excision of the rectum, and removing the coccyx and one side of the lower segment of the sacrum. Such a wound as this, which bears the name of Kraske, who uses it for excision of the rectum, gives thorough access to the lower part of the pelvis, and would give excellent dependent drainage in case of an abscess which was burrowing in that region, and which did not sufficiently discharge itself through the more anterior openings.

PENETRATING PISTOL-SHOT WOUNDS OF THE SKULL.¹

BY E. H. BRADFORD, M.D., AND H. L. SMITH, M.D., BOSTON.

PENETRATING pistol-shot wounds of the skull constitute surgical lesions, which need for their treatment strict rules of procedure, as the cases are exceedingly grave, not very frequent in the experience of many surgeons, and involve great responsibilities. Against surgical interference may be urged the fact that the chances of benefit are very slight; in favor, the general surgical instinct which prompts attempting whatever offers a possibility of success in cases where death seems certain. The number of instances where surgical interference has resulted successfully are comparatively few, and the fact that many cases have recovered without operation suggests that the improvement in these instances may have been due to accidental causes and not surgical intervention. The question, therefore, is a pertinent one, whether from the point of view of recent surgery operative interference offers better chances of recovery than non-intervention.

In drawing conclusions from the recorded facts, it is necessary to distinguish between gun-shot wounds of war and pistol-shot wounds of civil life. For, although there are no statistics to prove the fact, it is reasonable to imagine that injury from a rifle ball will be greater than that from a ball of smaller calibre. The exact mortality from rifle-shot wounds of the skull cannot be determined, as by far the greater number of them in the war died on the field without record. This is also true, to a certain extent, in civil life, as those who are killed instantly are not brought to the hospitals, but cases of instantaneous death from pistol-shot wounds must be rare, and in the majority of cases surgical treatment of some sort is solicited; and for this reason the hospital statistics for pistol-shot wounds may be considered as of accuracy in representing the mortality of this class of wounds. If, therefore, there is a possibility of recovery from gun-shot wounds or penetrating and perforating gun-shot wounds of the skull, as is well established, it is probable that the prospect of such recovery is greater in pistol-shot wounds of the skull.

The most historic case of this class of injury is one which brought such calamity to the nation that the surgical details were overlooked, and are not generally known. The surgical facts may be found in the "Medical History of the War of the Rebellion," Part I, Surgical Volume, page 305, classed among the gun-shot wounds of the skull. They are of surgical interest, and deserve careful perusal. The following is extracted from the report of the case:

A. L., aged fifty-six years, was shot in the head at Washington, on the evening of April 14, 1865, by a large, round ball from a Derringer pistol in the hands

of an assassin. The wounded man was found "in a profoundly comatose condition," the breathing "exceeding stertorous."

Dr. Leale writes: "No pulsation was perceptible at the right wrist. When the head was examined, I passed my fingers over a large, firm clot of blood, situated about one inch below the superior curved line of the occipital bone and an inch and a half to the left of the median line of the same bone. The coagulum I easily removed, and passed the little finger of my left hand through the perfectly smooth opening made by the ball, and found that it had entered the encephalon. As soon as I removed my finger, a slight oozing of blood followed, and his breathing became more regular and less stertorous. After the administration of a small quantity of brandy and water, of which a mouthful appeared to have passed into the stomach, the patient was removed to a neighboring house. The pulse was very feeble and vacillating, from 40 to 48; the respiration was oppressed and labored; the surface was cold. Over the left eyelid there was slight ecchymosis. The pupil of that eye was slightly dilated, the right pupil was contracted; both were irresponsive to light. Sinapisms were applied to the surface. A few drops of brandy and water placed into the fauces were not swallowed, and the attempt to administer internal stimulants was not insisted on. It was observed that when blood and cerebral matter oozed unimpededly from the wound, the condition of the pulse and respiration improved. The Surgeon-General accordingly kept the external wound open by means of a silver probe, until a Nelaton's probe being brought, he made an exploration of the course of the ball. A splinter obstructed the track at the depth of about two and a half inches. An inch and a half further on, the bulb came in contact with a foreign body, which proved to be the disk from the occipital forced out by the ball; passing beyond this, the ball was detected, at a distance of over six inches from the entrance wound. Drs. Stone and Crane, having also distinctly felt the ball at this depth in contact with the bulb of the probe, it was decided that no attempt should be made to remove it or the foreign bodies, further than to keep the opening free from coagula, which, when allowed to form and remain for a very short time, would produce signs of increased compression, the breathing becoming profoundly stertorous and intermittent, and the pulse more feeble and irregular. Notwithstanding the free oozing from the external orifice, there was evidently much internal bleeding going on, as was indicated by the excessive extravasation into the orbits, accompanied by great ecchymosis of the eyelids. The protracted death struggle ceased at twenty minutes past seven o'clock on the morning of April 15, 1865. The eyelids and surrounding parts of the face were greatly ecchymosed, and the eyes somewhat protuberant from effusion of blood into the orbits."

