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ANNALS OF SURGERY

A MONTHLY REVIEW OF SURGICAL SCIENCE AND PRACTICE

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ANNALS OF SURGERY

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No. 1

ORIGINAL MEMOIRS.

THE RESULTS OF RADICAL OPERATIONS FOR THE CURE OF CARCINOMA OF THE BREAST.*

BY WILLIAM STEWART HALSTED, M.D.,

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Surgeon to Johns Hopkins Hospital.

IT is especially true of breast cancer that the surgeon interested in furnishing the best statistics may in perfectly honorable ways provide them. The most conscientious man may refuse to operate upon any but favorable cases, and, by performing an incomplete operation, exclude from his list of complete operations such bad ones as he finds himself operating upon. Or the pathologist on whom he relies may classify as carcinoma, tumors which on microscopic examination show dangerous spots—*i.e.*, a few epithelial cells here and there escaping into the stroma.

But you will concede that little notion of the value of an operative procedure can be gained unless some attempt be made to exclude or consider apart cancers so far advanced that, however radical the operation, only a portion of the disease can be removed.

The Results.—As effecting the ultimate result, the variety of the cancer, the time elapsed since its appearance, the degree of outlying involvement, the activity of the gland (lactation, age of patient), the thoroughness of the operation, are important factors.

* Read before the American Surgical Association, May 8, 1907.

There will not be time in this discussion to consider in detail each of these influences. It is the particular wish of the Society, as I have understood it, to learn the results obtained by the modern, so-called complete, operation for the cure of cancer of the breast, and it affords me the greatest pleasure to express anew my obligation to Dr. Bloodgood for his efficiency and inexhaustible zeal in collating facts year after year for so many years, and to thank Mr. Schapiro for his invaluable assistance in tabulating from many points of view our results. I am exceedingly indebted also to the many physicians who have ardently assisted us in the search for data concerning their patients.

I ask your attention to the Tables. According to the plan of operation the cases have been divided into five groups; of these only three concern us to-day. In Group I are the cases in which, at the one occasion, the complete subclavian and neck operations were performed; in Group II, the cases in which at the first operation the complete pectoral or subclavin, and at a second the supraclavicular or neck part was performed; in Group III, those in which only the complete pectoral operation was done, the neck being unexplored. The small letters, *a*, *b*, *c*, *d*, indicate, approximately degrees of axillary involvement; *a*, signifying that the base or lowest part only of the axilla was implicated; *b*, involvement of the midaxilla as well as of the base; *c*, involvement, in addition, of the highest glands of the surgical axilla; and *d*, that the subclavian vein was involved or intimately adherent to the glands.

In the Tables here presented are included only the cases in which nothing less than the complete subclavicular operation was done and only those operated upon three or more years prior to the last news received of them. Excluding 65 cases in which, necessarily, an incomplete operation was performed there remain for study of the cases operated upon at the Johns Hopkins Hospital 232. The result in 18 of these we have been unable to determine. In calculating the percentage of cures untraced cases should be figured as dead of the disease.

In Tables II and III the ultimate results are considered

in relation to the glandular involvement, and in Table II in relation also to the particular operation performed. In 64 of the 232 cases glandular involvement was not discovered; nevertheless in 15 of these (23.4 per cent.) there was metastasis or recurrence of some sort sooner or later; in 6, metastasis three years after operation. It is interesting to note how late the

TABLE I
Carcinoma of the Breast.—Pathologic varieties.

	Number of cases.	Cured cases.	Per cent.
Cancer cysts	6	2 (1?)	33.3
Adenocarcinoma	32	24	75.0
Medullary carcinoma	25	12	48.0
Circumscribed scirrhus.	28	13	46.4
Small infiltrating scirrhus.	80	30	35.5
Large infiltrating scirrhus.	39	8	20.5
Total	210	89	

SYMBOLS USED IN THE TABLES.

Complete axillary operation { Group I, Supraclavicular glands removed at 1st oper.
Group II, Supraclavicular glands removed secondarily.
Group III, Supraclavicular glands not removed.

