiagram No. 50, in the head of the tibia. In the shafts of the long bones, at close range, the bullet deforms very completely. The whole of its substance seems to lodge and the area of fracture is marked by large pieces of bone and long fissures. See Skiagrams Nos. 51, 52 and 53.

For an exhibit of the dispersion of lead fragments when the projectile strikes the head, see Skiagram No. 54. Photographs showing the amount of injury to the skull will accompany the complete report; they have not yet been received.

S U M M A R Y.

The foregoing experiments in cadavers, and the skiagraphic evidence from the same, show that the effectiveness of weapons of the pistol or revolver class increases with caliber rather than with the velocity. This is illustrated specially in the

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joint ends of bones. In this spongy structure the uniform penetration by the envelope type of bullets is strikingly exhibited in the skiagrams. The perforations being seldom larger than the section area of the bullet, the amount of shock effect, destruction of tissue or loss of function that result is small compared with the hits from larger calibers. Speaking for the joint ends of bones and soft parts, in those cases where the Board endeavored to increase the shock effects and destruction of tissue by the use of metal patch or marred bullets, this expedient failed because these special bullets did not encounter sufficient resistance to cause deformation. In the hard substance of bone, the effects of the jacketed and unjacketed bullets were sufficiently severe and possessed the requisite amount of shock effects for a military pistol or revolver. The stopping power and shock effects increased, as already stated, with the sectional areas of the bullets used.

EXPERIMENTS ON LIVING ANIMALS.

Nelson Morris & Co's Bldg., Union Stock Yards,

Chicago, Ill.

5. The object of these experiments was to show the comparison in stopping power and shock effects of the different bullets upon the viscera of the chest and abdomen, independently of vital parts.

In these experiments, all shooting was done with the muzzle of the revolver or pistol at about three feet from the animal shot, in order that the bullet would strike the proper point.

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In all experiments upon living animals, the full charge (close range) cartridge was used. In each case, the animal was securely tied to a post.

1st Animal: Stag, about four years old, weighing, approximately 1200 to 1300 lbs.

Bullet from Colt's New Service Revolver, Caliber 0.476. Two shots through both lungs from left to right; second shot four inches in front of the first. Animal dropped at the end of four minutes. Was apparently not much disturbed by the first shot, only throwing his head slightly, but he was shocked by the second shot. Blood flowed from nostrils immediately after the first shot, showing that the lung was probably perforated. He was in a death struggle at the end of four and a half minutes; dead at the end of five minutes.

POST MORTEM: The two bullets went through both lungs in the same alignment that they were fired. The amount of contusion surrounding the channel track in the wounds extended from one inch to an inch and a half into the tissues. The bullets entered behind the left shoulder, the first shot striking the tenth rib and the second shot going through the eighth rib. Some of the bone was driven into the lung by the first shot. The second shot, after going through the right lung, struck the eighth rib and lodged in the muscle. The first bullet, after emerging from the right lung, struck the tenth rib, glanced off and was lost.

2d Animal: Stag, weighing approximately about the same as the first animal.

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Full jacketed bullet from Luger Pistol 7.65 M/M.

Animal shot through lungs from left to right. Dropped at the end of thirty seconds. Perceptibly shocked when hit. Blood flowed at once from nostrils; was in death struggle at end of three minutes.

POST MORTEM: The bullet perforated both lungs and cut the posterior aorta. The amount of contusion surrounding the channel track is not quite so extensive as we found it with the O'476 Colt's revolver. The posterior mediastinum was filled with blood from the injured aorta and the amount of hemorrhage in thorax was due to cutting of the artery. The bullet emerged on the opposite side between the eighth and ninth ribs, perforated the skin and was lost. In this case the bullet, in going in and out, did not strike any rib. Death in this case was so manifestly due to the hemorrhage from injury to the aorta, a vital part, that the Board deemed it advisable to repeat the experiment in order to secure a comparative test.

3rd Animal: Stag, weighing, approximately, 1200 lbs.

Bullet from Colt's Revolver, Caliber O'38, Model 1902, (the present service revolver).