At the autopsy it was found there was a pistol-shot wound of the head, around which the scalp was greatly thickened by hemorrhage into its tissues. The ball entered through the occipital bone about an inch to the left of the median line and just above the left lateral sinus, which it opened. It then penetrated the dura mater, passed through the left posterior lobe of the cerebrum, entered the left lateral ventricle, and lodged in the white matter of the cerebrum just above the anterior portion of the left corpus striatum, where

¹ Read before the American Surgical Association, Washington, September 25, 1891.

TABLE OF NINETY-ONE CASES OF PENETRATING PISTOL-SHOT WOUNDS OF THE BRAIN.

No.	Point of entry.	Operation.	Result.	Time.	Autopsy.	Remarks.	Reporter.	References.
1	Eye.	Probe.	Relieved.	10 days.	None.		Gay.	Boston City Hosp. Rec., lxxxix, 215
2	Temple.	None.	Died.	1 hour.			Fifield.	" " xci, 158
3	Ear.	Incision.	Died.	9 days.	Frag. in dura, ball entered $\frac{1}{2}$ in.	Could have been removed.	Ingalls.	" " xcv, 36
4	Eye.	Probe.	Relieved.	10 days.			Homans.	" " xcvi, 85
5	Ear.	None.	Relieved.	10 days.			Fifield.	" " xcvi, 124
6	Forehead.	None.	Died.	Few hrs.	Bullet f'nd against Occiput.		Ingalls.	" " cv, 20
7	Crown.	None.	Died.	Few hrs.	Bullet went to base of skull.	Large furrow thro' brain. Shock.	Gay.	" " cv, 206
8	Temple.	None.	Died.	Few hrs.	None.		Homans.	" " cxvii, 36
9	Crown.	None.	Died.	Few hrs.	None.	Shock.	Fifield.	" " cxviii, 129
10	Mouth.	Trephine, late.	Relieved.	4 months.				" " cxviii, 116
11	Ear.	Trephine.	Died.	Few hrs.	None.	Nothing found at operation. Shock of injury.	Bolles.	" " cxviii, 241
12	Forehead.	Bone removed.	Died.	9 days.	Bullet in frontal lobe, much fract.		Burrell.	" " cxviii, 46
13	Parietal.	Trephine, nothing found.	Died.	2 days.	None.	Clots were removed	Gay.	" " cxviii, 60
14	Parietal.	Incision opp. side.	Died.	1 day.	None.	Shock.	Bradford.	" " cxviii, 53
15	Nose.	Probe.	Died.	Few hrs.	None.		Post.	" " cxviii, 203
16	Temple.	Probe.	Died.	3 days.	Hæmorrhage in temporal fossa.		Gay.	" " cxix, 144
17	Temple.	Trephine.	Died.	Few hrs.	Made, not recorded		Bradford.	" " cxix, 263
18	Nostril.	None.	Died.	2 hrs.	Meningeal hæm'ge.		Bradford.	" " cxix, 24
19	Parietal.	None.	Died.	1 hr.	Hæmorrhage.		Cheever.	" " cxix, 244
20	Temple.	Incision.	Relieved.	18 days.		Bullet removed fm. inner table. Shock.	Bradford.	" " cxix, 144
21	Forehead.	None.	Died.	2 days.	None recorded.		Bolles.	" " cxix, 80
22	Temple.	Probe.	Died.	94 hrs.	Bullet passed into opp. hemisphere.	Hæmorrhage.	Gay.	" " not given.
23	Temple.	Probe.	Relieved.	6 weeks.			Smith.	London Lancet, 1879, i, 622
24	Temple.	Incision.	Recovered.	5 mos.	Died later (5 mos.) fm. cerebral soft'g. None.	Bullet removed, bone elevated. Passed completely through.	Trosseau.	" " "Aphasia," new Sydenham trans-lation.
25	Temple.	None.	Died.	7 hrs.	Meningitis.		Duncan.	Lancet, London, 1879, i, 863
26	Ear.	Bullet extracted.	Died.	5 days.			Gamgee.	" " 1880, ii, 538
27	Forehead.	Probe.	Recovered.	5 mos.			Barton.	" " 1881, i, 248
28	Temple.	None.	Recovered.	4 wks.			Editorial.	" " 1882, ii, 21
29	Forehead.	None.	Recovered.	4 wks.			Editorial.	" " 1882, ii, 1049
30	Forehead.	Died while taking chloroform.	Died.	2 days.	Bullet an inch from occipital bone.	Hæmorrhage into ventricles.	Emrys-Jones.	" " 1883, i, 11
31	Temple.	Incision and bullet later.	Recovered.	6 wks.			Bloxam.	" " 1886, i, 397
32	Forehead.	Fragments of bone.			Bullet in left clinoid process.	Trephined on 16th day by Mr. Clem-ent Lucas. Not	Bryant.	" " 1886, i, 971