Letters *a, b, c, d*, indicate degree of axillary involvement :
a, Base of axilla only.
b, Base and midaxilla.
c, Base, midaxilla and apex.
d, Veins intimately adherent.

metastasis occurred in these cases with undetected axillary involvement; another argument for wide operating. Forty-five of the 64, or 70 per cent., of the cases with undemonstrated glandular involvement are tabulated as cured, and 51 of the 64, or 80 per cent., were free for three years from signs of the disease. We must bear in mind, however, that surely in some and probably in many if not in most of the axillæ recorded as negative there was disease.

Of 110 cases with axillary involvement and negative neck, 27 cases, or 24.5 per cent., are cured for periods ranging from 16 to 3 years. Adding 11 untraced cases with axillary involvement to the 110 in which the result is definitely known,

reduces the percentage of cures in this category to 22.4 per cent.

The fact that in this country at least a number of the leading surgeons of the generation prior to mine made the pronouncement that they had not in their lifetime cured a single case of breast cancer notwithstanding the fact that they removed the entire breast, a liberal piece of skin, and after a fashion, some axillary glands, is strong presumptive evidence that in almost every instance the cancer, as then recognized, had entered the lymphatic vessels. As further proof of this is

TABLE II
Carcinoma of the Breast.—Cases operated upon 3 or more years prior to last news of them.

Ultimate result as affected by degree of axillary involvement.	Axilla only involved.				Axilla and Neck involved.				Totals
	a	b	c	Total	b	c	d	Total	
CURED, living 1906-1907.....	6	..	..	6	..	..	1	1	7
CURED, living in 1905.	3	3	..	6	..	..	..	..	6
CURED, dead of other causes 3 years +...	..	2	2	4	1	1	..	2	6
CURED, dead of other causes 3 years —...	..	..	1	1	..	..	..	..	1
Actual cures	9	5	3	17	1	1	1	3	20
WELL 3 years, metastasis later	1	4	..	5	..	1	1	2	7
Cured 3 years and over.....	10	9	3	22	1	2	2	5	27
DEAD, local recurrence	1	3	3	7	1	6	1	8	15
DEAD, regionary recurrence	5	4	6	15	2	7	2	11	26
DEAD, internal metastasis.....	5	13	5	23	1	9	5	15	38
Cases not cured	11	20	14	45	4	22	8	34	79
Cured 3-year cases	10	9	3	22	1	2	2	5	27
Postoperative deaths.....	..	..	..	3	..	..	..	1	4
Untraced .....	..	..	..	11	..	..	..	3	14
No data as to extent of axillary involvement	..	..	..	43	..	..	..	1	44
	21	29	17	124	5	24	10	44	168

our observation that even in the cases with microscopically negative axilla, and notwithstanding our extensive operation, there is death from metastasis in 23.4 per cent.

Fortunately we no longer need the proof which our figures so unmistakably give that the slightest delay is dangerous and that, other things being equal, the prognosis is quite good in the early stage of breast cancer, two in three being cured, and bad, three in four succumbing, when the axillary glands are demonstrably involved. We find encouragement for our operative

TABLE III
Carcinoma of the Breast.—Cases operated upon 3 or more years prior to last news of them.

	Glands of axilla and neck negative.			Glands of axilla and neck positive.			Totals.
	Glands of axilla and neck negative.			Glands of axilla and neck positive.			
	I.	II.	III. Total	I.	II.	Total	
Ultimate result as affected by axillary and neck involvement.							
CURED, living: heard from in 1906-1907.....	4	1	20	4	..	5	9
CURED, living: heard from in 1905.....	4	2	7	4	..	3	7
CURED, dead of other cause more than 3 years post op.	4	..	3	4	..	3	7
CURED, dead of other cause less than 3 years post op. ....	..	..	..	1	..	3	4
Cases actually cured.....	12	3	30	13	..	14	27
CURED 3 years after operation, metastasis later.....	1	..	5	3	..	4	7
Cases cured not less than 3 years.....	13	3	35	16	..	18	34
DEAD, local recurrence.....	..	..	..	5	..	11	16
DEAD, regional recurrence.....	1	..	3	13	1	7	21
DEAD, internal metastasis.....	2	..	3	15	1	23	39
Cases that have not been cured.....	3	..	6	33	2	41	76
Cases cured 3 years and more, as above.....	13	3	35	16	..	18	34
Postoperative Mortality.....	16	3	41	49	2	59	110
Untraced.....	..	..	..	2	..	1	3
	..	..	4	3	..	8	11
	16	3	45	54	2	68	124
	31	13	44	31	13	44	232