Animal shot from left to right through both lungs, as before; was very much shocked or frightened and scampered about; no blood from nostrils. At the end of one minute and thirty seconds after the first shot his eyes were bright and he was looking about; bowels moved, urine voided. He was made to turn around into the same position as before. At the end of two minutes and thirty seconds he was again shot, through the chest.

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He jumped as before, either from excitement caused by the report or from shock, more likely from the former. Animal was again shot at the end of fifty seconds. In this instance the animal was very much shocked and kept on his feet with difficulty; showed much distress. Animal dropped to the floor at the end of three minutes and fifty seconds, and died at the end of four minutes and forty-five seconds after the first shot.

POST MORTEM: There was a large emphysematous tumor 16 x 18 inches, on the right side opposite the entrance of the three bullets. The first two shots went through both lungs and lodged in the chest wall on the opposite side under the skin. The third shot missed the lung, going above it, and penetrated the aorta. The cause of death was undoubtedly from the effects of the last shot. The amount of hematoma surrounding the channel made by the bullet in the lung tissue extended about a half inch into the surrounding tissue.

4th Animal: Stag, weighing, approximately, 1300 lbs.

Bullet from Colt's New Service Revolver, Caliber O'476.

First shot: Bullet entered from left to right; animal was shocked by the report. The bullet was intended to traverse the intestinal area as much as possible. At the end of forty-five seconds the animal was breathing somewhat rapidly.

Second shot: Two minutes from first shot. Bullet struck to the right and below the point where the first entered. Animal was again shocked by the report of the revolver and, of course, by the force of the blow.

Third shot: Three minutes and ten seconds from first

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shot. Animal was very much shocked by the loudness of the report; his breathing became faster, but he soon quieted down.

As it became evident that the animal would not die immediately from the wounds already inflicted, he was shot in the head at the end of six minutes and thirty seconds from the time of the first shot, with no apparent effect.

Sixth shot: At the end of seven minutes and fifteen seconds, the animal, still standing, was shot into the ear, with no apparent effect.

Seventh shot: At the end of eight minutes and fifteen seconds, the animal still standing, was shot behind the ear. The animal continued to stand, the shots having failed to reach a vital spot, it was determined to kill him in accordance with the method practiced at the slaughter house. At the fourth blow on the head with a hammer he fell to the ground and expired.

POST MORTEM: The first shot in the head entered the forehead two inches to the left of the median line on a level with a horizontal between the eyes. The second shot in the head penetrated about one inch to the right of the median line and about three quarters of an inch below the horizontal line drawn between the eyes. The third shot in the head penetrated about two inches below and slightly in front of the root of the left ear, passing through the masseter muscle and lower jaw, it lodged in the muscles at the root of the tongue. The location of the fourth shot in the head could not be found. None of the shots penetrated the brain.

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Three of the bullets went through the stomach and mesentery, inflicting wounds of entrance and exit corresponding in size to the diameter of the bullets. There were thirteen perforations in the small intestines and two contusions, two perforations and one contusion in the large intestine, and one perforation through the liver without any special amount of laceration.

5th Animal, Steer, weighing, approximately, 1100 lbs.

Full jacketed bullet from Colt's Automatic Pistol, Military Model 1902.

1:38:25 P. M. Animal shot through chest from left to right; was on his knees and came to his feet when hit; there was no shock effect apparent. At 1:39:25 he was again shot. Shock effect from second bullet was more apparent than from the first; animal jumped and threw his right hind foot against his side. Thirty seconds after the second shot the animal had a fit coughing and protruded his tongue; his breathing became labored. At 1:40 P. M. the animal was again shot. In this instance he winced a little and pulled on the rope that fastened him to the post. As the three bullets, apparently through the lungs, had failed to kill him, the packers were requested to kill him in the prescribed method followed at the slaughter house. The animal fell to the ground after being struck four heavy blows over the forehead with a hammer. Death took place at the end of eight minutes from the time of the first shot.