32	Forehead.	Fragments of bone.	Bullet in left clinoid process.	Trephined on 16th day by Mr. Clement Lucas. Not found.	Bryant.	"	1886,	i, 971
33	Temple.	Incision and ball in opp. temple.	6 wks.	Recovered.	Sidney Jones.			
34	Forehead.	Probe.	2 mos.	Recovered.	Colbourne.	Brit. Med. Jour., 1879,	i, 624	
35	Under chin.	None.	7 wks.	Died.	Newington.	"	1881,	i, 593
36	Ear.	Probe.	1 mo.	Recovered.	Parsons.	"	1884,	ii, 759
37	Occiput.	None.	Few days.	Recovered.	Atkinson.	"	1886,	i, 149
38	Forehead.	Wound enlarged.	2½ hrs.	Died.	Atkinson.	"	1886,	i, 149
39	Mouth.	Probe.	6 wks.	Recovered.	Atkinson.	"	1886,	i, 149
40	Mastoid right.	Probe.	16 days.	Died.	Nancrede.	Phila. Med. Times, 1881-2,	xii, 540	
41	Forehead.	Probe.	12 wks.	Died.	Bobo.	"	1881-3,	xii, 171
42	Brow.	None.	8 days.	Died.	Ravogli.	Cincinnati Lancet and Critic, 1882,	ix, 292	
43	Temple.	Probe.	Few wks.	Recovered.	Brush.	"	1883,	x, 148
44	Forehead.	Incision and probe.	Few wks.	Recovered.	Bush.	Boston Med. and Surg. Jour., 1882,	cvi, 27	
45	Eye.		Not stated.	Recovered.	Elliot.	Edinb'h Med. Jour., 1880,	xxvi, 493	
46	Temple.	None.	5 days.	Died.	Richmond.	Lancet, London, 1881,	i, 596	
47	Parietal.	One piece of lead removed.	Not stated.	Recovered.	Hutchinson.	Med. Times and Gaz., 1886,	ii, 696	
48	Parietal.	Probe.	Not stated.	Recovered.	McKenzie.	Gaillard's Med. Jour., 1883,	xxxv, 120	
49	Forehead.	Counter trephining	Several months.	Recovered.	Flührer.	N. Y. Med. Jour., 1885,	xli, 345	
50	Crown.	Ball removed from inner table.	Few wks.	Recovered.	Peterson.	"	1889,	xl, 372
51	Parietal.	Telephone probe.	?	Died.	DeLaunoy.	N. Y. Med. Rec., 1887,	xlvi, 229	
52	Ear.	Probe.	?	Died.	?	Univ. Med. Mag., 1888,	i, 562	
53	Parietal.	Trephine late, abscess burst.	Several weeks.	Recovered.	Morton.	Phila. Polyclinic, 1883,	i, 22	
54	Temple.	Trephine.	Few wks.	Recovered.	Nancrede.	Phila. Med. News, 1888,	liii, 585	
55	Temple.	Ball and fragments by incision.	Few wks.	Recovered.				
56	Parietal.	Probe and frag.	3 wks.	Recovered.	Butterfield.	M. I. Med. Rec., 1885,	xxviii, 204	
57	Temple.	None.	Died, 5 wks.	Died.	Markoe.	M. Rec., 1889,	xviii, 164	
58	Parietal.	Operation 15th day, frag. bull. and ball.	6 wks.	Recovered.	Fredericks.	N. Y. Med. Rec., 1881,	xx, 488	
59	Ear.	Incision.	10½ wks.	Died.	Whittier.	B. M. and S. Jour., 1886,	cxiv, 170	
60	Occipital.		?	Died.	Thompson.	Brit. Med. Jour., 1884,	i, 767	
61	Forehead.	Frag. and ball.	?	Died.	Lucas.	Tr. Lanc. Soc., Lon.,	xii, 59	

