STATED MEETING, MAY 3, 1915

The President, Dr. John Gibbon, in the Chair

RESULT OF LATE NEURORRHAPHY

Dr. Edward B. Hodge presented a girl who had been in the Widener Memorial School, under treatment for tuberculosis in the left knee-joint. During her stay in the School she fell from a small express wagon and sustained a bad compound supracondylar fracture of the right humerus. A good result was obtained with the arm in Jones' position. During the treatment it was found that she had complete wrist drop. There was complete paralysis of the musculospiral nerve. This was treated expectantly and three months later Dr. Willard cut down upon the nerve, finding it contused but apparently not severed. No improvement in function followed. In January, 1914, 5 years after injury, the speaker cut down upon the nerve, traced it down and found that it had been completely sheared through, the proximal portion continuing past the elbow as a fibrous cord. The distal portion of the nerve was buried under muscle and adherent to the humerus below the fracture. After reaching into normal nerve tissue, the ends were united with 2 silk sutures with the elbow in acute flexion to relieve tension. Later a cast was applied with the wrist hyperextended and still later massage and passive motion employed. At the end of ten months some improvement was shown, and now at the end of a year and a half there is pretty fair power. She has nearly complete power in extension of the wrist, good supination, and everything but complete extension of the fingers. The case was reported to encourage late attempts at neurorrhaphy. At the time of operation, there was partial reaction of degeneration in the muscles involved.

OLD POSTERIOR DISLOCATION OF SHOULDER

Dr. Hodge presented a young woman who had been the subject of a posterior dislocation of the shoulder of unusual etiology, which had become replaced in an unusual manner. The shoulder was luxated either from receiving a blow with a broom in sweeping, or in the motion of putting the hand to the head to do up her hair. This was followed by complete disability, swelling and pain. Dr. Hodge saw the patient at the end of five or six weeks. The arm was swollen and

painful and there was almost complete disability. Below the acromion there was a considerable gap, the elbow was against the chest and forward, the head could not be felt in the axilla. A series of skiagraphs demonstrated a posterior dislocation below the acromion. An effort to obtain reduction under ether was about to be made, when during the anæsthetization the nurse who was holding the patient's hand left it for a moment to attend to a detail of the service and the arm dropped off the edge of the table. When Dr. Hodge grasped the arm to manipulate, he found the head already in the glenoid. Dr. Wharton was in the next room at the time and he confirmed the reduction. The patient has had complete comfort since though she has greatly limited function.

END RESULTS IN FRACTURES OF BOTH BONES OF THE LEG*

By Rutherford L. John, M.D.
of Philadelphia, Pa.

In presuming to bring forward the subject of fractures of both bones of the leg, this paper has no intention of discussing the question of treatment. It will limit itself to a statement of the end results in a series of 40 cases, that being the number I was able to follow up of 288 cases treated in the Episcopal Hospital between the years 1905 and 1915.

Of the forty cases followed, 6 were compound and 34 not compound fractures, *i.e.*, they were either simple or comminuted.

Group I classes cases as to age, sex, and leg involved, as follows:

Years	No. cases	Male	Female	Right	Left
0–14	7	6	1	3	3
15–44	22	13	9	13	8
45–59	9	7	2	5	4
60–	2	0	2	2	0
	—	—	—	Two cases unnoted	
Total	40	26	14	23	15

As can be seen from the table, by far the greater number of cases occurred between the ages of 15 and 44 years, 22 out of 40, or 55 per cent. Males were involved in 65 per cent., and 57.5 per cent. of the fractures occurred in the right leg.

Group II gives us one of the most interesting classifications of the series. Here I have endeavored to show the effect of the anatomical result on the period of disability. The period of disability has been taken to mean the number of weeks the patient was kept from his work. The measurements were made from the lower border of the patella to the internal malleolus.

Group II a. (All Cases)

Anatomical result	Amt. of shortening	No. cases	Aver. period disability
Good	0–0.99 cm.	17	14.8
Moderate	1.0–1.99 cm.	16	21.7
Bad	2.0– cm.	6	45.3

The above group includes all cases. The following table gives the same data for cases not compound:

*Read by invitation before the Philadelphia Academy of Surgery, May 3, 1915.

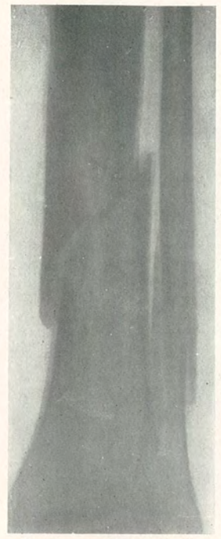

Fig. 1.—Comminuted fracture of tibia and fibula before treatment by Steinmann nail traction. See Fig. 2.

Fig. 2.—Comminuted fracture of tibia and fibula treated by Steinmann nail traction (sixteen pounds). Five months after injury; no shortening.

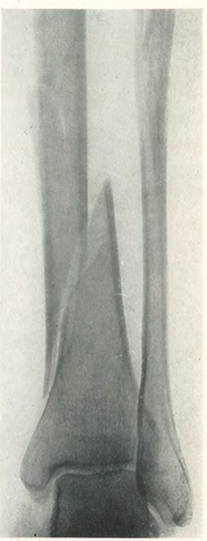

Fig. 3.—Comminuted fracture of tibia and fibula before treatment by Steinmann nail traction. See Fig. 4.

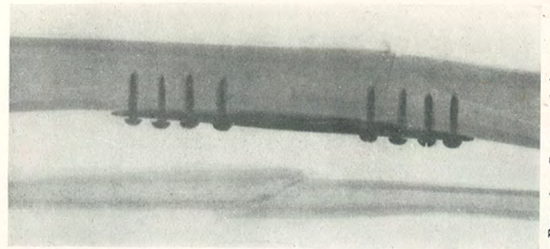

FIG. 6.—Compound fracture of tibia and fibula. Tibia plated eighteen days after injury; shortening 1 cm.

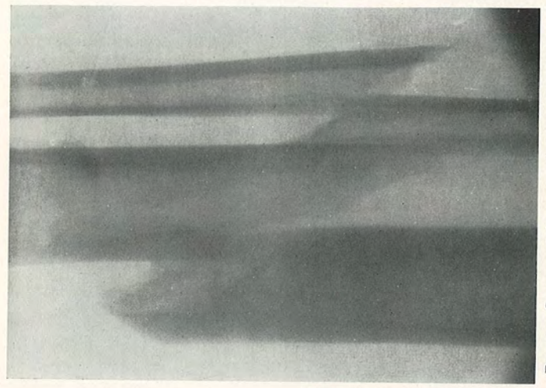

FIG. 5.—Compound fracture of tibia and fibula after Steinmann nail traction for twelve days (twenty-two pounds). See Fig. 6.

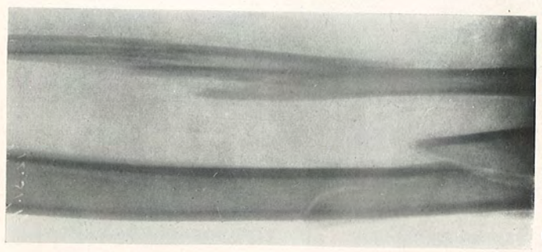

FIG. 4.—Comminuted fracture of tibia and fibula treated by Steinmann nail traction. Twenty days after injury; no shortening.

GROUP II B. (CASES NOT COMPOUND)

Anatomical result	Amt. of shortening	No. cases	Aver. period disability
Good	0–0.99 cm.	15	14.5
Moderate	1.0–1.99 cm.	14	20.1
Bad	2.0– cm.	4	42.0

While in the above tables, a shortening of from 1.0 to 1.99 cm. is classed as a moderate *anatomical* result, yet in practically all of these cases there was a very good *functional* result, the patients being able to do their former work without any loss of endurance or knowledge of the shortening of one leg.

Of all of the cases followed, there had been no open operative treatment in any of the simple or comminuted fractures. Two cases of comminuted fractures (X-ray photographs, Figs. 1, 2, 3 and 4) were treated by the Steinmann nail traction. Both of these cases healed with no shortening. The average period of disability for these two cases was 12.5 weeks, as compared with the average period of 15 weeks for the other 15 cases in the same group. Both cases were badly comminuted and, aside from the more rapid recovery and the perfect anatomical result, the Steinmann nail traction allowed these patients, while under constant traction, to move about a bit in bed, a fact which gave them considerable comfort and of which they speak with gratitude. That traction by means of the Steinmann nail is not always so satisfactory can be realized from a glance at Fig. 5. This case of compound fracture of both bones had a Steinmann nail driven through the os calcis on the sixth day after injury and twenty-two pounds of weight applied for twelve days, with no apparent reduction of the deformity. The bones were then exposed and the tibia plated, with an ultimately good anatomical and functional result (see Fig. 6).

The six compound cases of the series are grouped in the following table to show age periods and operative treatment:

GROUP III

Years	No cases	No. oper.	Immed. oper.	Delayed oper. (after 10 days)
0–14	2	1	1	
15–44	4			4
45–59	0			
60–	0			

Group IV shows the compound cases grouped as to amount of shortening and average period of disability:

GROUP IV

Amt. of shortening	No. cases	Aver. period of disability
0–0.99 cm.	2	16
1.0–1.99 cm.	2	24
2.0– cm.	2	52

The following table gives the average period of disability in weeks for each region of bone considered, according to age periods.

GROUP V

AVERAGE PERIOD OF DISABILITY

Years	Upper ⅓		Middle ⅓		Lower ⅓	
0–14	11.5	(2)	15	(2)	15	(3)
15–44	0		16	(2)	23+	(19)
45–59	0		86	(2)	21.4	(8)
60–	0		0		9	(2)

The figures in parentheses represent the number of cases in each region. While Pott's fractures are not included in the series, it will be noted that the great majority of cases occurred in the lower third of the leg.

The conclusions to be drawn from these tables point to neither a strictly conservative nor a radical operative treatment as giving the best ultimate results. As so often stated, the majority of fractures occurred in males, between 15 and 40 years of age.

1. The right leg was affected in 57.5 per cent. of cases.
2. The average period of disability is directly dependent upon the anatomical result.
3. A moderate anatomical result may mean a perfect functional result.
4. Traction by means of the Steinmann nail would seem to be a hopeful compromise between a conservative and an operative treatment of obstinate cases.
5. The lower third of the bone is the most often involved but this fact has no apparent relation to age or period of disability.
6. The average time for reduction was on the day of injury except in four cases of compound fractures.

DR. GEORGE C. ROSS, in connection with extension by the Steinmann nail, asked whether any of the Fellows had used a method for extension in this type of fracture when the fracture is so close to the ankle that the limb cannot be put in a box. The device consists of an old shoe with the heel and toe cut out. To this a piece of heavy cord is attached bearing 20 to 25 pounds weight. The shoe is laced around

the man's ankle. This makes satisfactory extension and if persisted in gives very good results.

DR. JOHN, in closing, said that the measurements were made from the lower border of the patella to the internal malleolus in all the cases. The old shoe method suggested by Dr. Ross is valuable in quite a number of cases except where there is much œdema of the foot, under which condition there is considerable danger of sloughing. In the presence of possible sloughing a heavy felt placed over the instep before the shoe is laced up is of advantage. The Steinmann nail, however, obviates this danger (of sloughing) and causes no pain to the patient while it is in use.

FRACTURES OF THE FEMUR

WITH END RESULTS IN 62 CASES

By Carl R. Steinke, M.D.

of Philadelphia

Instructor in Surgery, University of Pennsylvania School of Medicine

The poor functional and anatomical results in fractures of the long bones of the extremities led the American Surgical Association and the British Medical Association to investigate the causes for such results. A waning interest in fractures has been renewed, and with the form-blanks covering all the important facts to be obtained concerning fractures, more uniform, complete and exact data are being gathered.

Much has been written concerning fractures of all bones but the femur presents some of the greatest difficulties to be encountered, while its anatomical and physiological importance accentuates the necessity for a good result.

In considering fractures of the femur it is well to take them up in different groups according to the portion of the bone fractured, such as those of the upper end (neck and through the trochanters), the shaft and the lower end. The varieties, manner of production and treatment of fractures have been so thoroughly dealt with in the special fracture number of the *American Journal of Surgery* for March, 1915, by such authorities as A. Lane, W. L. Estes, A. P. C. Ashhurst, F. H. Albee, J. B. Walker and others, that they will not be considered in this paper except as they concern reported cases.

With the more general use of the Röntgen rays we are enabled to see the exact position of the fragments before and after treatment, so we can follow cases to observe how kind nature is in producing generous callus to cover our defective reductions, with resultant solid union (Figs. 1, 2, 3, 4, 5, 6 and 7). The anatomical relation of the fragments may be bad and still give a good functional result (Table IV).

The basis of this article consists of the fractured femurs from Dr. Charles H. Frazier's service at the Episcopal Hospital during the 10 years from 1905 to 1915, and I am indebted to him for the privilege of reporting the cases.

Of the 109 cases on record we were able to follow 62 (57 per cent.), 15 fractured through the neck, 6 through the trochanters, 36 of the shaft, and 5 of the lower end. A number of the cases have been previously reported more in detail before this Academy and elsewhere

* Read before the Philadelphia Academy of Surgery, May 3, 1915.

by Dr. A. P. C. Ashhurst.[1] Of the 47 fractures not followed there were 4 each through the trochanters and of the lower end, 15 of the neck and 24 of the shaft; the condition of the patients at the time of discharge was as follows: 10 cured, 24 recovered, 10 improved, 1 at own request, and 2 refused treatment.