POST MORTEM: One of the bullets struck the tenth rib on

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the left side and perforated it, with slight comminution. The other bullet entered between the eighth and ninth ribs. At the point of fracture of the rib caused by the first bullet, there was the appearance of two bullets having gone through the same wound, which more than likely marked the entrance of the third bullet. One bullet was found in the cellular tissue under the skin of the right side, after perforating the rib completely without fracture. Another bullet was found in the cellular tissue nearby. The bullets recovered were slightly dented at their conical ends, with no impairment of the jacket. The third bullet was lost.

Three bullets perforated the left lung and only two perforations could be found in the right lung. The amount of hematoma surrounding the channel track of the bullets was more extensive than that found in the case of the third animal, shot with Colt's Revolver, Caliber 0738, measuring in one instance 3" x 2-1/2".

6th Animal: Cow, weighing, approximately, 1000 lbs.

Bullet with hole in point from Colt's Revolver, Caliber 0745, New Service.

1:50:35 P. M. Animal shot through chest from left to right; shock slight. At the end of twentyfive seconds the animal coughed, looked about and stood firmly on her feet. At 1:51:35 P. M. the animal was again shot. She winced a trifle; voided urine; hemorrhage was noticed in the mouth; difficult breathing soon set in. At 1:52:35 P. M. she was shot through the abdomen twice in rapid succession, as she was falling to

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the floor. Death occurred at 1:59 P. M.

POST MORTEM: One bullet entered between the eighth and ninth ribs and the other between the ninth and tenth ribs on the left side. One of the bullets fractured the ninth rib on the opposite side and lodged in the area of fracture. When extracted it was found to be split in two at the conical end. The other bullet fractured the eighth rib on the right side, and was found in the cellular tissue under the skin opposite the point of fracture. It was set up. Bullet perforated both lungs. In the left lung the amount of hematoma surrounding the channel track was less than that found with the Colt's Automatic Pistol, Caliber 0738. In the right lung it was about the same.

There were five perforations in the intestines, corresponding to the caliber of the bullet; three perforations in the mesentery, one of them twice the size of the bullet; two perforations were noted in the paunch about the size of the bullet. One of the bullets lodged in the neighborhood of the udder, undeformed. The other could not be located. Death due to hemorrhage in lungs causing suffocation.

7th Animal: Bull, about ten years old, weighing approximately 1300 lbs.

Blunt-pointed bullet from Colt's Revolver, Caliber 0745, New Service.

2.15 P. M. Shot through chest from left to right. Animal jumped and appeared startled by report of the revolver. At the end of twenty-five seconds he was standing perfectly quiet

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At 2:16 P. M. was again shot. He again gave evidence of being startled by the report of the revolver. At the end of one minute and twenty-five seconds from first shot the animal was coughing and bleeding from the mouth. At 2:17 P. M. animal was again shot; at this time he was coughing up a great deal of blood. At 2:17:35 P. M. animal was again shot, this time through the abdomen, when he fell to the ground. At 2:17:45 P. M. was again shot through the abdomen. After the second shot through the abdomen the animal got up, walked about and fell again. One minute and ten seconds after last shot the animal was struggling to get upon his feet. Finally orders were issued to kill him in accordance with the method pursued at the slaughter house. Animal was dead at the end of four minutes from the first shot.

POST MORTEM: The bullets going through the chest entered in the skin through the same wound on the left side, one entering the chest between the eighth and ninth ribs and the other fracturing the ninth rib, with more or less fragmentation. On emerging from the chest, one of them struck the eighth rib on the right side, fracturing it with a great deal of shattering, and the other struck the ninth rib, perforating it with little or no shattering. The bullets were recovered under the skin on the right side near the point of emergence from chest, undeformed.

Bullet perforated both lungs. The amount of hematoma surrounding the channel track in the left lung was more extensive than we have seen from any bullet so far, measuring

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3 X 3 inches. In the right lung where the bullet emerged the amount of hematoma is greater still.

There were eleven perforations through the small intestines, some of them a trifle larger than the bullet, but most of them were of the same size. Two perforations were found in the paunch going in, and one of the bullets was found on the opposite side lodged in the muscular wall of the paunch; the other went through the paunch and was lost. The bullet found was not deformed.