it was found. The wound in the occipital bone was quite smooth, circular in shape, with bevelled edges, the opening through the internal table being larger than that through the external table. The track of the ball was full of clotted blood and contained several little fragments of bone, with a small piece of the ball near its external orifice. The brain around the track was pulsatous and livid from capillary hæmorrhage into its substance. The ventricles of the brain were full of clotted blood. A thick clot beneath the dura mater coated the right cerebral lobe. There was a smaller clot under the dura mater of the left side. But little blood was found at the base of the brain. Both the orbital plates of the frontal bone were fractured, and the fragments pushed up towards the brain. The dura mater over these fractures were uninjured. The orbits were gorged with blood.

There is certainly no possible criticism of the treatment in this noted case; but, as a matter of scientific investigation, it may be queried whether, if the shock in this instance had not been so profound, active surgical intervention for the removal of the fragment would have been advisable or not, and, if not, what advantage was gained by the use of a probe?

In a large number of instances the surgeon has to meet such cases where the patients are not moribund, and may well consider the following questions: Whether active interference, involving the use of the trephine, is demanded as a rule in severe cases of this class; whether the removal of the bullet or of fragments should be attempted in penetrating wounds of the skull; whether to probe without the use of the trephine is advisable?

In order to add to the statistics on the subject, the accompanying table has been prepared by Dr. Herbert Smith, of Boston:

An analysis of these cases is worthy of attention. Ninety-one cases of penetrating pistol-shot wounds of the brain have been collected. Of these, 22 were found in the records of the Boston City Hospital, all the cases that entered during the last twelve years being taken according to date of entry. The remaining 69 cases were found recorded in current literature, most of them within the last fifteen years.² None of the cases antedated the period during which modern antiseptic treatment, in some form or other, has been employed, and no case has been included unless the bullet had penetrated the skull, or at least rested on the dura mater. As was to be expected, the percentage of recoveries in the hospital cases has been considerably smaller than in those extracted from the journals, since it may be presumed that the majority of the latter class had some special features, oftentimes an unexpected recovery, which seemed to warrant their being put on record.

Of the 22 City Hospital cases, five recovered, and 17 died, a percentage of recoveries of 22.7; of the whole 91 cases, 40 recovered and 51 died, a recovery percentage of 43.9. It is probable, therefore, that the ratios given in the following computations will in each case seem to show a better result than would be true of the whole number of such injuries, were it possible to collect them. The present investigation, however, is made for the purpose of obtaining *principles* for guidance in treatment; and the relative results of the various modes of procedure in the cases here recorded will hardly be affected by the absence of unreported

cases. Moreover, the loss will probably be in those cases which die within a few hours, from shock, and since it is in this class that little or no operative interference is ever possible, as a working basis for treatment the results in the cases here given can hardly be fallacious.