Considering the fractures of the neck there were 10 females and 5 males, with ages ranging from 14 to 84 years (average 64½). All were simple fractures produced by indirect violence. The time in the hospital ranged from 2 to 29½ weeks (average 6⅔), while the average time from work of those who survived was 22½ weeks. Of the 8 cases dying in the hospital (5 intracapsular) 6 were females and 2 males, with ages ranging from 65 to 84 years (average 74½). The cause of death was given as 1 each from uræmia, senility and carcinoma of the stomach (autopsy confirmation), 2 from pneumonia, while in 3 it was not stated. A peculiar fact is noted in that 6 of these occurred during the services of 1905 and 1906, but no definite explanation for this was found. The functional and anatomical results are given in Table I.

There were 6 cases of simple fracture through the trochanters (Table II), all being of the male sex and treated non-operatively. Three were caused by direct and 3 by indirect violence. The number of weeks in the hospital averaged 7 with extremes from 4 to 10, while the time from work averaged 34 weeks, varying from 12 to 93. The earning power was less in 4 cases, each having a moderate anatomical result with moderate to bad functional result, while the 2 with the same earning capacity had both good anatomical and functional results.

Of the 5 cases where fracture occurred at the lower end of the femur, again they were all of the simple type produced by direct violence, all males with ages ranging from 6 to 61 years (average 34). One case with bad position of the fragments was plated with resultant good apposition but only moderate return of function. Here the time in the hospital varied from 2 to 11 weeks (average 5½), the patient going out in 2 weeks had the limb in a plaster cast returning later for the removal of the cast. The earning capacity in these cases was the same in 2 and less in 2; the fifth developed delirium tremens and died after 3 weeks. Functional and anatomical results are shown in Table III.

Over half the cases followed were fractures of the shaft, 33 males and 3 females with ages from 3 to 74 years (average 23 1/3). Five of the cases were plated because of the inability to obtain proper re-

[1] Ashhurst, A. P. C.: Fractures Through the Trochanters of the Femur. Annals of Surgery, Philadelphia, 1913, October, p. 495; also, The Prevention and Treatment of the Disabilities Following Fractures of the Limbs. American Journal of Surgery, 1915, xxix, 114.

duction; 3 good and 2 moderate anatomical results followed, and 4 good and 1 moderate functional result. The time in the hospital ranged from 1 day to 59 weeks (average 10 weeks). One case died of shock the day of admission, while another died on the third day of a fractured skull. The disability period was between 8 and 115 weeks (average 16.9), giving 29 good, 4 moderate, and 2 bad functional results from 25 good, 6 moderate and 4 bad anatomical results. The case who stayed in the hospital 59 weeks and was out of work 115, developed delirium tremens, got the leg in bad condition, causing sloughing of tissue, when a cast was applied, with both bad anatomical and functional results. Thirty cases were of the simple type, while Cases 3, 9, 19, 26, and 27 were comminuted, and Case 11 compound, the fracture having been produced by indirect violence (see Figs. 2 to 7). Twenty-four fractures resulted from direct and 12 from indirect violence.

Tables V, VI, VII, VIII, and IX have been compiled so that the various summaries of results, such as age groups, disability periods, etc., of the different classes of fractures may be noted at a glance.

As to treatment the non-operative gave as good results, functionally, as the operative, although the plated cases were selected, which without operation most certainly would have given poor results. Anatomical results were based on röntgenograms when they were employed and in the other cases on the amount of shortening or deformity. The latter is faulty in that good approximation and alignment of the fragments is not necessary for a straight and unshortened limb. The skiagraph is the only accurate basis for our conclusions, but unfortunately not all had röntgenograms after completed treatment.

The mortality of 11 cases was not due directly to the fracture of the femur excepting in the one dying from shock, while in a number of the others it was a contributing factor.

In conclusion from the facts gathered:

1. Fractures of the neck were more frequent in the aged of the female sex, indirectly cause a high mortality because of the age of the patient and the lowered resistance, and give a moderate disability period.

2. Fractures through the trochanters were all males and gave a long disability period with lowered earning capacity in two-thirds of the cases.

3. Fractures of the lower end of the femur gave an average disability of about 6 months while a good functional result was obtained in about one-half of the cases. They were all males.

4. Fractures of the shaft gave the best results and had the shortest disability period. They were the most frequent and were mostly males.

5. The mortality from fractures of the femur other than of the neck was low, being about 2 per cent. in this series.

FIG. 1.—J. F., aged fifty years, who had broken his left femur shaft thirty years previous to this X-ray. He has two and one-half inches shortening, wears a high shoe and makes good wages, but says he could make one-third more if not for his disability. He has some pain in region of fracture during damp weather. Plate shown to illustrate the way nature cares for defects, giving moderate functional result.

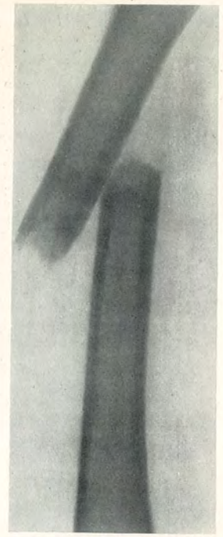

FIG. 2.—Case 11 of Table IV, under Fractures of the Shaft, which was compound. E. F., girl seven years of age. Lateral view before setting under ether. Had 3 cm. shortening. Left femur.

FIG. 3.—Same case as Fig. 2. Anteroposterior view before setting under ether.

FIG. 4.—Same case as Fig. 2. Lateral view after setting under ether.

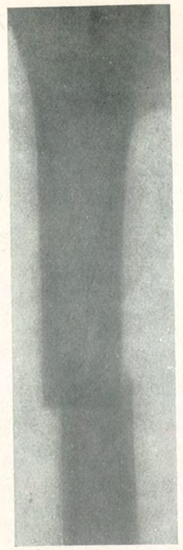

FIG. 5.—Same case as Fig. 2. Anteroposterior view after setting.

FIG. 6.—Same case as Fig. 2. Lateral view six months after setting.

FIG. 7.—Same case as Fig. 2. Anteroposterior view six months after setting.

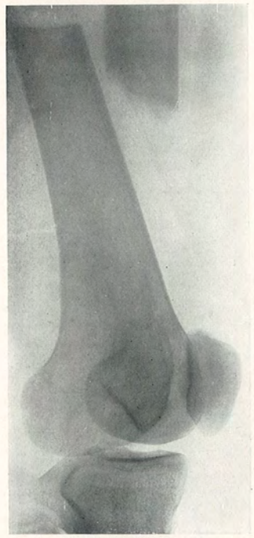

FIG. 8.—G. O'N., twenty years of age, fracture of femoral shaft. Lateral view.

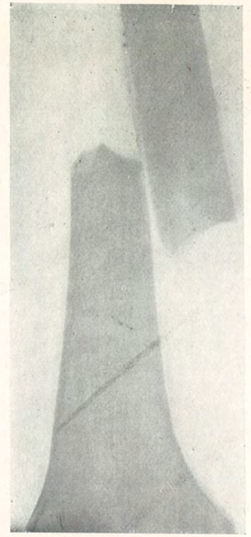

FIG. 9.—Same case as Fig. 8. Anteroposterior view.

FIG. 10.—Same case as Fig. 8. Dr. C. H. Frazier's service, Episcopal Hospital. Operated by Dr. A. P. C. Ashhurst, November 17, 1914, with good result. X-ray of limb four weeks after Lambotte plate was applied.

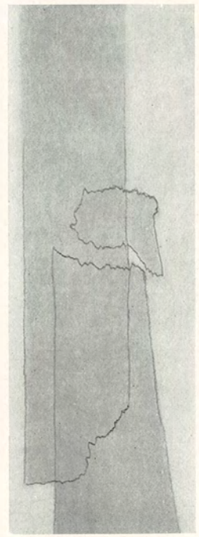

FIG. 11.—F. R., twenty-six years of age. Fracture of femur.

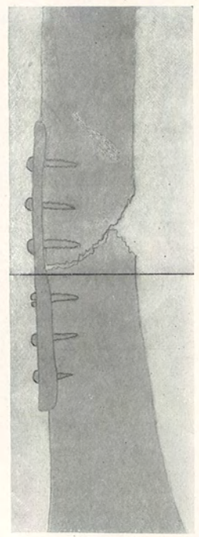

FIG. 12.—F. R. Same as Fig. 11, six weeks after operation (late).

TABLE I

FRACTURES OF NECK OF FEMUR

No.	Sex	Age	Treatment		X-ray		Weeks in hospital	Weeks from work	Earning power	Functional result			Anatomical result			Died
			Operative	Non-operative	Early	Late				Good	Mod.	Bad	Good	Mod.	Bad	
1	M	14	..	C	*	*	6	10	Same	*	..	..	*	..	..	
2	M	30	..	†	*	..	4	30	Less	..	..	*	..	..	*	
3	F	58	..	†	*	*	29½	Idle	Idle	..	*	..	..	*	..	
4	F	60	..	E and L	..	..	6	24	Same	*	..	..	*	..	..	
5	M	63	..	E	..	..	11	Idle	Idle	*	..	..	..	*	..	
6	M	65	..	†	..	..	2½	..	..	..	..	..	..	..	..	Pneumonia.
7	F	67	..	E	..	*	6½	26	Same	*	..	..	*	..	..	
8	F	70	..	E	*	..	17	..	..	..	..	..	..	..	..	Uræmia.
9	F	70	..	†	*	..	2	..	..	..	..	..	..	..	..	Cause not stated.
10	F	74	..	C	*	..	2½	..	..	..	..	..	..	..	..	Carcinoma of stomach.
11	F	75	..	E and C	..	..	3	..	..	..	..	..	..	..	..	Senility.
12	F	76	..	†	..	..	4	Idle	Idle	..	*	..	..	*	..	
13	F	77	..	†	..	..	6	..	..	..	..	..	..	..	..	Cause not stated.
14	M	82	..	E	..	..	2	..	..	..	..	..	..	..	..	Cause not stated.
15	F	84	..	†	..	..	2	..	..	..	..	..	..	..	..	Pneumonia.
Total	M F	Ave.					Ave.	Ave.	Same 3							
15	5 10	64½	0	15	6	3	6⅔	22½	Less 1	4	2	1	3	3	1	8
									Idle 3							

NOTE.—Case 3 died 3 years later. Case 5 died 5½ years later.

Key to tables:

Mod.=Moderate.
B=Buck's extension.
L=Lateral extension.
VE=Vertical extension.
C=Plaster-of-Paris cast.
H=Hamilton splint.
S=Splint.
Splint=Coaptation splint.
SB=Sand bags.
†=Type not stated.
Idle=Not working, being too old or for other cause.
*=Time X-rays were taken and end result in each case.

TABLE IV
Fractures of Shaft of Femur

No.	Sex	Age	Treatment: Operative	Treatment: Non-operative	X-ray: Early	X-ray: Late	Weeks in hospital	Weeks from work	Earning power	Functional result: Good	Functional result: Mod.	Functional result: Bad	Anatomical result: Good	Anatomical result: Mod.	Anatomical result: Bad	Died
1	F	3	..	E	*	..	7	13	Same	*	..	..	*	..	..	
2	M	3	..	VE	*	..	8	8	Same	*	..	..	*	..	..	
3	M	3	..	H and E	*	..	8	8	Same	*	..	..	*	..	..	
4	M	4	..	E and C	..	..	9	12	Same	*	..	..	*	..	..	
5	M	4	..	E and C	..	..	6	9	Same	*	..	..	*	..	..	
6	M	5	..	E	*	*	9½	11	Same	*	..	..	*	..	..	
7	M	5	..	H and E	*	*	8	9	Same	*	..	..	*	..	..	
8	M	6	..	H and E	*	..	12	17	Same	*	..	..	*	..	..	
9	M	6	..	H and E	*	..	6	8	Same	*	..	..	*	..	..	
10	M	6	..	C	*	..	7	9	Same	*	..	..	*	..	..	
11	F	7	..	E and C	*	*	8	10	Same	*	..	..	..	..	*	
12	M	7	..	H and E	*	..	11½	11½	Same	*	..	..	*	..	..	
13	M	8	..	E and SB	..	..	8½	13	Same	*	..	..	*	..	..	
14	M	10	..	E	..	..	6	9	Same	*	..	..	*	..	..	
15	M	11	Plate	....	*	*	11	14	Same	*	..	..	*	..	..	
16	M	13	..	E and C	*	..	6½	12	Same	*	..	..	*	..	..	
17	M	13	..	C	..	..	7	14	Same	*	..	..	..	*	..	
18	M	14	Plate	....	*	*	15	19	Same	..	*	..	*	..	..	
19	M	15	..	E	*	*	12½	30	Same	*	..	..	..	..	*	
20	M	16	Plate	....	*	*	12	20	Same	*	..	..	..	*	..	
21	M	18	..	Splint	*	*	13	17	Same	*	..	..	*	..	..	
22	M	18	..	Splint	*	*	13	17	Same	*	..	..	*	..	..	
23	M	21	..	†	..	..	1 day	..	....	..	..	..	..	..	..	Shock.
24	M	23	Plate	....	*	*	13	21	Same	*	..	..	..	*	..	
25	M	34	..	E and C	..	..	7½	19	Less	..	*	..	*	..	..	
26	M	34	Plate	....	*	*	10	26	Same	*	..	..	*	..	..	
27	M	38	..	Splint	*	*	8	24	Same	*	..	..	*	..	..	
28	M	45	..	C	..	..	9	20	Same	*	..	..	..	*	..	
29	M	47	..	E and C	*	*	59	115	Less	..	..	*	..	..	*	
30	M	50	..	†	..	..	3 days	....	....	..	..	..	..	..	..	Fractured skull.
31	M	50	..	C	..	*	6	12	Same	*	..	..	*	..	..	
32	M	50	..	E and SB	*	*	6½	9½	Same	*	..	..	*	..	..	
33	M	52	..	HE and C	*	*	7	21	Same	..	..	*	..	..	*	
34	M	53	..	E	..	..	15	26	Less	..	*	..	..	*	..	
35	M	73	..	E and C	*	*	14	Idle	Same	..	*	..	..	*	..	
36	F	74	..	†	..	..	7	Idle	Same	*	..	..	*	..	..	
Total 36	M F 33 3	Ave. 23⅓	5	31	24	17	Ave. 10	Ave. 16.9	Same 31 Less 3	28	4	2	24	6	4	2