8th Animal: Stag, weighing, approximately, 1250 lbs.

Cupped (so-called "Man-stopper") bullet from Colt's Revolver, Caliber 0.455, New Service.

2:40:20 P. M., shot through chest from left to right.

Animal was tied to a post with his head pressed against it. He remained in the same position when hit, only raising his left foot; he coughed but gave no evidence of shock. At 2:41:20 animal was again shot; no shock apparent, head was still butted against the post. At 2:42:30 P. M. animal was shot, this time through the abdomen. He was then between the post and the wall and was standing quietly. He was driven therefrom to put him in position for firing, as before. At 2:43:35 P. M. animal was again shot, through the abdomen; continued standing with head butted up against post. At 2:44:35 P. M. his eyes were clear and he showed no particular manifestation of pain or shock. Orders were then given to kill him with the hammer. Death ensued at 2:50 P. M.

POST MORTEM: The wound of entrance on the left side was

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larger than the caliber of the bullet, the two bullets having struck in the skin at nearly the same spot. The edges of the wound were sharp cut. The two bullets entered the chest between the eighth and ninth ribs, chipping the edge of the former. There was a large wound in the right side between the eighth and ninth ribs opposite the point of emergence of the bullets from the lung tissue. The missiles could not be found.

The point of entrance into the lung is marked by an area of contusion 4 x 3 inches in one instance and 3 x 2-1/2 inches in the other. The channel track surrounding the bullet wounds in the left lung was correspondingly great. The point of exit of the bullet in the right lung had not so much of an area of contusion as was found in the opposite lung nor was the amount of contusion surrounding the channel track so great.

There were nine lacerations in the small intestine, larger in diameter than the caliber of the bullet. The two bullets shot through the abdomen were recovered, one on the floor where the examination took place, and the other in the mesentery. They were uniformly set up. The edges of the cup were turned back, thereby increasing the sectional area of the projectiles.

QUICK FIRING.

6. The object of the following experiments was to fire a sufficient number of shots in rapid succession to cause the animal to fall to the floor. In case the animal did not fall within ten shots, to kill it by knocking it in the head with a hammer. The calibers used were the O'476, O'455, O'45, 9 M/M and 7.65 M/M.

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9th Animal: Cow, weighing, approximately 950 lbs.
Blunt-pointed bullet from Colt's Revolver, Caliber O'45, New Service.

9:46)30 A. M. Animal shot through lungs from left to right; fell to the floor at the sixth shot. Hemorrhage was free from one of the perforations in the right side. The animal was very much excited and kept jumping from side to side until she fell to the floor. Death occurred at 9:49 A. M.

POST MORTEM: The lungs were perforated by six bullets. The bullets were distributed in the lungs away from the main vessels and the amount of contusion surrounding the channel tracks was very extensive. There were five perforations in the right side of the chest, some of the bullets having fractured the ribs and others going into the interspaces. Five perforations were also found in the left side, one of them through the eighth rib. Two of the bullets fractured the above mentioned rib, the others going into the interspaces in the near neighborhood. Four bullets were recovered under the skin; the others were lost. The bullets showed considerable deformation at the point, in two instances forming sharp cutting edges.

10th Animal: Cow, weighing, approximately 950 lbs.

Full jacketed bullet from Luger Pistol 7.65 M/M.

9:57:30 A. M. Animal was shot through the chest from left to right, ten times; the animal did not fall. Owing to a hitch in the working of the pistol, there was an interval of one minute between the third and fourth shots, and a short

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interval between the eighth and ninth shots, due to reloading. The other shots were fired in rapid succession. The animal was more or less excited during the firing. At 10:02 A. M. she was killed with the hammer.

POST MORTEM: There were three perforations in the left lung near the edge of the posterior lobe, showing marked contusion; not near so great, however, as in the previous case. The margin of the posterior lobe on the right side was also perforated. The right lung showed four perforations. Six perforations were found in the chest wall on the left side, and some of these were large, indicating perforation by more than one bullet. There were six perforations in the chest wall on the right side. Seven of the bullets were recovered under the skin on the right side and one was lodged in the eighth rib. Four of them were more or less mushroomed at the point and four only slightly so.