In classifying the injuries in relation to the part of the brain penetrated, it was found impossible, from the descriptions given, to make anything like a complete table of the portions of the brain traversed by the ball. The cases were therefore grouped according to the point of entry into the skull, thus giving the following table:

	Recov'd.	Died.
Under chin	0	1
Mouth	2	0
Nose	0	2
Orbit	4	2
Eye-brow	2	4
Forehead	8	5
Temple	9	16
Auditory meatus	0	5
About ear	7	7
Crown of head	1	2
Parietal	6	0
Occipital	1	2
Not stated	0	1
Total	40	51
Hospital cases	5	17

This may be summarized to show that, when the ball enters the skull at some point anterior to the plane passing through the external auditory meatus, 25 have recovered and 34 died, out of 59 cases, a percentage of recoveries of 42.3. In 32 cases where the bullet entered in this vertical plane, or posterior to it, 15 recovered and 17 died, the percentage then being 40.6. If we except the five cases in which the ball entered directly into the auditory meatus, of which all died, the recoveries are 53.5% of the whole number. If we assume that those missiles which entered the anterior half of the skull injured the anterior portions of the brain, then these statistics will not bear out entirely the idea generally held, that lesions of the anterior lobes of the brain are less fatal than those of the posterior portions. Perhaps the greater fatality in these cases may be accounted for by the fact that in the majority the wounds were inflicted for suicidal purposes, the pistol being held close to the skull, where the bone is thinnest, and that therefore the direct injury to the brain is greater in the first series of cases than in the second. Again, most suicidal attempts are done in seclusion, and there is a considerable interval of delay before treatment is applied, so that the danger from shock is far greater, proportionally, than in gun-shot wounds received in battle, for example, since there all classes of wounds would be subject to a proportionate delay. This may explain the difference between the statistics of civil and military surgery. It is to be noted that next to the auditory meatus the most dangerous point of entry was in the temple, where, out of 25 cases 16, or 48%, were fatal.

Another series of tables (see page 402) illustrates the fatality of those cases where the bullet remained in the cranial cavity, as compared with that of the instances where the bullet perforated or was removed.

From these tables it will be seen that the mortality in the latter class is but 33.3%, while in the former it is 54%. Out of the five cases where the bullet perforated by its own momentum there were two deaths, while in six cases where the bullet was extracted by the trephine there were no deaths; and in

² The table contains no cases later than 1890.

five other cases, where the bullet had passed through the bone, but had not perforated the soft parts beyond, requiring an incision before it was dislodged, there were three deaths. These results are what would be expected, since, generally speaking, those bullets are removed by means of the trephine which have passed but a little way into the brain, the damage to the cerebral substance being slight, and the ease and thoroughness of drainage far greater. Though the numbers are too few to warrant conclusions as to operating, yet it is very significant that 100% of the cases of removal of the bullet by the trephine were successful, while 50% of those where the bullet passed completely through the brain proved fatal. We may yet, perhaps, come to believe that the damage which the careful surgeon will do in attempts to extract a ball which has penetrated the cerebral tissues will not be greater than the injury already done by the missile. If such should prove to be the truth, very decided views may properly be taken as to the advisability of thorough search for the ball in every instance.

BULLETS LODGED.

	Recov'd.	Died.
Chin	0	1
Mouth	2	0
Nose	0	2
Orbit	4	0
Brow	3	3
Forehead	10	7
Temple	5	14
Meatus	0	5
About ear	6	4
Parietal	3	0
Crown	0	2
Occipital	1	2
Total	34	40

BULLETS OUT.

	Recov'd.	Died.
Perforated	3	2
By trephine	6	0
Incision	2	3
Total	10	5

Analyzing the cases where the ball remained in the cavity of the skull with reference to the point of entry, we find that 51, or 69% penetrated at a point anterior to the vertical plane passing the auditory meati, and of these 47% recovered, while 23, or 31% entered posterior to the same plane, in whom 10, or 43% recovered.

The following table was compiled for the purpose of showing the results of the various forms of treatment. Many of the records were incomplete in this respect, and it is probable that many more of the cases were at least probed than the table shows, though the records of trephining are probably quite correct, as so formal an operation would hardly be omitted in the account.

	Recov'd.	Died.
Trephined, ball removed	5	1
Trephined, fragments removed	1	2
Trephined, ball not removed	1	3
Fragments removed	3	5
Incision	2	1
Incision, ball removed	5	4
Probed	12	13
Nothing recorded	8	21
Trephined secondarily	3	0
Died under operation	0	1
Total	40	51

SUMMARY.