TABLE II
Fractures Through Trochanters

No.	Sex	Age	Treatment: Operative	Treatment: Non-operative	X-ray: Early	X-ray: Late	Weeks in hospital	Weeks from work	Earning power	Functional result: Good	Functional result: Mod.	Functional result: Bad	Anatomical result: Good	Anatomical result: Mod.	Anatomical result: Bad	Died
1	M	42	..	S and C	*	..	8	27½	Less	..	*	..	..	*	..	
2	M	45	..	B	*	..	6½	12	Same	..	*	..	..	*	..	
3	M	48	..	B	*	..	4	48	Less	..	*	..	..	*	..	
4	M	54	..	B	*	..	4½	9½	Same	*	..	..	*	..	..	
5	M	54	..	B and S	*	..	10	93	Less	..	*	..	..	*	..	
6	M	70	..	†	*	..	8	over 14½	Less	..	*	..	..	*	..	
Total 6	6	Ave. 52	0	6	6	0	Ave. 7	Ave. 34	Same 2 Less 4	2	2	2	2	4	0	

TABLE III
Fractures of Lower End of Femur

No.	Sex	Age	Treatment: Operative	Treatment: Non-operative	X-ray: Early	X-ray: Late	Weeks in hospital	Weeks from work	Earning power	Functional result: Good	Functional result: Mod.	Functional result: Bad	Anatomical result: Good	Anatomical result: Mod.	Anatomical result: Bad	Died
1	M	6	..	C	*	..	4	4	Same	*	..	..	*	..	..	
2	M	30	..	B and C	*	..	11	7½	Same	*	..	..	*	..	..	
3	M	35	Plate	....	..	..	11	28	Same	*	..	..	*	..	..	
4	M	38	..	B and C	*	..	34	34	Less	..	*	..	..	*	..	
5	M	61	..	†	..	..	2	28	Less	..	*	..	..	*	..	
Total 5	5	Ave. 34	1	4	3	0	Ave. 5½	Ave. 23½	Same 2 Less 2	2	1	1	3	1	0	Delirium tremens.

TABLE V

FRACTURE OF FEMUR

FRACTURE LEVEL ACCORDING TO AGE WITH AVERAGE DISABILITY IN WEEKS

FRACTURE LEVEL	Total	Under 15 years		15 to 45		45 to 60		60 and over	
		Non-operative	Operative	Non-operative	Operative	Non-operative	Operative	Non-operative	Operative
Neck	15	1	..	1	..	..	..	12	..
Trochanters	6	..	..	1	..	4	..	1	..
Upper	5	2	..	2	1	..	..	..	..
Middle	28	13	2	4	1	7	..	1	..
Shaft, lower	1	..	..	..	..	..	..	1	..
?	2	1	..	..	1	..	..	..	..
Total	(36)	(16)	(2)	(6)	(3)	(7)	..	(2)	..
Lower end	5	1	..	2	1	..	..	..	..
Sum totals	62	18	2	10	4	11	0	15	0
Average disability		10	....	30 27.5	....	....	....	....	....
		....	....	....	....	....	....	25 14.5	....
		....	....	....	....	....	....	....	....
		....	....	....	....	....	....	....	....
		....	....	....	....	....	....	....	....
		11.3 4	....	....	21.7 22	....	....	....	Over 52.*

* The 11 cases which died early are not considered in Average Disability.
? Region of shaft not stated.

TABLE VI

FRACTURE OF FEMUR

DISABILITY PERIOD ACCORDING TO ANATOMICAL RESULT AND AGE

	Total	Anatomical result				Under 15 years	15–45	45–60	Over 60
		Good	Moderate	Bad	Died				
Under 6 weeks	11	1	..	..	10	1	1	1	8
6 to 12 weeks	16	16	..	..	..	12	..	4	..
3 to 6 months	19	11	5	2	1	7	7	2	3
6 to 9 months	8	4	3	1	..	..	6	1	1
9 to 12 months	1	..	1	..	..	..	..	1	..
Over 12 months	4	1	2	1	..	..	..	2	2
Not stated	3	..	3	..	..	..	..	1	2
Total	62	33	14	4	11	20	14	12	16

TABLE VII

FRACTURE OF FEMUR

FUNCTIONAL AND ANATOMICAL RESULTS ACCORDING TO AGE (NON-OPERATIVE AND OPERATIVE)

	Total	Under 15		15 to 45		45 to 60		60 and over	
		Non-operative	Operative	Non-operative	Operative	Non-operative	Operative	Non-operative	Operative
Functional:									
Good	36	18	1	5	3	5	..	4	..
Moderate	9	..	1	2	1	3	..	2	..
Bad	6	..	..	2	..	3	..	1	..
Death	11	..	..	1	..	1	..	9	..
Anatomical:									
Good	33	17	2	5	2	4	..	3	..
Moderate	14	1	..	2	2	5	..	4	..
Bad	4	..	..	2	..	2	..	..	..

TABLE VIII

FRACTURE OF FEMUR

FUNCTIONAL RESULTS ACCORDING TO ANATOMICAL RESULTS

	Total	Functional		
		Good	Moderate	Bad
Anatomical:				
Good	33	30	3	..
Moderate	14	5	6	3
Bad	4	1	..	3
Total	51	36	9	6

TABLE IX

FRACTURE OF FEMUR

SUMMARY TABLE

Location	Number	Sex: Male	Sex: Female	Age in years: Average	Age in years: Old	Age in years: Young	Treatment: Operative	Treatment: Non-operative	Time in hospital in weeks: Total	Time in hospital in weeks: Average	Time in hospital in weeks: Long	Time in hospital in weeks: Short	Weeks absent from work: Total	Weeks absent from work: Average	Weeks absent from work: Long	Weeks absent from work: Short	Earning capacity: Same	Earning capacity: Less	Functional result: Good	Functional result: Moderate	Functional result: Bad	Anatomical result: Good	Anatomical result: Moderate	Anatomical result: Bad	Died
Neck	15	4	11	64½	84	14	0	15	100	6⅔	29½	2	90	22½	30	10	7	8	4	2	1	3	3	1	8
Trochanter	6	6	0	52	88	46	0	6	41	7	10	4	204	34	91	9½	2	4	2	2	2	2	4	0	0
Shaft	36	33	3	23⅓	74	3	5	31	362	10	59	½	571	16⅙	115	8	31	5	29	4	1	25	6	4	2
Lower extremity	5	5	0	34	61	6	1	4	27½	5½	11	2	94	23½	34	4	2	2	2	1	1	3	1	0	1
Totals	62	48	14	37	88	3	6	56	530	9	59	½	959	20	115	4	42	19	37	9	5	33	14	5	11

	Under 15 years	Over 15 years
Neck	1	14
Trochanters	0	6
Shaft	19	17
Lower end	1	4

Result of Operated Cases

Shaft.....4 good and 1 moderate functional.
4 good and 1 anatomical moderate.
Lower end.....1 good anatomical and moderate functional.

NOTE:
Neck.....
Trochanters.....
Shaft.....
Lower end.....

DR. A. P. C. ASHHURST said it is surprising to find, in these two series of fractures of the leg bones and of the femur, that there is very little difference in the period of disability. One is apt to think of a longer period of disability following fractures of the thigh than those of the leg. He had recently been going over hundreds of case reports of fractures for the American Surgical Association, and had found that the period of disability in all fractures was much longer than is commonly supposed. Such results are not very creditable. It is only by studious and painstaking investigations such as these of Dr. John and Dr. Steinke that one is able to realize that the patients are by no means cured when they leave the hospital, but that often a long period of disability follows. It should be the object of surgeons not only to get good functional results, but to get such results in as short a time as possible.

DR. JOHN B. ROBERTS said that what Dr. Ashhurst had said was perfectly true and the reason is perfectly plain. Surgeons do not get good results in fractures of the lower extremity because most of these cases are put to bed and are not given mobilization early and massage all the time as is more apt to be done in fractures of the upper extremity. There are many illustrations to be found showing how few cases of fractures of the lower extremity are properly taken care of by orderlies, nurses and resident physicians; whereas, similar injuries of the upper extremity are more apt to be seen not only by the resident physician, but also by the chief. A study of the results reported by the British Fracture Committee and the reports of the Committee on Fractures of the American Surgical Association, shows that the great faults in the treatment of fractures are (1) want of anæsthesia and reduction; (2) want of early mobilization and gentle massage. It is not only the fractured bone that needs treatment always; but also the soft parts surrounding and near the bone. The neglect of the soft parts is largely responsible for many poor functional results. He had in his possession a series of pictures and clinical reports, obtained some years ago, in which there is very great anatomic deformity according to the photographs and X-ray prints, but good functional result. These patients were treated by men who believed in early mobilization and massage, but did not pay as much attention to the anatomical reconstruction of bones at the point of fracture as many American surgeons are accustomed to do. The great defects in treatment of fractures of the lower extremities have been, neglect of reduction under general anæsthesia, poor attention to the soft parts, and the want of proper early mobilization and light massage from the

very beginning,—light massage, not the vigorous motions and kneadings used by the average graduate of a massage school for lazy manhood and overfed women. The fragments should first be put in place under anæsthesia, and then the soft parts given as much attention as surgeons have usually given to bad sprains and formerly gave to the bones alone in fractures which they personally treated in private practice. Such methods will greatly lessen the need for direct metallic fixation of broken bones. Post-graduate teaching should emphasize the non-operative treatment of fracture and hospitals should provide proper ward service for these injuries.

Dr. Gwilym G. Davis emphasized the point to which Dr. Ashhurst had called attention, namely, the period of cure, particularly in relation to the question of treatment. The charter of most hospitals requires that a person must be admitted to the hospital if application is made within twenty-four hours of the injury. The treatment of fractures by operative means is probably the result of the effort to shorten the period of disability. This attempt is going to be more definitely emphasized on account of the passage of the workmen's compensation act. There should be more definite means of treating patients after they have been discharged from the general hospital and have become walking patients until the time they are again able to resume work.

SARCOMA OF THE CLAVICLE AND THE SCAPULA

Dr. A. Bruce Gill reported the following case which occurred in the orthopædic service of Dr. Ashhurst at the Episcopal Hospital.

A woman aged fifty-one years presented herself complaining of a lump on her left shoulder and of pain in the shoulder, particularly on motion. The mass had first appeared about 4 weeks before her coming to the clinic and had gradually increased in size. For 2 years prior to her admission she had been having pain in her left shoulder on motion of the arm. This pain was sharp, paroxysmal, and was referred down the arm. It was relieved by heat and increased by massage and motion. The patient could ascribe no cause for the pain and the appearance of the tumor and stated that she had never suffered any injury to the arm or shoulder.

She was admitted to the Hospital on July 28, 1914. She was pale and poorly nourished and had been losing weight. On the top of her left shoulder in the neighborhood of the acromioclavicular joint was a mass about 1½ inches in diameter, rounded, soft, fluctuating, slightly red and warm, and slightly tender. It was not painful except on motion

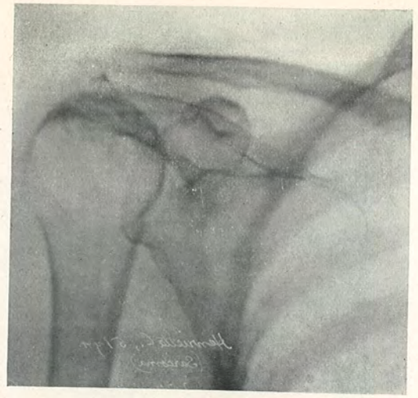

Fig. 1.—Sarcoma of clavicle.

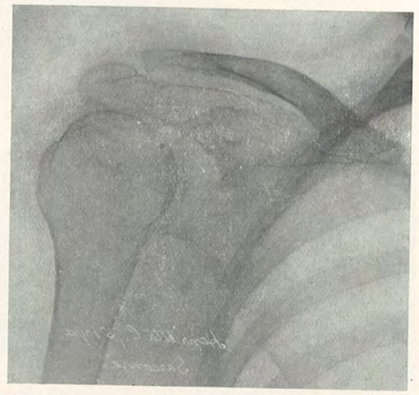

Fig. 2.—Sarcoma of clavicle, four months after first operation.

Fig. 3.—Recurrence three and one-half months after first operation (November 5, 1914).