11th Animal: Cow, weighing, approximately, 1100 lbs.

Full jacketed bullet from Luger Pistol 9 M/M.

10:15 A. M. Animal was shot from left to right. There was an interval of one minute between the second and third shots, due to a hitch in the working of the pistol. At 10:18:15 A. M., when the animal had been shot eight times, there was a short interval on account of reloading the magazine. Two shots were fired through the abdomen; at this time the animal was bleeding from the mouth. After twelve shots had been fired the cow was still standing and had to be killed by the hammer. Ten shots were fired through the lungs and two through the

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abdomen in this experiment.

POST MORTEM: There were four perforations in the right lung and seven through the left lung. The perforations in the lungs were principally away from the main vessels. The amount of contusion was well marked around the channel tracks but was not as great as was found in the case of the 0.45 Caliber Colt's Revolver (ninth animal). Two bullets perforated the paunch; the intestines were uninjured. Six bullets were recovered, three practically undeformed, two slightly dented at the points and one slightly mushroomed.

12th Animal: Bull, weighing, approximately, 1100 to 1150 lbs.

Bullet from Colt's Revolver, Caliber 0.476, New Service.

10:35:30 A. M. Animal was shot through the chest from left to right; he struggled a great deal and coughed. The animal seemed to be very much shocked and distressed by the first shot and became more so until the sixth shot, when he fell to the floor. Death occurred at 10:38 A. M. Air issued from the lung through the perforations in the chest wall, made by this large caliber, so that the rhythm of breathing was strikingly observed by the condensed vapor.

POST MORTEM: There were three perforations in the right lung; the amount of contusion or hematoma was the most extensive yet seen. Three of the bullets were recovered, two of them set up and one undeformed.

13th Animal: Bull, weighing, approximately 1150 lbs.

Cupped (so-called "Man-stopper") bullet from Colt's

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Revolver, Caliber 07455, New Service.

11:00:30 A. M. Animal was shot through the chest from left to right and up to the fifth shot the firing was done in rapid succession. Between the fifth and sixth shots there was an interval of one-half minute and an interval of one minute between the eighth and ninth shots. Ten shots were fired through the chest and two through the abdomen. At the tenth shot the animal began to fall and two shots were fired rapidly through the abdomen while animal was falling. He showed perceptible shock at every shot. Death occurred at 11:05 A. M.

POST MORTEM: Seven perforations were found in the left lung and two in the right lung. Three fragments of bone, two of them an inch long, were extracted from the left lung. Three bullets were found in the right lung and one in the left lung, all of them set up. The edge of the cup on two of the bullets was turned back irregularly, showing that in all probability they struck a rib. The amount of contusion surrounding the seven perforations in the left lung was apparently not as great as was found in the animal where the 07476 Caliber had been used and where only three perforations were found, (12th Animal). Two bullets were found in the paunch; these bullets were mushroomed to about .70" caliber. So far, this is the only bullet, with which we have experimented, which shows mushrooming while traversing soft parts only.

S U M M A R Y.

The experiments in cattle demonstrate that shock effects, and destruction of tissue, go hand in hand with sectional areas

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of bullets, rather than with their velocities. This is exemplified in the tests with the small and large calibers, in the series of shots preceding the QUICK FIRING experiments, and it is markedly shown in the latter. In the Quick Firing it will be noted that the animal fell to the ground in each instance when shot with the 07476, 07455 and 0745 lead bullets; and in neither instance when shot with the 9 M/M. and 7.65 M/M. jacketed bullets.

The mushrooming and deformation of the lead bullet doubtless adds to the shock effects, and also to the great contusion of lung tissue noted.

EXPERIMENTS UPON HORSES.