Ball removed	10	5
Operation, ball not removed	10	12
Probed only	12	13
Nothing recorded	8	21
	40	51

It would seem to show that operative interference, whether resulting in successful extraction of the missile or not, is not in itself so serious as some writers have supposed. Five out of six cases where the bullet was removed by the trephine, recovered. Out of 15 cases where the bullet was removed by various operations 10, or 66% recovered. In 37 instances of operative interference 20, or 54% recovered. Of 25 cases where the expectant plan was followed, except that the probe was passed, only 12, or 48% recovered, while in the remaining 29 cases, in which no record is made on the point under discussion, only eight, or 27.5% got well. To be classed among the latter cases, however, were those who were moribund when first seen, and where no treatment would have availed.

Turning to those cases where the bullet remained in the brain substance, the following table shows the mortality after various forms of treatment:

	Recov'd.	Died.
Trephined	6	2
Fragments removed	3	8
Probed	12	10
Nothing recorded	13	20
Total	34	40

Here again the operation of trephining has shown better results than simple expectancy. Six cases out of eight that were trephined, that is, 75%, recovered. Of 11 cases where fragments were removed all but three died, while in the 55 cases that were either probed, or in which no mention is made of treatment, there were 25 recoveries and 30 deaths, showing that, taking all the cases into consideration, the results with operation, and without operation, where the bullet remains lodged in the brain, are not markedly different.

Of very considerable interest is the large proportion of cases, 34 out of 91, or 37.4%, who lived for a longer or shorter time, carrying about with them a bullet in the brain. The following table was made to show what proportion of these cases suffered afterward with symptoms referable to the bullet:

LATER SYMPTOMS OF BULLET IN BRAIN.

	Recov'd.	Died.
Dizziness	1	0
Epilepsy	2	2
Pain	1	0
Dull and weak	3	0
Meningitis	0	3
Softening from fragments	0	4
Total	7	9

It is to be noted that many of these cases, that is, where bullets had lodged, were regarded as well within a few months after the injury, because up to that time no symptoms had supervened, so that the proportion of 16 out of 34 cannot properly represent the likelihood of after symptoms in these cases. In fact, in every case where the patient has been followed for several years after the accident there were noted more or less intense cerebral symptoms, and probably if the ultimate history of all these cases could be known, many more than the table shows would be found to have died from the injury done by the foreign body.

Of the 16 cases which were noted as having later symptoms, nine, or 56.2% died. If from the 34 cases of recovery with bullets in the skull we subtract the 16 who afterward had symptoms, there remain but 18, or 27% of the whole number injured who recovered without recorded symptoms.

The relatively large number of patients who are reported as having died later on from injury done by

fragments of bone imbedded in the brain, naturally raised the query as to how often such fragments were found and removed at operations, or were discovered later at the autopsy.

Out of 30 cases where record is made, in 15, or 50%, it is recorded that fragments of bone were found in the brain substance. In 10 cases the final unfavorable issue seems to be wholly or in part due to the presence of these spiculas of bone. In some of these cases the bits of bone were small and were in close apposition to the projectile when found; but in several instances there were large irregular fragments, splintered from the inner table, which had been carried a greater or less distance and various directions into the cerebral substance. This fact emphasizes the view that in all gun-shot wounds of the brain the problem is not a simple one of a single projectile of known size, but it must be remembered that there may be multiple projectiles, of jagged outlines, driven in various directions, causing laceration and pressure. In this connection, also, may be mentioned the fact that other foreign bodies, such as hair, bits of clothing, etc., may be carried in as well: under such circumstances it is hardly to be hoped that the wound is in an aseptic condition.

Cause of Death.—In not all of the 51 cases could the absolute cause be obtained. The following is approximately correct, and will serve as a working basis:

Shock	15	29.4%
Meningitis	9	17.6
Exhaustion	8	15.6
Abscess	8	15.6
Hæmorrhage	8	15.6
Edema of lung	1	1.9
Septicæmia	2	3.9

Roughly speaking, 30% died within a few hours from shock; 18% died from meningitis; 16% from hæmorrhage; 16% later from cerebral softening or breaking down of bruised tissue; while the remaining 20% sank and died from the constitutional effects or from exhaustion. Of these causes of death the most frequent, namely, shock, can be but imperfectly controlled. The other classes are more under the control of surgery, and it is in these directions that we must look for future advances in this branch of cerebral surgery. The prevention of hæmorrhage by early operation, and of meningitis, abscess and death from exhaustion by the timely removal of foreign bodies and septic material will do much to better our present statistics.