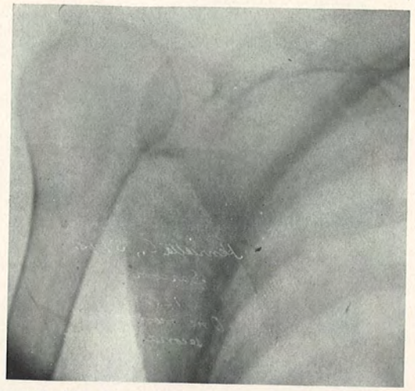

FIG. 4.—Sarcoma of clavicle, after excision of outer end of clavicle, acromion and coracoid.

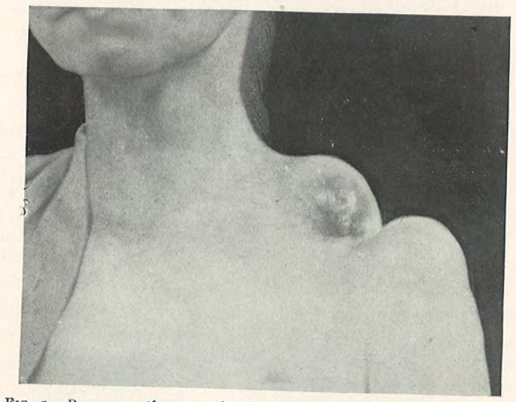

FIG. 5.—Recurrence three months after second operation (February 8, 1915).

of the shoulder when the pain became severe. The X-ray plate (Fig. 1) showed a mass about the acromioclavicular joint with possibly slight atrophy of the acromion and the acromial end of the clavicle. A tentative diagnosis of tuberculous abscess was made.

Operation was performed on July 29, 1914, by Dr. Gill. A curved incision was made in front of the tumor and a skin flap dissected upward. The tumor lay close beneath the skin and was soon penetrated. A mass of soft tissue resembling a soft blood clot in consistency but grayish in color oozed out abundantly. Hemorrhage was quite free. The tumor mass was cleaned out as thoroughly as possible with finger, sponges, and curette. It seemed to be enclosed in front, at least, by a thin capsule lined with large veins. The lower surface of the acromial end of the clavicle felt roughened. Otherwise there appeared to be no other bony origin of the tumor. Bleeding was controlled by packing tightly with iodoform gauze and a few sutures were placed to close the incision in part. Diagnosis was made of sarcoma of the clavicle. Microscopic section of the tumor showed it to be of the spindle-celled variety.

The use of Coley's fluid was begun shortly after the operation and was continued in ascending doses until considerable reaction was produced. The wound healed on August 18, 1914. But in less than 2 months the tumor gave evidence of recurrence (Figs. 2 and 3). On November 7, 1914 Dr. Ashhurst operated and removed in one mass a third to a half of the clavicle, the acromion, and the coracoid process together with the surrounding soft tissues. More of the deltoid and trapezius muscles were then removed until no evidence of tumor remained. The skin was approximated and sutured with the arm abducted to a right angle.

The use of Coley's fluid was continued, and the wound was healed by December 19, 1914 (Fig. 4). About the middle of January the tumor appeared to be recurring in the trapezius and the scapula.

On February 8, 1915 the tumor appeared as shown in Fig. 5. At this time the mass was dark in color, owing to hemorrhage within the tumor substance. She was readmitted for operation. Spontaneous rupture of the tumor occurred after her admission and about a pint of blood was lost before the hemorrhage could be controlled by packing.

On February 17, 1915, Dr. Ashhurst performed the third operation consisting of complete excision of the scapula with the exception of the lower angle and the glenoid, and of the trapezius half way to the occiput. Very little hemorrhage occurred owing to the fact that the line of incision was carried wide of the tumor. Part of the clavicle was

removed although it did not appear to be involved in the tumor. The brachial plexus was freely exposed, but was not injured in the operation. The skin was approximated and sutured again with the arm in abduction.

The patient failed to recover consciousness after the operation and died three hours later. Autopsy showed sarcomatous metastases in the lungs.

Coley has reported 10 cases of sarcoma of the clavicle. Of these 8 gave a distinct history of antecedent trauma. In the case recorded above there is no such history. Coley in his report (ANNALS OF SURG., 1913, p. 556) of a case discusses the literature briefly and confirms his conclusions expressed in 1910 that:

1. Primary sarcoma of the clavicle is one of the most malignant of all neoplasms.
2. While a rare condition, it requires early diagnosis and very radical treatment.
3. The mortality of the operation itself should be small.
4. The danger of local and general metastases is very great.
5. The use of Coley's fluid is strongly indicated as a routine measure immediately after operation.

GIANT-CELL SARCOMA OF PELVIS

DR. GUY BLAIR DENIT reported the case of a lad, fourteen years of age, who was admitted to the Orthopædic Hospital under the care of Dr. A. P. C. Ashhurst. He was complaining of severe pain in the right hip and small of the back. Six weeks previously he had strained his back by lifting one end of an elevator weight, weighing 300 pounds. That night he suffered severe pain in his back radiating from the lumbar region to the right hip. In several days the pain ceased. One month later, while playing at school, he was knocked down and struck his right lumbar region against a stone wall. This caused him much pain and he was taken home and put to bed. He remained in bed for a time, and then on crutches until December 1. On December 1 he was taken to a hospital and treated for rheumatic arthritis of the right hip. He was admitted to the Orthopædic Hospital on December 28. On admission he was suffering with severe pain in the right lower quadrant of the abdomen and in the right hip. His pain was paroxysmal in character, lasting an hour or more at a time. He was a fairly well nourished boy about average size for age.

In lumbar region on the right side there was a large mass, semisolid in consistency, occupying the whole of the right lumbar region and right

lower quadrant of the abdomen. On palpation this mass was extremely tender.

An incision was made through the bulging mass in the loin, and a portion of the tumor was excised and sent to the laboratory for examination. The wound was sutured and drained without further operative procedure.

One specimen of the tumor was examined by Dr. C. Y. White, director of the Pathological Laboratories of the Episcopal Hospital, and another by Dr. E. P. Corson White, Pathologist to the Orthopædic Hospital. The report from both laboratories was that the tumor was a giant-cell sarcoma.

Matthew J. Stewart (*Lancet*, ii, 1236) gives the following classification of giant-cell sarcoma: "Giant-cell sarcoma is used in its widest sense as a term to include all sarcomata in which giant-cells of blastomatous origin constitute an important part, it may be the essential feature of the microscopic picture. This large class is made up of two groups of cases: (1) the myeloid sarcomata (myelomata of some authors) and (2) the malignant giant-cell sarcomata. The latter are equivalent to mixed-cell sarcomas, as there are cells of all sizes, but in some the giant-cells are so numerous as to justify special recognition in the term used. Giant-cells of the myeloid sarcoma resemble osteoblasts and clasts, not myeloplaxes or mononuclear giant-cells or bone marrow. Cytoplasm is abundant especially at periphery and presents a homogeneous ground glass appearance. Vacuoles mostly peripherally situated are often present and may be of large size when they not infrequently contain cell inclusion. The nuclei are uniformly small in size and when not closely packed together are round or oval in shape. There are no mitoses in these giant-cells even when mitoses are present in cells forming matrix of the tumor. The nuclei in smaller giant-cells and in many of the larger are uniformly distributed through the cytoplasm, but in larger giant-cells they often are grouped in the centre in 'whorls.' The peripheral ring-like distribution of the nuclei, so characteristic of tubercular giant-cells, is practically unknown in cases of myeloid sarcoma. N. B. There are no transitional forms between the giant-cells and other cellular constituents of the growth, every cell is either a giant-cell or not a giant-cell without any doubt whatever.

"In malignant giant-cell sarcoma, as in myeloid sarcoma the stroma may be round, spindle or mixed celled, and as in it the number of giant-cells varies greatly in different parts of the same growth. Cells of the stroma are very irregular and almost always one can find transition forms from smallest to the largest. Mitoses are very frequent both in

giant-cells and in the matrix. The giant-cells and especially their nuclei are the chief distinguishing characteristics. The nuclei are extremely irregular in size and shape, often presenting lobes and indentations while most of them are of large size. Enormous nuclei may be met with and the giant-cells may be mononuclear. The number of nuclei seldom exceeds six, and most cells have from one to five only. Usually they are clumped together and it may be difficult to count them precisely. Vacuolation of cytoplasm is rare."

The tumor in this case belonged to the first group of cases, the myeloid sarcomata.

On January 22, three weeks after the operation the first injection of Coley's fluid was administered. The first injection, 1/10 minim, was given into the buttocks. Seventeen weeks after the beginning the dosage had been gradually increased until minims 42 were being given. At no time during these weeks were the reactions severe. He was then given a rest from treatment for a period of three weeks, at the end of which time the injections were resumed, beginning with minims 42 and gradually increasing the dosage until minims 48 were being given. Again he was given a rest over a period of three weeks, at the end of which time the injections were resumed, beginning with minims 48. From this time on the reactions were rather severe, the temperature often going above 102° and at times reaching 103.2°. Chills accompanied the temperature and there was always severe pain at the site of the needle puncture.

The injections were discontinued on September 18, 1914, eight months after the beginning of the treatment, at which time he was given minims 56. This caused a severe reaction, the temperature going up to 103.8°, and a severe chill accompanied the temperature. However, his condition was at no time alarming.

As stated before, the injections were given over a period of eight months with only six weeks rest from treatment. As a rule these injections were given every other day; however, three or four days often elapsed between injections.

The fluid was first injected into the buttocks. First on one side and then on the other. They were then given nearer and nearer the tumor until the tumor in the loin itself was injected. There was always severe pain at the site of the needle puncture and often marked skin reactions. The constitutional reactions were on the whole very mild, but at times they were rather severe. At no time was it necessary to give stimulants, but morphine, codeine and aspirin were frequently given for the relief of pain. At no time were the injections given daily. Twice the patient

was given a rest of three weeks from treatment, during which time his general condition improved a great deal. The bowels were always kept open and tonics were given at intervals during the treatment. The injections were given deeply in and around the tumor in the loin and at no time were the reactions so severe as to cause alarm.

The directions as prepared by Dr. Coley were followed except as to dosage; as stated before, the first injection was minim 1/10, and the highest dosage was minims 56, this being, so far as I can find out, the highest dosage of the fluid that has ever been administered. In a recent letter received from Dr. Martha Tracy, of Germantown, Phila., whose preparation of Coley's fluid was used, she states that the highest dosage that has been administered by Dr. Coley himself was minims 26, but states that she knows of one surgeon who has given as high as minims 30. She further states that Dr. Coley believes there are few cases in which minims 26 would be safe. In a statistical study prepared by Dr. Tracy she finds about ten per cent. of the cases of sarcomata in general are benefited by the treatment.

Results of the treatment. As to the actual time in which the tumor began to diminish in size it is somewhat difficult to state owing to the position of the tumor. However, there was marked diminution in the pain two weeks after the first injection, at which time the patient was allowed to sit up several hours daily. Soon after this he was able to walk around the ward without discomfort, but he had a distinct limp on the right side. There was always a local reaction at the site of the tumor when the injections were made into it. This mass retained its somewhat semisolid consistency until the last of September, at which time it began to become softer and softer and increased in size. Several days later the mass broke down and discharged through the scar of the incision in the loin. From this time the mass in the loin diminished in size and became harder and harder in consistency and at the time the injections were discontinued the mass had the consistency of a bony tumor. This tumor seemed to be adjacent to the fourth and fifth lumbar vertebræ in the right loin.

The patient was discharged November 10, 1914. He had none of the symptoms which were so prominent on admission. No tumor could be palpated through the abdominal wall, the mass in the loin had decreased in size and assumed the form of a bony tumor. There was no pain on walking or running. His general health had improved a great deal. A skiagraph taken at this time shows a small tumor adjacent to the fourth and fifth lumbar vertebræ.

On December 1 the patient was readmitted to the Hospital for

examination. There was no sign of an increase in the size of the tumor. There had been no return of pain or lameness. A skiagraph taken at this time shows the tumor to be about the same as at the time of his discharge in November.

At the present time the patient goes to school, he rides a bicycle, plays base-ball and has no difficulty in running and playing. There has been no return of pain. He now weighs 103 pounds; while at the time of his discharge he weighed 76½ pounds. A skiagraph taken May 1, 1915, shows that there has been no change in the size of the tumor since his discharge in November, 1914.

Dr. A. P. C. Ashhurst called attention to the marked contrast between the cases reported by Dr. Gill and by Dr. Denit, the former a typically malignant sarcoma, and the latter a so-called giant-cell sarcoma. In both the tumor was curetted, and the patients were treated by Coley's fluid. In both patients, likewise, the tumors recurred after operation in spite of this treatment. But in the case of the woman (Dr. Gill's case) death followed the operation for the second recurrence, only 7 months after the first operation; while in the boy (Dr. Denit's case) the recurrent tumor gradually melted away under the influence of the toxins, seemed to become more and more bony, and the patient is at present apparently in perfect health, more than 7 months after cessation of treatment, and 17 months after the first and only operation.