7. The Shooting into horses was done as follows: The animals were shot with the 0745 Caliber Colt's Revolver, carrying the blunt-pointed bullet. The bullet was made to enter the skull about two inches above the eye and the same distance away from the median line on the corresponding side. The barrel of the weapon was placed on a line ranging downwards and backwards, with a view to traversing the base of the brain or the floor of the fourth ventricle, the most vital of the brain centers. In each case the animal dropped to the floor as soon as shot and death was almost instantaneous. The hide having been removed, the carcass was next quartered, and each of the four quarters was fired into for the purpose of noting the effects of pistol and revolver bullets upon the soft and hard bones of the horse.

Examination of the plates, the Skiagrams being still in-

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complete, shows that the joint ends of bone are uniformly perforated by all the bullets tested, with the possible exception of the "man-stopper." It will be seen, in one of the illustrations, that this bullet lies deformed against one of the joints. The bullet traversed a large mass of flesh before it reached the bone, otherwise it would have caused an injury to the bone substance not unlike that seen in man. Injury to the hard substance of bone by all of the projectiles tested is naturally the same as found in the human skeleton.

The effect of the explosive bullet, which was fired into the horse, and the only result recorded with this bullet, cannot fail to interest those who have read the effects of explosive bullets per se. Prior to the revelations of x-ray evidence it was not possible to give a correct picture of a wound that to most military men is purely a myth. The dispersion of the pieces of bullet and bone fragments as exhibited in the plate are not unlike those seen in hard bone injuries from lead or partially jacketed bullets, except that the picture is more suggestive of the effects of a true explosion. So far as known to the Board, this is the first and only attempt to show the effects of an explosive bullet.

S U M M A R Y.

The effects of pistol and revolver bullets on the bones of the horse may be stated to be identical to those on the skeleton of man.

GENERAL SUMMARY.

8. The foregoing evidence from shooting in cadavers,

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living cattle, living and dead horses, shows that any of the bullets tested has, of course, sufficient shock effect upon striking a vital part of a man or horse, and that the stopping power of these bullets when hitting the body structures and non-vital parts, like the soft parts, the lungs, liver, intestines, etc., increases markedly with the caliber rather than with the velocity, within the limits of energy permissible in a military pistol or revolver.

Explosive effects, such as are well known to attend the use of the high velocity projectiles of the military rifle, like the U. S. Magazine Rifle, at proximal ranges, have not been noted in any of these experiments with revolvers or pistols. The explosive effect of the military rifle bullet, when a resistant bone has been hit, shows a great deal of bony sand distributed in all directions, some of it even appearing in the wound of entrance, and the pulpification of the soft parts, amounting to entire destruction of the tissues, extends some distance around the channel made by the bullet. The wound of entrance generally corresponds to the size of the bullet while the wound of exit appears like a bursting forth of the skin. The channel made by the bullet from the point of impact on the bone to the exit wound in the skin is funnel shaped, the apex of the funnel corresponding to the point of fracture of the bone, while the base of the funnel corresponds to the exit wound in the skin. In bony cavities filled with semi-fluid contents, like the brain in the skull, this rifle bullet exhibits explosive effects of a striking character. The top of

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the skull cap in such cases is torn away entirely, leaving nothing but mutilated brain tissue and torn scalp exposed to view. Explosive effects by the military rifle have been minutely described, because some inventors, in advocacy of their pistols, have claimed expanding or spreading effects, in the nature of explosive effects, because of the superior energy of their bullets. The Board found nothing to approach explosive effects with any of the revolvers or pistols used. The interior velocity and energy of the bullets of these hand weapons compared to the velocity and energy of the rifle bullets, is a convincing argument against such a claim.

The Board has also duly considered the claim of some inventors pertaining to the efficacy of the small jacketed over the larger lead bullets when hitting blood vessels. It is said that the former cut the vessels more readily, so that their stopping power is thereby enhanced. The Board considers it doubtful if the claim that they cut vessels more readily is established. It is a well known fact, as observed by military surgeons in recent years, that wounds of blood vessels by the reduced caliber military rifle bullets bleed less, and that the hemorrhage in such wounds is apt to stop spontaneously. The reason adduced is that the channel of the small metal clad bullet leading to and from the cut vessel is so small that a change of the arrangement of the layers of muscles and other soft parts which occurs upon change of position of a limb, for instance, destroys the continuity of the channel communicating with the surface of the body, so that the hemorrhage is arrested

by the unyielding barriers. A spontaneous arrest of hemorrhage as just stated is not apt to take place when the vessel has been hit by a large caliber lead bullet, and past experience shows that when a main vessel has been injured by it, that alarming and fatal hemorrhage occurs through the large channel made by the bullet.