and laboratory labors and to increased endeavor quite as great from the relatively poor results obtained in the advanced cases as from the more favorable outcome in the cases in which no involvement of lymphatic glands was detected.

The neck operation was done in 101 cases primarily and in 18 secondarily. In 113 of the 232 cases the supraclavicular operation was omitted. In 44 patients the glands of the neck as well as of the axilla were involved. Three of these, or 7 per cent., were, it seems, definitely cured. One is still living, twelve and a half years since the operation; a second lived six years and died of diabetes; a third, three and three-quarter years without signs of return, died of acute pneumonia; and in a fourth, after three years of apparent freedom, the disease re-manifested itself. We have reason to be quite certain that there

TABLE IV
Carcinoma of the Breast.—Study of cured 5-year cases. (To January, 1907.)

	Cases.	P.O.D. and lost.	No. of cases.	Cured, living.	Cured, dead.	Metast. after 5 years.	Total.	Per cent.
Group I	96	8	88	13	6	5	24	27.27
Group II	16	..	16	3	1	1	5	31.25
Group III	92	5	87	23	3	4	30	34.48
	204	13	191	39	10	10	59	30.89

was also involvement in some of the necks reported as negative.

Before accepting the statement of any one that he has cured a case of breast cancer with neck involvement, incontrovertible proof should be demanded. I confess that even if the microscopic findings were confirmed by an able pathologist I should still feel that an error might have occurred, for example, in the labeling of the specimen. The naked eye diagnosis of the surgeon should count for nothing unless he is a sound pathologist and the macroscopic findings are specifically detailed. Inflammation may produce appearances in lymphatic glands quite indistinguishable macroscopically from carcinoma, whether medullary or scirrhus. If the deposit is described as sharply outlined against the more normal portions of the gland, particularly if cortical, the observation deserves consideration. We

should demand as further proof of cure in these positive neck cases that the patient live at least five years after the operation, or negative autopsy findings, a year or perhaps even two years thereafter. With these stipulations fulfilled I should still be sceptical as to the cure. Cancer was diagnosed both macroscopically and microscopically in the three cases of cure claimed by us. But even without the proof which we offer, it is, I think, incumbent upon the surgeon to perform in many cases the supraclavicular operation. He should surely perform it, barring, of course, special contraindications, (1) in all cases with palpable, operable, neck involvement; (2) when the apex of the surgical axilla is involved. When midaxillary involvement is demonstrable at the operation apical implication is almost certain, and hence (3) in these cases also the neck should be typically cleaned of its lymphatics, as high, at the very least, as the bifurcation of the carotid.

We find ourselves for the past two years again performing the neck operation in most cases. We omit it in hopeless cases, in most "duct cancers," and in some carcinomata of emphatically adenomatous type in which the axilla at operation is not macroscopically involved.

To determine the relation of supraclavicular to subclavicular involvement detailed observations at the operating table with especial reference to this point must be made; and almost endless laboratory work is necessary. To be able to assert with any degree of positiveness that the axilla and neck are negative involves infinite toil. The findings at operation must be recorded on charts designed especially for this purpose; and a laboratory enthusiast of a rare type is indispensable.