As to the real nature of giant-cell sarcomas, many papers have been written by surgeons setting forth their views; but the pathologists really are wiser, for like Socrates they admit that they know nothing. In the *Lancet* some months ago is a paper by Stewart (*Lancet*, 1914, ii, 1236), the Clinical Pathologist at the Leeds General Infirmary, based on a study of about 50 cases of giant-cell sarcoma. He concludes that the benignancy or malignancy of the tumor can be predicated absolutely upon the characters of the giant-cells present; whereas it is Bloodgood's contention that it is the stroma which is especially characteristic, and that in the benign growths it resembles granulation tissue. Then there is Barrie of New York (Annals of Surgery, 1913, i, 244) who goes still further, claiming that it is really granulation tissue, and calling the disease hemorrhagic osteomyelitis.

AN ANATOMICAL STUDY OF FEMORAL HERNIA *

TOGETHER WITH A REPORT OF SIX CASES OF INGUINAL HERNIA OF SPECIAL INTEREST THREE WITH PROTRUSION OF THE BLADDER

By T. Turner Thomas, M.D.
of Philadelphia

Interesting herniæ are rather frequent in the surgical service of the Philadelphia General Hospital. All but one of the cases upon which the present report is based were operated on last year during a three months' service and that of Dr. A. C. Wood, to whom I am indebted for the privilege of operating on and reporting the cases admitted to his service. I shall briefly report, first, the inguinal hernia with some important facts concerning bladder hernia, taken from Eggenberger's excellent paper and not generally accessible, and then present a brief anatomical study of femoral hernia.

Case I.—*Inguinal hernia with cystocele.* Man, fifty-eight years, admitted to service of Dr. A. C. Wood February 20, 1914, with a right-sided, direct, inguinal hernia of about two years' duration. Bassini operation the following day. The sac was opened to facilitate the stripping of it from the surrounding tissues, during which there was seen to its inner side, in front of the spermatic cord, and not adherent to the sac, a very thin-walled cystic formation suggesting a hydrocele of the cord. It was not tensely filled and seemed to contain a serous translucent fluid which did not escape during the manipulations until it was opened. When a finger was introduced it passed downward and inward into a larger mucosa-lined cavity which was evidently that of the bladder. The opened hernial sac was then closed by gauze, a part of the bladder diverticulum cut away, and the opening in the bladder closed by catgut sutures which inverted the edges without passing through the mucous membrane. The Bassini operation was completed and a small gauze drain left in the inner angle of the wound down to the bladder sutures. Slight abdominal distention followed but soon passed away and the skin sutures were removed on the eighth day, the small, serum-discharging drainage sinus soon closing.

Case II.—*Inguinal hernia with partially descended testicle and vaginal process closed only at internal ring.* Man, forty-five years, admitted to insane department of Philadelphia Hospital,

* Read before the Philadelphia Academy of Surgery, May 3, 1915.

January 3, 1910, when it was noted that he had a right inguinal hernia. Of late it has been giving him trouble. It is the size of a closed fist, reducible, direct, and the testicle on that side is a little below the external ring. Bassini operation, February 23, 1914. After opening what appeared to be the sac of the hernia it was found to be empty and the finger did not pass into the peritoneal cavity but was stopped at the internal ring. Below the testicle projected into it. Flattened out, its width was about two inches. The hernia was behind it and the hernial sac separated from it by loose areolar tissue. Its unusually large lumen was evidently caused by its being spread out gradually during the growth of the hernia underneath to which it was adherent. We had here a so-called infantile congenital hernia in which one must cut through three layers of peritoneum before reaching the contents of the hernia, the first two being those of the unobliterated vaginal process and the third being that of the hernial sac. This condition is very rare, but a congenital hernia into a completely patulous vaginal process is frequently associated with an undescended testicle. The vaginal process in this case was divided just above the testicle, the upper part removed and the lower part closed above the testicle by catgut suture. The Bassini operation was completed as usual. Recovery was uninterrupted except for some swelling of the scrotum which disappeared later.

CASE III.—*Sliding inguinal hernia.* Man, aged thirty-seven years, admitted to my service July 27, 1914, with a left inguinal hernia about the size of the closed fist, of about ten years' duration. Bassini operation July 31. The sac had a wide communication with the peritoneal cavity and contained a large mass of omentum. A considerable portion of the colon uncovered by peritoneum presented in the lower part of the hernia, a sliding hernia. The lower margin of the sac was cut away to its attachment to the colon, the protruding portion of which was turned into the abdominal cavity by suturing the upper margin of the sac to the posterior, extraperitoneal wall of the colon. Bassini operation completed and recovery uninterrupted.

CASE IV.—*Inguinal hernia with small bladder protrusion.* Man fifty-seven years old, admitted to my service July 27, 1914, with a right direct inguinal hernia, about size of a goose egg. Bassini operation August 3, 1914. The sac was surrounded by much fat. In separating this from the sac on its inner side near the neck the adhesions were firm and their separation started more than the usual bleeding which led to the recognition of a small mass firmer than the fat which covered it. From its position on the inner side of the sac and its consistency it was decided that it could only be bladder, and it was not opened. When the neck of the sac

was closed by a catgut ligature and the rest of the sac removed, the stump with the mass retracted downward and inward under the rectus muscle toward the normal position of the bladder. The chief reason for deciding it to be bladder, however, was a previous experience with Case VI, which had been previously operated on. The Bassini operation was completed, the outer edge of the rectus muscle being also sutured to Poupart's ligament. Uneventful recovery.

CASE V.—*Strangulated inguinal hernia, with early operation.* Man sixty-seven years old, a patient in the department for the insane suffering from senile dementia. Had a large, inguinal hernia on the right side, reducible until the morning of August 21, 1914, when it became painful and irreducible and vomiting set in. Operation the same afternoon. The inguinal tumor was hard, tense, tender, reddened and gave no impulse on coughing. The pulse was rapid and the skin covered by cool perspiration. The evidence seemed to show that there had been no bowel movement for two days. Bassini operation. When the constriction at the neck was relieved and the sac opened, much fluid escaped. The intestinal contents were of a dark red color which returned almost to the normal in about fifteen minutes. The Bassini operation was completed and was followed by an uneventful recovery.

CASE VI.—*Recurrent right inguinal hernia associated with an overlooked bladder protrusion and with a femoral hernia on the same side.* Man sixty-eight years old, admitted to service of Dr. A. C. Wood in the Philadelphia Hospital, March 9, 1914. Had the inguinal hernia 12 years when it was operated on in 1907. It recurred about three years ago. Has a femoral hernia on the same side. Operation March 11, 1914. Inguinal hernia first exposed and much scar tissue encountered in exposing the sac which proved to be that of a direct hernia. The spermatic cord which contained much fat was first freed from its bed with the sac, which was then isolated from the abundant surrounding fat, its neck ligated and the rest removed. The femoral hernia was then exposed after drawing the lower margin of the skin and fascial portion of the incision downward. Its sac was surrounded by and adherent to much fat which was stripped from the sac after opening the latter. After ligation of the neck and cutting the rest away the stump retracted upward under Poupart's ligament into the inguinal region. The stripping of the excessive fat from the sac of the femoral hernia and the removal of only the sac left much fat around and over the femoral vein. In clearing this fat from the pectineus fascia and muscle for the closure of the ring much difficulty was experienced in guarding against a possible wound of the femoral vein which lay under the fat. During this stage

of the operation a hemorrhage was started which proved to be coming from a small opening in the wall of the vein. This was closed by a hæmostat and a lateral ligature applied. The pectineus muscle and fascia were then exposed and approximated to Poupart's ligament by two catgut mattress sutures. Attention was then directed to the inguinal portion of the wound, in the inner part of which was much oozing from what seemed to be a mass of fat. This was ligated in mass and the hemorrhage, apparently, controlled. The Bassini operation was completed, the outer edge of the rectus being brought down with the conjoined tendon by the sutures to the lower edge of Poupart's ligament. The dressings were applied and the patient returned to the ward.

I was still in the hospital an hour later when it was reported that the patient was doing badly. Internal hemorrhage was diagnosed and the patient returned immediately to the operating room. As only the wound in the femoral vein was suspected, only the superficial part of the wound was opened, the suture in the external oblique not being removed. A free exposure of the femoral vein and of the whole wound above and below Poupart's ligament showed no signs of bleeding and the wound was again closed. Intravenous infusion, enteroclysis and other stimulation were given. At noon of the following day, twenty-four hours after operation, only two ounces of urine had been voided. At 6 P.M. of the same day a catheter withdrew only five ounces of urine, which contained a considerable percentage of blood that could not be accounted for. The breath sounds over both lungs were very rough. Forty-eight hours after operation the breathing was dyspnœic, and on auscultation harsh sounds and bubbling râles were heard. The patient died on the same day.

The autopsy showed a large collection of blood extending from the operative wound to the space of Retzius and deeper in the pelvis at the right side of the bladder, some being found in the peritoneal cavity. A ligature was found loosely encompassing a small portion of the top of the bladder on the right side. There was also a large amount of blood in both pleural sacs and blood-stained fluid in the pericardial sac, the origin of which could not be explained.

The reopening of the wound proved that the pelvic hemorrhage did not come from the operative opening in the femoral vein, which was then shown to be securely closed. The only explanation left is that the ligature which was supposed to grasp only a mass of fat encircled a small portion of the bladder which is very vascular, the veins being especially large. This ligature, probably, became loosened at the knot or by the pulling away from its grasp of the small included portion of the bladder, which has a

substantial layer of muscle. This would account, also, for the blood in the urine. At the time of operation I had not thought of the bladder being involved. It was this case which led me to seek further information on bladder hernia and to make an anatomical study of femoral hernia.

Bladder Hernia.—There is a fair probability that the bladder in this case, as well as that in Case IV, had not passed out through the hernial orifice, and, therefore, was not actually a part of the hernia, although it was adherent in both cases to the inner side of the neck of the sac. It was the starting of the hemorrhage during the separation of the firm fatty mass from the inner side of the sac in Case IV, which was operated on subsequently to Case VI, that led to the recognition of the bladder. It suggests that the bladder may frequently be found adherent to the inner side of the sac of a direct inguinal hernia.

One finds little attention given to bladder hernia, aside from the vaginal variety which is not considered here, in our books on surgery even in the large systems, and special studies do not appear frequently in the literature. Eggenberger's paper,[1] published in 1908, reports 5 new cases seen in the previous ten years in Wilm's clinic and 105 new cases reported since Brunner's report of 182 collected cases in 1896. It is a fund of information on the subject upon which I shall draw freely in view of the fact that so little information is generally accessible. In my 3 cases the bladder did not project into the hernial sac but in 2 it was closely adherent to the sac. In only 1 of Eggenberger's 110 cases did the summit of a diverticulum of the bladder entirely covered by peritoneum project into the sac, making it a true bladder hernia. Brunner found 5 in his 182 cases. In 25 of Eggenberger's cases, the hernia was said not to have an associated sac. Of the whole number there were 53 per cent. indirect inguinal, 27 per cent. femoral, 17 per cent. direct inguinal, with 2 in the linea alba and 1 in the perineum. The usual size of the portion of bladder involved is that of a cherry to that of a walnut, rarely being as large as a hen's egg or involving half of the bladder. The ureter has been observed in the hernia. In only one of my cases was the bladder abnormally thin, as far as I could determine, and in that one it was exceedingly thin. Eggenberger says that the diverticulum may have one or two muscle layers or merely the mucous membrane, and its wall be so thin as to be mistaken for the hernia sac, which would apply to my case if it were not for the fluid the diverticulum contained. Notwithstanding this retention the finger later easily passed through its communication with the bladder. In Tedenat's case the diverticulum contained pus

which was not found in the urine, although boric solution was forced into the diverticulum from the bladder. Karewski found the communication so small that after the diverticulum had been opened, fluid could not be forced into it from the bladder.

In the other 2 of my cases the bladder protrusion gave the impression of a mass of fat unusually firm. In the reported cases the herniated portion of the bladder was often surrounded by fat which had to be gone through or removed before the bladder was exposed. Frequently a real lipoma was encountered. Monod and Delageniere as well as Lotheissen considered the prevesical lipoma as a constant sign in bladder hernia. Only in exceptional cases was the absence of the fat expressly noted. The percentage of bladder hernia found in all herniæ operated on varied from 1 to 3 per cent., although Becker in 30 cases found it 26 per cent. Lotheissen said that the number observed depends upon the special attention of the operator and the method of operation, the Bassini operation being especially favorable to their exposure. In one of mine it was discovered by the escape of urine during operation, in one at autopsy, which was responsible for my finding it in the third at operation. All three were found during the Bassini operation. In only 2 of Eggenberger's 110 cases and 18 of Brunner's 182 cases, was the bladder hernia recognized before operation.

Incarceration of the bladder by the hernial orifice sometimes occurs. It does not produce the clinical picture of an intestinal incarceration, although it is similar and easily distinguishable by the colicky pains in the region of the hernia or radiating to the thigh; disturbances of micturition; long continued retention; frequent tenderness over the hernia, and occasionally blood in the urine. Reflex gastric colic and vomiting and other reflex irritative symptoms are not infrequently present. Eggenberger believes that intestinal obstruction is not likely to occur, although in one case there was said to be no stool for eight days and fecal vomiting for four days before operation, while at operation only incarceration of the bladder was found.