Touching upon the question of shock effects and stopping power, so essential in pistol firing, the Board is of the opinion that soldiers armed with pistols or revolvers should be drilled unremittingly in the accuracy of fire, and that the vital parts of the body, their location and distribution in the organism, should be intelligently explained. Based upon the distribution of the vital parts, and parts of the body which when hit insure sudden stopping of an adversary, the Board hopes, in its complete report, to furnish a target of a shape to include the more essential points to be hit in the body. It is thought that men drilled at such a target could do more effective firing at close range with pistols and revolvers. The Board has been prompted to refer to this point because of the prime importance of decisive shooting at close quarters, and of the large amount of the target area of the human body which offers no hope of stopping an adversary by shock or other immediate results when hit.

FINDING.

9. After mature deliberation, the Board finds that a bullet which will have the shock effect and stopping power at short ranges necessary for a military pistol or revolver

should have a caliber not less than 0.45.

The 0.476 lead bullet undoubtedly has the greatest stopping power, and the Board is particularly impressed with the design, construction and other characteristics of the bullet, (see samples herewith). The weight of the bullet is 288.1 grains, its muzzle velocity 729 f. s. and its muzzle energy 340 ft. lbs., (see Ballistical Table, Page 4). These cartridges are manufactured by Eley Bros. Ltd., London, and are known as the .476 Government, Mark III, Solid brass, central-fire for revolvers."

The caliber 0.45 lead bullet, slightly blunted point, manufactured by the Union Metallic Cartridge Co., is next in stopping power. A slightly blunt point has the advantage of making the bullet "bite" more in striking a hard bone at an angle or in clipping the edge of an artery. This bullet (see sample herewith) weighs 250 grains, has a muzzle velocity of 720 f. s., and a muzzle energy of 288 ft. lbs., (see Ballistical Table, page 4). All things considered, the Board believes that this bullet, possessing the necessary stopping power, is most suitable for service.

With the regular bullet, caliber 0.45, or above, as may be adopted, the Board recommends that, if found practicable, a "cupped" bullet of soft lead, like the so-called "man-stopper" be issued for service of troops in the brush or wooded country. This bullet could be issued in connection with the regular bullet in proportion deemed advisable, according to circumstances. The stopping power of this bullet at close range is

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remarkable. The cupped bullet (see sample herewith), caliber 0.455, weighs 218.5 grains, and has a muzzle velocity of 801 f. s. and a muzzle energy of 288 ft. lbs., (see Ballistical Table, page 4).

None of the full jacketed or metal patched bullets, (all of which were less than caliber 0.45) tried by the Board had the necessary shock effect or stopping power. Their lack of these necessary qualities was principally observed in their less destructive action in the ends of bones and non-vital parts, which comprises a large part of the target area presented by the human or animal body. They make more complete penetrations of these parts than do the large lead bullets mentioned above and escape with a considerable part of their energy, which is lost so far as shock effect is concerned.

In case of an automatic pistol of the caliber recommended, or higher, be adopted for service at any time, thereby necessitating a jacket, the point of the jacket should be made thinner and the lead core softer than in the case of any jacketed bullet tried by or known to the members of the Board. In the metal patched bullet, the nose should be made of the softest lead, permitting ready loading from the magazine into the chamber. The object of this is, of course, to secure "mushrooming" of bullet, with its attendant great shock effect and stopping power.

There being no further business before it, the Board adjourned March 18, 1904.

(Signed) Louis A. La Garde,

(42) Major & Surgeon, U.S.A., President.

(Signed) Jno. T. Thompson,
Captain, Ordnance Department, U.S.A.
Member and Recorder.