With a view of determining the cause of death after the various methods of treatment, the following table was prepared:

	Shock.	Hæmorrhage.	Abscess.	Exhaustion.	Meningitis.	Septicæmia.	Edema of lung.	Total.
Trephine and ball,	0	0	0	0	0	0	0	0
Incision and ball,	1	0	1	0	0	0	0	2
Incision late,	0	0	1	0	1	0	0	2
Probe,	1	3	5	2	2	0	0	13
Operation, no ball,	2	3	8	3	1	0	1	18
Nothing recorded,	8	7	1	2	5	1	0	24
	12	13	16	7	9	1	1	59*

* This table includes cases who died later, after apparent recovery.

It will be seen that hæmorrhage caused death in ten cases where no operation was performed, and in but three cases where an attempt was made to extract the bullet. The deaths from meningitis give a similar showing, seven cases resulting fatally when no operation was performed, and but two when a preliminary operation was attempted. On the other hand cases of cerebral softening were met with eight times after operation when the missile was not extracted, but five times after probing, and but once when no operation was performed. This is perhaps explained by the fact that these cases were the protracted ones, giving time for late consideration and operative attempt.

The following table shows roughly the duration of life after injury in the various parts of the skull:

Duration of Life after Injury.	Face.	Forehead.	Temple.	Parietal.	Crown.	Occiput.	Total.
Few hours,	1	4	8	3	2	1	19
Few days,	0	7	6	7	0	0	20
Weeks,	1	5	2	3	0	0	11
Years,	0	4	0	0	0	0	4
Not given,	0	0	0	1	0	1	2
	2	20	16	14	2	2	56

It is to be noted that in the case of wounds in the temporal region, on the crown of the head and on the occiput, the larger number died of shock. The secondary results, namely, meningitis, cerebral abscess and exhaustion from constant suppuration, are most often found when the injury has been in the forehead or about the ear.

From a study of the preceding cases the following statements have been formulated:

Penetrating gun-shot injuries of the head differ from penetrating wounds of the other cavities of the body in that it is known that the foreign body has done damage to the contents of the cavity.

The consideration of these cases is not a simple problem of the localization of a single body, because not only may the projectile be split up into a number of fragments, but there are very likely to be larger or smaller fragments of bone carried in with it.

The bullet which plows its way through the soft cerebral substance always makes a track much larger than itself, necessarily bruising the surrounding brain substance a great deal. If this broken-down tissue becomes septic, the injury needs an unusually free opening for drainage, owing to the density of the surrounding wall, and the comparative softness of the contents.

If fragments of bone are not carried into the brain tissue, and if the disorganized brain substance does not become infected, and if cicatrization or encapsulation of the bullet does take place, it is to be considered a piece of good fortune, and not due to efficacy of treatment.

Even if the bullet lodges safely in the brain, and recovery appears to have taken place, a goodly number of these patients may be expected to have more or less disabling symptoms afterward, and a considerable proportion of them succumb ultimately to the missile which they carry.

A certain number of cases must necessarily die of primary shock. Many die of hæmorrhage, but hæmorrhage is best treated when its source can be reached.

Operations for the removal of projectiles, as far as can be determined by statistics, do not seem in themselves to be especially dangerous. It is likely that the injury already done to the cerebral tissues will not be added to by the manipulations of any competent surgeon, even if he be very thorough in his search for the missile; and this is particularly true from the fact that the surgeon has still a fear of manipulating inside the cranial cavity, and violence is rarely used.

The Nelaton probe, or one of similar construction should be dropped into the canal. The telephone probe has occasionally located the ball, but has many times failed. If a hard substance is felt the latter probe will determine whether or not it is metal.