Of the 45 of his 110 cases in which the presence of the bladder was first recognized during the operation, and was not wounded, only one is reported to have died. In 39 cases in which the blader was first recognized after being wounded and was then sutured, 3 died. In 9 cases in which the bladder was wounded during operation and overlooked, 4 died. The recognition of the bladder during the operation, therefore, becomes important and is easy enough if its presence is suspected. The failure to separate the sac from the tissues on the

inner side as easily as usual and the presence of a more or less adherent lipoma, should excite suspicion. In palpating the mass one may get the feel of two mucous surfaces moving on each other. In most cases the end of a catheter introduced through the urethra can be made to pass into the diverticulum and can be felt through its walls. If this fails the diverticulum may be distended by boric or other solution injected into the bladder. The color and feel of the bladder, if exposed, as well as its continuation in the direction of the normal bladder, will suffice for diagnosis. The fatty accumulation here should receive attention. If the bladder is unexpectedly opened the escape of urine and even if no urine escapes the passage of a catheter will establish a communication with the bladder. If the cystocele is not wounded during an incomplete separation from the sac, it may be included in the ligature of the sac and a part of the bladder be cut away with the sac. The bladder, during a contracture, may then slip out of the ligature and the opening in the bladder may not be detected.

The diagnosis after operation may be made by the occurrence of hæmaturia or anuria soon after the operation, by a temporary urinary infiltration of the wound and fistula formation, or by the development of peritonitis from the presence of urine in the peritoneal cavity. In two of Eggenberger's cases, a second operation was done in time and the bladder wound sutured. The use of a truss is contra-indicated in all cases in which the presence of a cystocele is recognized, because the hernia is usually irreducible and the truss causes irritation, tenesmus, pain, and leads to inflammation and even gangrene. Small cystoceles found first at operation were repeatedly allowed to remain after being reduced without special treatment. If the bladder has strong adhesions to the sac, it is advisable not to attempt to separate them but to cut away the sac to the bladder, close the sac opening by sutures and reduce the cystocele with the sac. The partly changed bladder wall should restore itself to the normal later. The herniated portion of the bladder may be so thin or friable as to require its excision and closure of the opening by sutures, when a drain should be placed down to the suture line in the bladder. If a secure suture cannot be placed on account of the friability of the bladder wall, the edges of the bladder opening can be sutured to the external wound and drained. If after the operation the urine escapes into the operation wound and not into the peritoneal cavity, a fistula forms and usually closes in three to five weeks. To avoid urinary fistula after bladder suture, a permanent catheter in the urethra is serviceable. In the 39 cases in which the bladder was wounded during operation, the permanent catheter was

employed in 19, a fistula forming in 4. Of the 20 cases in which the permanent catheter was not used, 2 died in consequence of unretentive sutures and 7 developed temporary fistulæ.

Femoral Hernia.—The most essential knowledge of this as of any other hernia concerns its anatomy. But the anatomy of this hernia has been so thoroughly studied and so long established that there would seem to be little profit to be expected from studying it further. Its anatomy, however, was established in the days when operations were rare or not done at all, and was based upon theoretical considerations, chiefly. Except for the femoral ring, which I think is the only important part, the canal is made up of a very weak fascia, and in those cases in which the femoral vein is in close contact with Gimbernat's ligament, there can be no femoral canal. It is the innermost compartment of the femoral sheath and its fascial wall is so thin that it can be traced with difficulty. The only practical purpose it ever served, so far as I can learn, is to explain the peculiar course of a femoral hernia, which is first downward under Poupart's ligament, then forward through the saphenous opening, and then slightly upward. That there is a much simpler and more satisfactory explanation for this course and that the femoral ring is very important and the rest of the canal unimportant, will be one of the chief purposes of my study to show.

To study the anatomy of femoral hernia a formalin hardened body is much better than one prepared in the usual manner, because in the former the structures shown by dissection will better maintain the position they occupied in life. The structures most liable to variation are the femoral vessels, because in life they were filled by a fluid which has largely disappeared after death, especially the vein, because of its larger calibre, more flaccid walls and its adjacency to the site of the femoral hernia which is under study, and is disturbed most by the dissection. In none of the formalin hardened specimens, here illustrated, which are from the department of applied anatomy of the University of Pennsylvania, were the veins distended by injection after death, although the arteries were employed for the injection of the preserving formalin solution. Such collapse of the walls of the vein as did occur disturbed very little its relation to the femoral ring, so that we have in these specimens a fair demonstration of the actual condition of the ring in life and the formation of its boundaries, as well as of some of the variations that may be expected.

Modern illustrations made by skilful artists will best emphasize the features of an anatomical illustration, but they are not convincing when there is doubt concerning the accuracy of the anatomy illustrated. The camera would be much more effective if it did not confuse by the mass of unimportant detail and by its failure to bring all parts of the specimen into proper focus. Because of the defects of the camera it will be important to fix attention on the very small part of each illustration under study, the femoral ring or the relation of the femoral vein to the margin of Gimbernat's ligament. A preliminary general study of each illustration will help in making it serve the purpose for which it was intended.

The following reasons for the peculiar course of a femoral hernia have been taken from standard works on surgical anatomy: (1) Slight curve in femoral canal with its concavity forward; (2) narrowing below of the portion of the femoral sheath forming the femoral canal, and the unyielding nature of its adhesion to the lower margin of the saphenous opening and the cribriform fascia; (3) constant flexion of the thigh; (4) traction of the mesentery; (5) the superficial blood-vessels (chiefly veins) and lymphatics descend to the saphenous opening, the veins to join the saphenous vein and the lymphatics to the deeper lymph-nodes, the looping upward tending to suspend a femoral hernia and thus prevent its further progress downward. Let us consider these reasons, briefly, in order. (1) The canal is said to be only a half to three-quarters of an inch long, so that it cannot have much of a curve. (2) The fascial wall of the canal is so thin and weak that it can be found only with difficulty. Regardless of any adhesions it may have, it can offer little or no resistance to the progress of the hernia. (3) Flexion of the thigh should push an inguinal hernia forward and upward if it does so with a femoral. (4) Traction of the mesentery should be no greater than in an inguinal hernia which frequently descends to the bottom of the normal scrotum and sometimes much lower. (5) The blood-vessels referred to (superficial epigastrics) lie external to the course of a femoral hernia and cannot obstruct it, while the lymphatics are so small as hardly to be worth considering. The following explanation, in my opinion, is much more simple and satisfactory and will be best illustrated by the left side of the body shown in Fig. 2. The model illustrated in Fig. 3 will also be of service.

As soon as they pass through the femoral ring, with its three unyielding sides, the hernial contents immediately re-expand. This expansion takes place in all directions except backward, in which direction it cannot expand because immediately behind the hernia is the pectineus muscle resting directly on the pubic bone (see Figs. 4 and 5). Only the skin and weak fascia resist anteriorly so that the whole antero-posterior expansion is forward, and the central axis, therefore, curves

forward. I believe that this central axis does not curve upward, but that the expanding mass simply overlaps Poupart's ligament above (see Figs. 6 and 7), because the narrow neck is just below Poupart's ligament and is curving forward. The intestinal loop in Fig. 3 does curve upward, but we should bear in mind that this represents only a model made to show what some surgeon wanted it to show. Such an intestinal femoral hernia without accompanying omentum is probably uncommon. Rarely the hernia will force its way backward slightly by separating the fibres of the pectineus muscle (see Figs. 2, 4 and 5). This is known as the hernia of Cloquet. Very rarely the hernia escapes outside of the femoral vessels and then is usually also in front of them. Still more rarely it may come down behind the vessels.

The small size and infrequency of the femoral as compared with the inguinal hernia, in all probability is due to the small space through which it must escape from the abdomen and the unyielding margins of this space on three sides. It is a little difficult to understand why the femoral vein does not suffer more from the pressure of the hernial neck with swelling of that limb, as it is on the only side of the neck which can yield much to the pressure. It is likely that it is aided by the attachments of its fascial sheath to Poupart's ligament above and the pubic bone below in accommodating itself to its crowded condition. The size and character of the opening have an important bearing, also, on the nature of the hernial contents. Not infrequently, writers refer to the contents as though they were usually omentum and intestine or one was present as frequently as the other, Da Costa,[2] however, says that femoral hernia contains omentum, but rarely intestine, except in strangulated cases. My study of femoral hernia seems to support this statement, and leads me to regard it as a particularly dangerous hernia because at any time intestine may escape and cause strangulation. The ring may be unusually large, as in Fig. 4, and the intestine escape strangulation. Thomson and Miles[3] say that the hernia is often as small as a cherry or a pigeon's egg and may contain only a small tag of omentum or a portion of the circumference of the bowel—Littre's hernia. Large herniæ containing several coils of intestine are sometimes met with. In my group of cases intestine was not present when the sac was opened in any, except the two which were strangulated, and in both of these a small single loop was surrounded by a much larger mass of omentum. This suggests that both were purely omental until the escape of intestine caused the strangulation. The probability is that in most cases, as soon as the wall of the intestine gets into the ring its circulation is dangerously restricted by the pressure and that

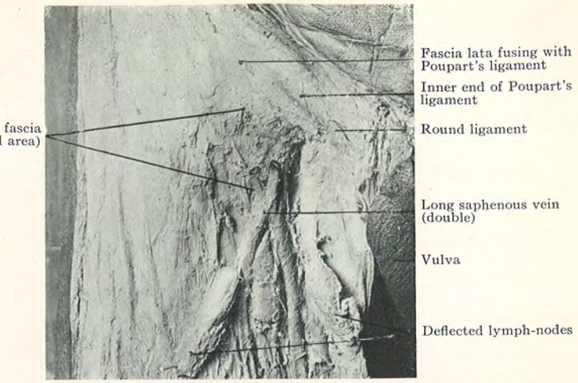

FIG. 1.—Right groin. Skin and superficial fascia removed. Fascia lata fuses with Poupart's ligament and becomes thin (cribriform fascia) where perforated by saphenous vein. Saphenous opening must be made by dissector's knife or scissors. Lymph-nodes which covered cribriform fascia have been deflected.

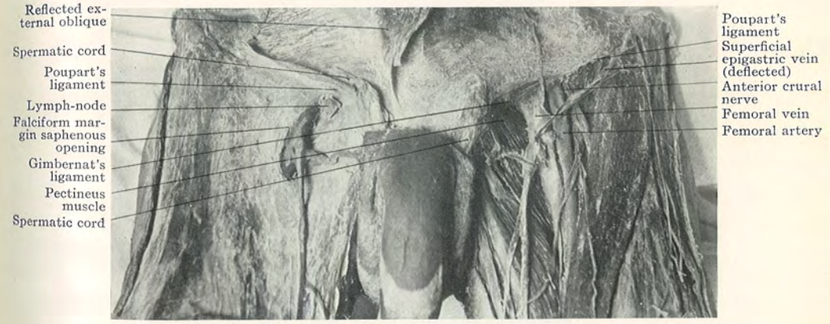

FIG. 2.—Regions of inguinal and femoral herniæ on both sides of body. On right side fascia lata exposed with removal of cribriform fascia, making saphenous opening. Lymph-node resting against femoral ring, but not passing through it as shown in Fig. 10. Portion of external oblique muscle turned inward, leaving Poupart's ligament, internal oblique and spermatic cord in normal positions. On left side fascia lata removed, exposing Scarpa's triangle with its contained structures in normal position. Only Gimbernat's ligament has been touched by paint brush to emphasize absence of any space between it and femoral vein.

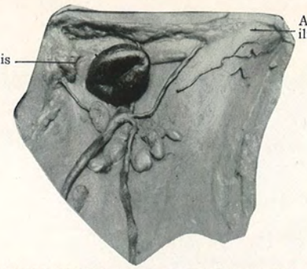

FIG. 3.—Taken from a museum model of a strangulated femoral hernia in the University of Pennsylvania. The small size of the hernia, the single loop of intestine and the turning forward of the hernia are characteristic. The turning upward is, probably, exaggerated. The color of the intestine indicates strangulation.

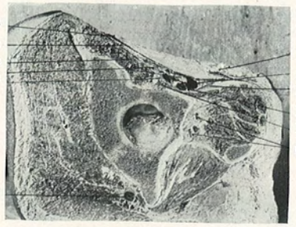

FIG. 4.—Cross-section of thigh at its junction with abdomen, a little above outer half of Poupart's ligament. Femoral ring unusually large, partly because of small femoral vein. Space between Poupart's ligament and pubic bone almost entirely filled by iliacus and psoas muscles with anterior crural nerve between the two. Boundaries of femoral ring shown clearly. Pectineus muscle seen under ring when viewed externally, but not when looked at from inside (see Fig. 8) because the pectineus ends above at the margin of the ring.

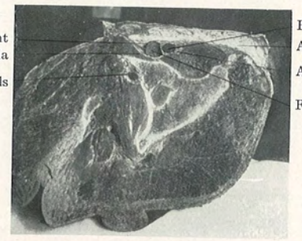

FIG. 5.—Cross-section of thigh at its junction with abdomen, as in Fig. 4. Inner portion of thigh cut longitudinally to save the penis and scrotum. Femoral vein larger than in Fig. 4 and in intimate contact with margin of Gimbernat's ligament, so that in such a patient no femoral ring exists until a hernia comes through and pushes the vein outward.

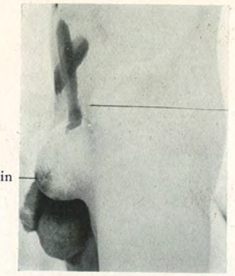

FIG. 6.—Case VII. An unusually large femoral hernia. It clearly does not turn upward, although in its upper part it overlaps Poupart's ligament. The darkened area of skin over the most prominent portion was very thin and became the apex of a conical tumor when the patient coughed.

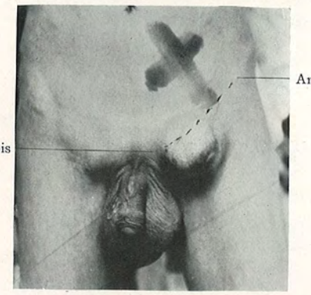

FIG. 7.—Case VII. More clearly shows that most of the hernia is below Poupart's ligament

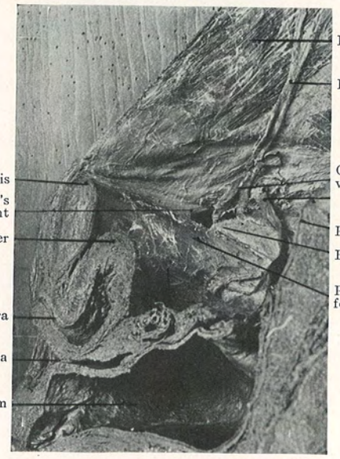

FIG. 8.—View from inside of specimen shown in Fig. 4. Lower boundary of femoral ring now seen to be the pubic bone. Wall of the small femoral vein seems to have fallen away slightly, enlarging the ring still more.

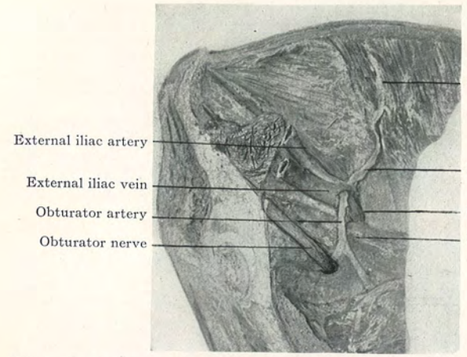

FIG. 9.—Inside view of left half of specimen shown in Fig. 2. Absence of femoral ring again shown by close contact of femoral vein with Gimbernat's ligament. It was particularly difficult to obtain a satisfactory picture of this specimen from the inside. This side has been emphasized slightly by the artist.

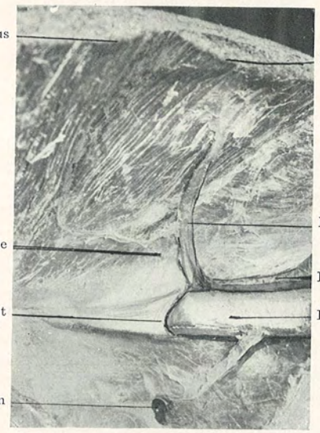

FIG. 10.—Inside view of right half of specimen shown in Fig. 2. Margins of the vessels and Gimbernat's ligament emphasized slightly by the artist. No actual femoral ring here and lymph-node seen on this side in external view (Fig. 2) not seen on inside.

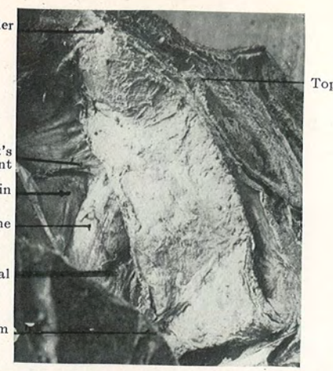

FIG. 11.—Left half of male pelvis looked at from right side and posteriorly. Rest of picture sacrificed to focus attention on femoral ring. Bladder in this specimen rises more than an inch above the top of the symphysis pubis. Normally it is at or below this level. It is also seen to extend close to the femoral ring and inguinal canal, the inner end of which is just above the femoral ring, so that the bladder might find its way into a femoral or a direct inguinal hernia.

FIG. 12.—Right half of same pelvis shown in Fig. 11. Femoral ring filled and perhaps effectively plugged by a lymph-node. Enlarged bladder again evident. Abnormal fold in abdominal wall above due to bending it forward.

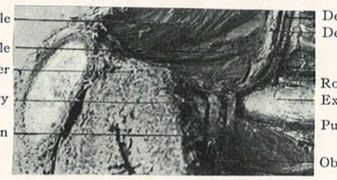

FIG. 13.—Right half of pelvis showing femoral ring covered over by the obturator artery and vein which are coming from the deep epigastrics. These might effectively prevent the development of a femoral hernia. On lifting these vessels and exposing the femoral ring, the margin of Gimbernat's ligament was found separated from the vein about a quarter of an inch. Much thickened bladder, probably due to its complete collapse.

strangulation is present either before the whole circumference of the bowel can escape or soon afterward, so that more than a single coil is rarely met with. The surgeon knows how difficult it is, frequently, to prevent the escape of very small portions of the omentum between the stitches while closing the peritoneal layer of an abdominal incision. He, therefore, knows that omentum can escape through a very small opening and may not suffer much from the constriction. But all of the omentum would not make a very large hernia, and all of it could not escape without taking with it the transverse colon. In a recent case of strangulated inguinal hernia upon which I operated, the length of the hernia was about equal to two closed fists side by side and the diameter slightly larger than that of the fist; the contents consisted of almost all of the omentum and a considerable portion of the transverse colon. The mass of extruded omentum was about the size of that of the colon. Very large herniæ are, therefore, made up chiefly of intestine, and a femoral hernia usually remains small because only omentum in varying quantity can come through or the early constriction and strangulation of the first loop of intestine prevents more from escaping. This is particularly true because the neck of the hernia is usually already filled with omentum before the intestine comes through.

Akerman,[4] in 1889, reported 235 cases of gangrenous intestinal hernia operated on in the Swedish Hospitals; and in 1913, 664 new cases, making a total of 899 cases. Of these, 214 were inguinal, 658 femoral, 13 umbilical, 7 ventral and 7 obturator. The femoral were slightly more than three times as frequent as the inguinal and the proportions of all kinds varied very little in the two groups of cases, which contributes to the reliability of the proportions since they are made up from cases operated on at different hospitals and by different surgeons. Von Bergmann and Bull [5] quote the following authorities on proportions of inguinal to femoral, in strangulated herniæ: Bryant, 50 to 44; Gosselin, 113 to 104; Maydl, 159 to 132; Henggeler, 111 to 159. Deaver and Ross [6] recently gave them as 77 to 50. The total number of cases in this group is 999, or 510 inguinal and 489 femoral. But Akerman reported only cases in which gangrenous intestine was found, while this group includes all strangulated herniæ. A pure omental femoral hernia may become strangulated but this is probably rare. One in an elderly hemiplegic woman came to autopsy at the Philadelphia Hospital recently. Many strangulated herniæ are now operated on before gangrene sets in but, owing to the smaller space and sharp, rigid margin of Gimbernat's ligament, gangrenous intestine may be expected earlier and more frequently in femoral than in inguinal hernia. Coley [7] says that of

75,535 cases of hernia admitted to the New York Hospital for Ruptured and Crippled Children, the relative frequency of femoral to inguinal was about as 1 to 17, which he says is the same proportion as that observed at the London Truss Society, according to the statistics of Macready. In 1720 operations for hernia, Sertoli [8] found 106 femoral and 1543 inguinal, or a proportion of 1 to 15. If we estimate strangulation in femoral as almost as frequent as in inguinal and the general proportion of inguinal as 15 to 17 times greater than femoral, the chances of strangulation are correspondingly greater in femoral. Intestine is very frequently present in inguinal hernia, and DaCosta's observation that it is rarely present in femoral, except in strangulated cases, is probably correct. If all inguinal herniæ are 15 to 17 times more frequent than all femoral, intestine very frequently present in inguinal and rarely in femoral, and strangulated femoral almost as common as strangulated inguinal, then intestine escaping into a femoral hernia will rarely escape strangulation.

There were said to be 116 Littre's herniæ in Akerman's second group of 664 gangrenous intestinal herniæ (154 inguinal and 487 femoral), but his report does not show their relative frequency among the different varieties of hernia. A Littre's hernia is one in which only a part of the circumference of the bowel escapes, *i.e.*, in Akerman's cases, strangulation occurred before the whole circumference of the bowel could get through the constricting ring. The presence of a small single loop is characteristic of a strangulated femoral hernia because of the small space through which it must pass and the rigid and sharp margins of the ring, as shown by the illustrations. Strangulation is more frequent, relatively, in obturator hernia because the obturator ring has still more rigid margins and is not capable of being enlarged as much as the femoral ring. These facts support the suggestion that intestine will rarely escape through the femoral ring without becoming strangulated, and that, therefore, all femoral herniæ are dangerous because intestine may escape on any severe strain. When the femoral ring is large, as in Fig. 4, there may be little danger of constriction, but such large rings are probably the exception and not the rule.

The diagnosis of a femoral from an inguinal hernia is sometimes difficult. In four of this group inguinal hernia had been diagnosed. Some years ago a group of young surgeons debated the diagnosis in the case of a boy. It was finally decided that it was probably an inguinal hernia. I had the privilege of operating on this case and it proved to be a femoral. The tendency has seemed to be to diagnose inguinal, when

in doubt, because, owing to the greater frequency of inguinal, the chances are in its favor. According to my experience, if the diagnosis is difficult the hernia is likely to prove to be a femoral. It is more easy to demonstrate that an inguinal hernia is above Poupart's ligament than that a femoral hernia is below, because the latter pushes forward immediately below the ligament and its upward expansion covers and obscures it (see Figs. 6 and 7), while an inguinal hernia makes the ligament rather more distinct than normal. In the male, the external inguinal ring can be felt by invaginating the scrotum, in the absence of a hernia, and when it has been enlarged by a hernia it is more easily recognized. Examination of this ring is a valuable aid in determining if the hernia is inguinal or not. But it is much less easy to feel the external ring in a female in whom femoral hernia is much more frequent, and it is not easy to feel the margins of the femoral ring when a hernia has been reduced through it, especially if the patient is fat, as many of them are. When there is little fat it is not difficult to recognize that the tip of the finger sinks into an abnormal depression, at the site of the femoral ring, just below Poupart's ligament and well outside of the spine of the pubis. When there is much fat, the patient a female, the hernia irreducible, and the external inguinal ring cannot be felt, it may be very difficult to positively diagnose a femoral hernia. During the past fifteen years, it has been my privilege to examine a large number of hernia, especially at the Philadelphia Hospital, and this experience has taught me that it is best, when the diagnosis is doubtful, to regard the hernia as femoral until I can prove that it is not. The best evidence in favor of its being femoral is that most of the tumor lies below the approximate line of Poupart's ligament (an inguinal is distinctly above), that it is well outside of the pubic spine (the spine can be felt outside of an inguinal hernia), and when the hernia is reduced the finger can usually be pressed into a depression just below Poupart's ligament.

The great danger to which hernia patients are exposed is that of strangulation, and the risk is greater in femoral than in any of the other common forms. Obturator hernia is comparatively more frequently strangulated than femoral but is not as common a hernia. So long as a femoral contains only omentum there is probably little danger of strangulation, but a knuckle of gut may escape at any time and bring on strangulation. Akerman discussed, chiefly, the results of operation for gangrenous intestinal hernia which were bad, v. Bergmann [9] says that there is little reason to expect a favorable result from taxis in strangulated femoral hernia and that one should advise

against it and in favor of radical operation. Since the patient is always in danger of the escape of intestine and the development of strangulation, the best treatment is to prevent gangrenous hernia by operating before strangulation occurs. Operation in this stage has a very low mortality and recurrence of the hernia is rare. Many different operations have been performed in comparatively recent years. Ochsner [10] enumerated 20 and Sprengel [11] (quoting Goebel) 50. The plastic operations for filling the canal by muscular, periosteal, osteoperiosteal and heteroplastic flaps are wrong in principle, in my opinion, and have had little support, while the simpler operations prevail. Ochsner says that removal of the sac without closure of the canal will cure all cases. While I added one or two mattress sutures to close the ring, I found much in my anatomical study to support Ochsner's radical statement. With proper regard for the femoral vein the operation becomes almost a minor one. The hernia is almost subcutaneous, no muscles are divided and the peritoneal cavity is barely opened. The placing of one or two mattress sutures to approximate Poupart's ligament to the pectineus muscle and fascia adds little or nothing to the danger of the operation, the early performance of which in practically all cases would involve much less risk than taking the chances of intestine or bladder escaping through the ring and causing strangulation.

If the sac is separated from the margins of the ring on all sides, drawn down and the ligature placed as high as possible, the stump will retract or can be pushed upward into the abdomen, when nothing will intervene between the femoral vein and the remaining margins of the ring. The anatomical illustrations show that the femoral vein must have been pushed outward by the hernia away from the curving margin of Gimbernat's ligament. When the hernia has been entirely removed the femoral vein relieved of this pressure should soon find its way back to its normal position, close to or in contact with the margin of Gimbernat's ligament. The vigorous contractions of the very active iliacus and psoas muscles should be important factors in forcing the vein against the ligament, since they almost completely fill the space between Poupart's ligament and the underlying pubic bone (see Figs. 4 and 5). The effect of sutures forcing Poupart's ligament down to the pectineus muscle would be to compress the vein and thus force it into closer contact with the remaining margins of the ring. The introduction of tissue of any kind, as bone, muscle, etc., into the ring would not close it more effectively but would only serve to permanently displace the vein from its normal position. Cicatricial adhesion of the vein to the remainder margins of the ring would be more effective in preventing a recurrence of the hernia, since it is just this relation which best prevents the first development of the hernia. A purse-string suture would accomplish the same purpose as the mattress sutures but has no advantages over them.