In pistol-shot wounds of the skull the dangers are not the same as in similar wounds in the abdominal cavity. In the latter there is danger of immediate death from hæmorrhage, and also from the injury caused by facial extravasation. In the cranial cavity the chief cause of death is the irremedial one, shock; and although septic inflammation is of almost equal importance, there is certainly nothing comparable to the danger from facial extravasation that is to be dreaded in abdominal wounds. Furthermore, the danger of death from hæmorrhage is not an imminent one, as, owing to the nature of the contents of the cranial cavity, and also to the unyielding character of its walls, hæmorrhage is held within the fatal limit by the resistance of skull. There is, however, a danger, which is peculiar to the cranial cavity; namely, that the increasing pressure of the hæmorrhage taking place within the unyielding walls of the skull, may increase the shock, cause death or degeneration of nerve substances, with the resulting impairment of mental condition. Under these circumstances it may be said that a delay of a few hours is not of as great injury in cases of injury to the skull as of injuries to the abdominal cavities; but that treatment should be undertaken without unusual loss of time, yet its urgency is not as paramount as in cases of the abdominal injuries.

On referring to the table it will be seen that of 51 cases, 15 deaths occurred from shock; while in 19 cases death followed some suppurative process; and in eight there was death from hæmorrhage. Death from hæmorrhage can be prevented, if the diagnosis is certain, and time is given, by ligature of the carotid or of the meningeal arteries in a small number of cases. In the majority of cases, however, this operative treatment will be of little avail. It is, however, fair to suppose, that in the suppurative cases, a certain number can be saved by thorough aseptic and antiseptic irrigation, and careful surgical treatment in the way of promotion of asepsis and of drainage.

The following generalization seems justified:

It should be considered as a surgical rule, where the patient was not moribund, that the scalp should be dissected up, the wound thoroughly exposed; as a rule, the trephine should be applied. This will provide for thorough examination, and for drainage, as well as for a thorough exploration of the injury of the inside of the cranial cavity, and for the removal of splinters.

The treatment of the dura will require the exercise of some judgment. The wound of the dura is usually smaller than the calibre of the bullet. This wound

occasionally becomes clogged with clotted blood, and the proper egress of fluid is not granted. There may be an accumulation of blood behind it and of clot, which will prevent proper drainage, and cause abnormal pressure upon the cerebral substance. If this is the case, or if there is probability of this being the case, the wound in the dura should be enlarged to allow the escape of clot.

The use of the probe without a free dissection of the scalp is not likely to give much information of value. The introduction of a Nelaton probe carefully, after trephining into the pistol-shot wound of the cerebellar substance, is not attended with danger; a soft catheter can also be employed. Irrigation, by a gentle current of aseptic fluid, is also non-injurious, and may be of advantage in cleansing a cavity. The introduction of a large instrument or of the fingers will depend upon the size of the wound. The danger of such introduction, if done with skill, is not great; but the possibility of successfully removing the bullet hid in the cerebral substance is slight. It is desirable to localize the bullet as far as possible, but the means for doing so successfully are as yet imperfect.

Where the bullet can be traced directly to the opposite side of the skull, the counter-trephining should be done at that point; not necessarily with the expectation of finding the missile, since the angle of rebound is very variable and cannot be calculated, but in order to give better drainage, and to determine the presence of a fracture on the opposite side of the skull. The introduction of drainage-tubes into disorganized cerebral substance is perfectly justifiable, and has been used to advantage; in fact, there are cases where tubes have been passed completely through with excellent results.

In short, it may be said that the treatment of pistol-shot wounds of the skull should be conducted on the same principles as the treatment of perforating fractures of the skull by a sharp instrument. That is, the wound should be thoroughly explored and thoroughly cleaned; all loose fragments should be removed, including the bullet, if readily accessible. Drainage and strict asepsis are essential.

Clinical Department.

GYNECOLOGICAL CASES AT THE ST. ELIZABETH'S HOSPITAL.

SERVICE OF F. W. JOHNSON, M.D.

REPORTED BY DR. E. H. ROSS, *House-Officer.*

(Continued from No. 15, page 373.)

ELEVEN ALEXANDER-ADAMS OPERATIONS.

CASE I. Dilatation of the cervix.

N. W., single, twenty-three years of age, entered the Out-patient Department July 15, 1890, with the following history. Pain in the left ovarian region, running down the left thigh. Backache for one year. Slight leucorrhœa. Micturition at times painful. Bearing and dragging down feeling on standing. Menstruation began at fifteen; unwell every two months; flows two weeks; confined to bed first day.

Entered the hospital September 30th. Dr. Kingman used the packing faithfully to overcome the retroflexion until December 1st, when the same treatment