The usual method of exposing the sac, separating it from the surrounding fat, and after ligating its neck cutting it away, leaves the ring and the femoral vein covered by a confusing mass of fat which is retracted with some difficulty and makes the exposure of the pectineus muscle and fascia and protection of the vein rather troublesome. The normal fat of this region is considerably increased by the preperitoneal fat pushed out with the sac and left here after the sac has been removed. I have found it advantageous to remove a thick layer of fat with the sac, so that the later exposure of the margins of the ring, femoral vein and pectineus muscle becomes less troublesome. In my opinion, the vertical has advantages over the transverse incision. In its upper part the external oblique aponeurosis is quickly exposed and its lower border, Poupart's ligament, easily outlined. This is an excellent landmark. Just below it the neck of the sac with its surrounding fat can be seen, just external to which is the femoral vein. Removal of the adherent fat with the sac, high ligation of the neck with retraction upward of the stump out of the operative field, will facilitate the protection of the femoral vein and the passing of one or two mattress sutures to approximate the pectineus muscle and Poupart's ligament or the floor and roof of the ring.

Having had no experience with the method of closing the ring from the inside, through the inguinal canal, I can express an opinion based only upon my anatomical study and my experience with the ordinary closure of the ring from the outside. The illustrations showing the ring from the inside (see Figs. 8, 9, 10, 11, 12 and 13) demonstrate that its lower boundary is the pubic bone. This is covered only by loose connective tissue and peritoneum. In exposing the ring for the placing of the sutures, most of the overlying connective tissue is pushed away, leaving only the periosteum and a little connective tissue to hold the sutures. I would not trust the needle to pass under the periosteum without cutting its way out, in which case the suture could have no influence in closing the ring. On the other hand, the obturator vessels not infrequently come from the deep epigastric and pass to the obturator canal over the internal surface of the ring, as shown in Fig. 13. In most other cases pubic branches of the deep epigastric of considerable size have the same general relation to the ring as they pass to the pubic region. There are no such vessels to interfere

with the exposure and suture of the ring from the outside, where the suture can take hold of the substantial pectineus muscle and overlying fascia forming the floor of the ring. This muscle arises at the bony margin of the ring so that the suture catches it immediately below the ring. The advantage, therefore, should be with the external operation.

Case VII.—Man, forty-four years old. Admitted to tuberculous wards of Philadelphia Hospital, December 6, 1913. Diagnosis of advanced tuberculosis of lungs and tuberculosis of intestines. Now has a hernia in the left groin. Says he was operated on in this hospital for a hernia on the left side during the past summer, and this is confirmed by the presence of a linear scar over the position of the inguinal canal. It was, therefore, assumed that we were dealing with an inguinal hernia recurring after operation and no further effort was made to establish the diagnosis. Transferred to surgical service of Dr. A. C. Wood, January 10, 1914. The size and shape of the hernia are shown in Figs. 6 and 7. During standing and coughing, which is severe, the hernia assumes a conical shape and the skin over the most prominent part is bluish in color and evidently very thin. The patient desires operation because, during coughing, he has the feeling that the hernia is about to burst, and it then looks as though it might do so.

Operation (January 12).—Under spinal anæsthesia, with 10 c.c. of a ½ per cent. novocaine solution. The incision was made to expose an inguinal hernia. The skin was very thin over the most prominent portion of the hernia and was here very adherent to the sac. The external oblique and external ring appeared to be normal, no evidence of a scar of a previous operation being found in this muscle. The neck of the sac was found to be coming through the femoral ring. It afterward developed that he had been operated on for an abscess of the groin and no record of a previous operation for hernia could be found. The only contents of the sac found at operation was omentum, although my recollection of the way in which the hernia distended during coughing and its size led me to believe that it then contained intestine also. The neck of the sac was isolated as high as possible, drawn down and ligated as high as possible, and after removal of the sac the stump retracted upward. Two catgut mattress sutures were employed to approximate Poupart's ligament to the pectineus fascia and muscle in order to close the probably large ring. Silkworm-gut sutures for the skin. Dressing. Primary healing. Firm pressure was maintained over the wound by adhesive strips and a spica bandage of the groin for five weeks. Notwithstanding the continuous severe coughing no recurrence of the hernia had occurred up to the time of his death on December 9, 1914.

Case VIII.—Woman, forty-six years old, well nourished. Transferred to my service in the Philadelphia Hospital, July 4, 1914, from the nervous ward where a cervical myelitis was diagnosed. On the right side, just below Poupart's ligament, is a hernia about the size of a hen's egg, which is easily reducible and had been diagnosed as an inguinal hernia. The patient has been and is now complaining of much pain in the abdomen, particularly in the pelvic region. A dilatation and curettement of the uterus had been done for the possible relief of the pelvic pain.

Operation (July 10).—The patient requested that her abdomen be opened on account of her pain. Trendelenberg position. Pfannenstiel incision just above the pubis, and the abdomen opened and explored, but nothing abnormal found that would account for the abdominal pain. Abdominal wound then closed up to and including anterior sheath of the rectus muscle. Right end of skin and fascial portion of incision lengthened to region of hernia, the neck of which was easily outlined just below Poupart's ligament. The sac with its adherent fat was separated from the surrounding tissue, opened and found to contain some adherent omentum which was drawn down and ligated high and cut away beyond the ligature, the stump retracting upward into the abdomen. Poupart's ligament sutured to the pectineus muscle and fascia as in the preceding cases, and the skin incision closed with silkworm gut. Uneventful recovery and no recurrence of the hernia up to the present time.

Case IX.—Man, fifty years old, laborer. Admitted to my service in the Philadelphia Hospital, July 30, 1914, with a hernia in the left groin about the size a small fist, which is reducible. Femoral hernia diagnosed and operated on July 31.

Operation.—Vertical incision over hernia, exposure of external oblique first and neck of hernia just below Poupart's ligament. Sac with adherent fat isolated, ligated high and removed as in preceding cases, and Poupart's ligament sutured to pectineus muscle and fascia. Silkworm gut for skin wound. Uneventful recovery and no recurrence up to present time.

Case X.—Woman, sixty-nine years old. Emaciation and wrinkling of face make her appear ten years older. Admitted to my service, July 5, 1914, with a strangulated femoral hernia on the left side, and in a stuporous condition. From a relative it was learned that the hernia had existed about four years. For about four days before admission it had been irreducible and painful and after admission mild attempts at reduction by the

interne were unsuccessful. Operation the same day under local anæsthesia with a 2 per cent. novocaine solution.

Operation.—Sac exposed by an incision parallel to Poupart's ligament, opened and found to contain a considerable mass of omentum and a single loop of small intestine about four inches long. Both omentum and intestine were dark in color but neither was completely gangrenous, the intestine being a dark red. Gimbernat's ligament was divided on a grooved director and the loop of intestine drawn out until healthy bowel was reached. In doing this the inner limb of the loop gave way into the lumen at what was clearly the line of constriction by the sharp edge of Gimbernat's ligament and where the bowel wall was distinctly necrotic. The omentum was also driven out until a healthy portion was reached and it and the intestine were sutured to the margin of the ring. A portion of the omentum was removed, but the intestine was not resected because of the very weak condition of the patient. The bowels were freely opened, but no fæces appeared until the following day, when they escaped freely. The patient showed no signs of reaction after the operation and died two days later.

Case XI.—Woman, fifty-seven years old. Admitted to my service in the Philadelphia Hospital, August 7, 1914, with an irreducible right femoral hernia, which extended about six inches in the line of the groin and about two inches from above downward. The patient is dull and semistuporous and her statements are hardly reliable. The only apparently reliable answers she gave seemed to show that the hernia became irreducible about two weeks ago, that the bowels have not moved in that time and that she has not vomited. The overlying skin is dark red in color and the hernia tense and very tender. It is irreducible, there is no impulse on coughing and there is fluctuation in one part. Diagnosis of a strangulated femoral hernia was made. The patient is fairly well nourished, but there is a purulent discharge from both eyes and the left nostril. Heart and lungs negative, abdomen much distended, and a small umbilical hernia which is apparently giving no trouble. Operation soon after admission under local anæsthesia with a 2 per cent. novocaine solution.

Operation.—Incision in long axis of hernia. As soon as skin and subcutaneous tissue were divided, a small quantity of dark, grumous, foul-smelling material was evacuated. The sac was thick and dark in color and when opened was found to contain a considerable mass of omentum and a small single loop of small intestine, both of which were distinctly gangrenous. Gimbernat's ligament was carefully divided on a grooved director and the intestine and omentum brought out until healthy portions of both could be sutured to the margins of the ring. A portion of the protruding omentum was cut away. The line of demarcation in the intestine was distinct. On the following day the gangrenous portion of the bowel was cut away and soon afterward fæces appeared in the wound. The patient did not react from her weak and semistuporous condition, although she lived for three days after the operation.

Case XII.—Medical student, twenty-four years old. While playing foot-ball about ten years ago, developed a severe pain in the right groin. A direct inguinal hernia was diagnosed at the time and at different examinations afterwards. I saw him July 6, 1914, and diagnosed a femoral hernia which was found at operation, two days later, at St. Agnes Hospital.

Operation.—A longitudinal incision about 2½ inches long was made over the hernia, the sac exposed and opened but the neck was so small that a finger could not be passed through the ring, a grooved director being necessary for the purpose. The sac with its adherent fat was isolated, drawn down, ligated high and cut away, the stump retracting upward under Poupart's ligament. The pectineus muscle covered by its fascia was exposed and Poupart's ligament drawn down to it by one catgut mattress suture. Silkworm gut for the skin and dressing applied. Healing uneventful. He has since engaged in vigorous exercises without any sign of recurrence of the hernia.

Conclusions on Femoral Hernia.—In femoral hernia we are concerned not with a canal as in inguinal hernia, but with a ring as in umbilical hernia.

The femoral hernia turns forward immediately after passing under Poupart's ligament, because it can expand only forward, the pectineus muscle lying on the pubic bone preventing any backward expansion. The upward expansion of the hernia overlaps and conceals Poupart's ligament, but the whole hernia does not turn upward. Occasionally it separates the fibres of the pectineus, posteriorly, and is then called a hernia of Cloquet.

A femoral hernia is usually small and comparatively infrequent, for the same reason that an obturator hernia is small and infrequent, because of the small ring and its rigid margins. The femoral ring is small or does not exist until the escaping hernia pushes the femoral vein away from the margin of Poupart's ligament, which it does with difficulty and for a small distance. Omentum gets through with difficulty and intestine is usually strangulated soon after it begins to come through. Most femoral herniæ are, therefore, omental until intestine escapes and causes strangulation.

When the diagnosis between inguinal and femoral hernia is difficult, a femoral hernia will probably be present.

All femoral herniæ should be considered dangerous because intestine may escape on any severe strain and cause strangulation. For this reason it is safer to operate on all femoral herniæ before strangulation than to take the chances of strangulation.

The hernia is subcutaneous, no muscles are divided, and the peritoneal cavity is barely opened. Simple removal of the sac will probably cure in the great majority of cases, but the approximation of Poupart's ligament to the pectineal muscle and fascia by one or two catgut sutures will add to the certainty of cure.

The vertical has advantages over the transverse incision, and the removal of a thick layer of the fat adherent to the sac favors the easier exposure and suture of the ring.

The closure of the ring by the external exposure and suture is safer, easier and more effective than by the internal exposure through the inguinal canal.

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STATED MEETING, HELD OCTOBER 4, 1915

The President, Dr. John H. Gibbon, in the Chair

FRACTURE OF THE OS CALCIS

Dr. Nathaniel Ginsburg related the details of four cases of fracture of the os calcis. The first two of these were observed and treated by him through the courtesy of Dr. Edward Martin. Their histories are as follows:

Case I.—Case No. 10468. M. I., male, was admitted to the Mt. Sinai Hospital on April 4, 1915, and discharged on May 20, 1915. He had jumped out of a second-story window to escape from a fire, and landed on the heel bones of both feet. He was immediately brought to the hospital, unable to stand, with severe pain, swelling, and discoloration of the entire posterior portion of the foot and lower leg. X-ray showed present fracture of both ossa calcis. The patient remained in the hospital about six weeks and was finally discharged able to go about on a cane and crutch. He died six weeks ago of heart disease.

Case II.—Case No. 10690. A. M., male, was admitted to Mt. Sinai Hospital on April 18, 1915, and discharged May 27, 1915. He fell from a step-ladder, alighting on the heel-bone of the right foot, and sustained a fracture of the os calcis. He now walks with a cane and has pain on the outer side of the foot below the external malleolus.

Case III.—Female, aged thirty-five years, was admitted to Dr. Ginsburg's service at the Jewish Hospital, June 22, 1915, having fallen through a skylight to the floor below, landing upon both feet. She sustained a fracture of the left os calcis and a transverse fracture of the internal and external malleoli of the left tibia and fibula without separation of the latter fragments. In addition she sustained a fracture of the external tuberosity of the right tibia, the line of fracture running into the knee-joint, and a fracture of the adjacent head of the fibula with some impaction. This type of fracture of the tibia in this region is of rare occurrence. The patient was put to bed with moderate extension by traction apparatus on the right leg, not sufficient, however, to separate the fragments but merely to prevent contact of the knee-joint surfaces.

The displacement of the os calcis was regarded as one which could not be markedly improved by operation or by much manipulation, and the foot and leg were put at rest in a fracture box