For the greater convenience of the reader the following summary is given. Of the 232 cases considered, 18 remain untraced. Of the 210 traced cases we accept as *cured*:

35 cases reported living in 1906-1907	16.6 per cent. of 210
20 cases reported living in 1905	9.5 per cent. of 210
16 cases known to have died of causes other than carcinoma of the breast three or more years after the operation	7.9 per cent. of 210

4 cases dead of other disease, less than
three years post op., in which the cure
was demonstrated by autopsy 1.9 per cent. of 210

Total, cured, 75 cases = 32.3 per cent. of 232, and 53.6 per cent. of 210

In 14 cases metastasis appeared after three years; in one instance manifesting itself as late as eight years and in two instances more than six years after the operation. Thus, 89 cases (42.3 per cent. of 210, and 38.3 per cent. of 232), were apparently cured for three or more years.

In the 210 traced cases the condition of the axilla and neck as regards glandular involvement was as follows:

		Cured.	Per cent.	Cured 3 years.	Per cent.
Axilla and neck negative	60 cases	45	= 75	51	= 85
Axilla positive, neck negative	110 cases	27	= 24.5	34	= 31
Axilla and neck positive	40 cases	3	= 7.5	4	= 10
Total.....	210				

The Mortality.—Four of the 232 patients died in the hospital, a mortality of one and seven-tenths per cent. The group apportionment of the deaths is as follows:

Group I;in 101 cases, 3 deaths = 3 per cent.
Group II;in 18 cases, 0 deaths = 0 per cent. } 2.5 per cent.
Group III;in 113 cases, 1 death = .88 per cent.

Thus it would seem, without particulars, that the neck operations were responsible for the greater mortality, Groups I and II yielding a two and one-half per cent. death rate, and Group III, in which the neck operation was omitted, a mortality of hardly one per cent. But two of the deaths in the neck cases were clearly due to an avoidable error, quite independent of the operation. These two patients, operated upon just twenty-four hours apart, were convalescing normally until the first dressing, which was made in both cases the same day and hour, respectively eight and nine days after the operation. Within a few hours of the dressing each patient had a chill with high temperature. The skin grafts and wound, which in each had a perfectly normal appearance at the time of the dressing,

rapidly acquired the features so characteristic of general infection. Excepting these two cases, the mortality in the patients with neck operation becomes .99 per cent., only a shade more than in the cases with axillary operation alone, in which it is .88 per cent.

Recurrence and Metastasis.—We know little of what is going on under the skin along the fascial planes even when our attention is drawn to the disease by the appearance, here and there, of cutaneous or subcutaneous nodules at long distance from the primary tumor. I recall distinctly one case and less distinctly one or two other cases of intestinal and peritoneal cancer in which general metastasis was believed, erroneously I think, to have occurred by way of the blood-vessels, although the only evidence of metastasis were numerous subcutaneous and fewer cutaneous nodules situated chiefly over the abdomen and confined altogether to the trunk or to the trunk and its immediate vicinity. Although it undoubtedly occurs, I am not sure that I have observed from breast cancer, metastasis which seemed definitely to have been conveyed by way of the blood-vessels; and my views as to the dissemination of carcinoma of the breast accord so fully with Handley's¹ that I may, in justice to him, who has formulated and expressed them so well, quote now and again from his admirable chapters. "In showing that cancer cells in the blood excite thrombosis, and that the thrombus as it organizes usually destroys or renders them harmless, Goldmann and Schmidt seem to have established a fact of primary importance and one which is strongly opposed to the embolic theory as applied to carcinoma." We believe with Handley that cancer of the breast in spreading centrifugally preserves in the main continuity with the original growth, and before involving the viscera may become widely diffused along surface planes.

Statistics obtained from many sources indicate that bone metastasis in cases of breast cancer occur, as phrased by Handley, very rarely in areas not actually invaded by the subcutane-

¹ Handley. *Cancer of the Breast and its Operative Treatment*, London, 1907, (W. Sampson).

ous nodules. As is well known, the sternum, ribs, spinal column, femur, and humerus, and perhaps also the skull, are the bones most frequently attacked in cases of breast cancer. Distal to the elbow and knee the bones escape, except in rare instances, cancerous invasion. We have in our cases no record of bone involvement below these joints. "The liability of a bone to cancerous metastasis increases with its proximity to the site of the primary growth." Figs. A and B (Handley) graphically represent the coincidence of the areas liable, respectively, to bone metastases and to subcutaneous nodules.

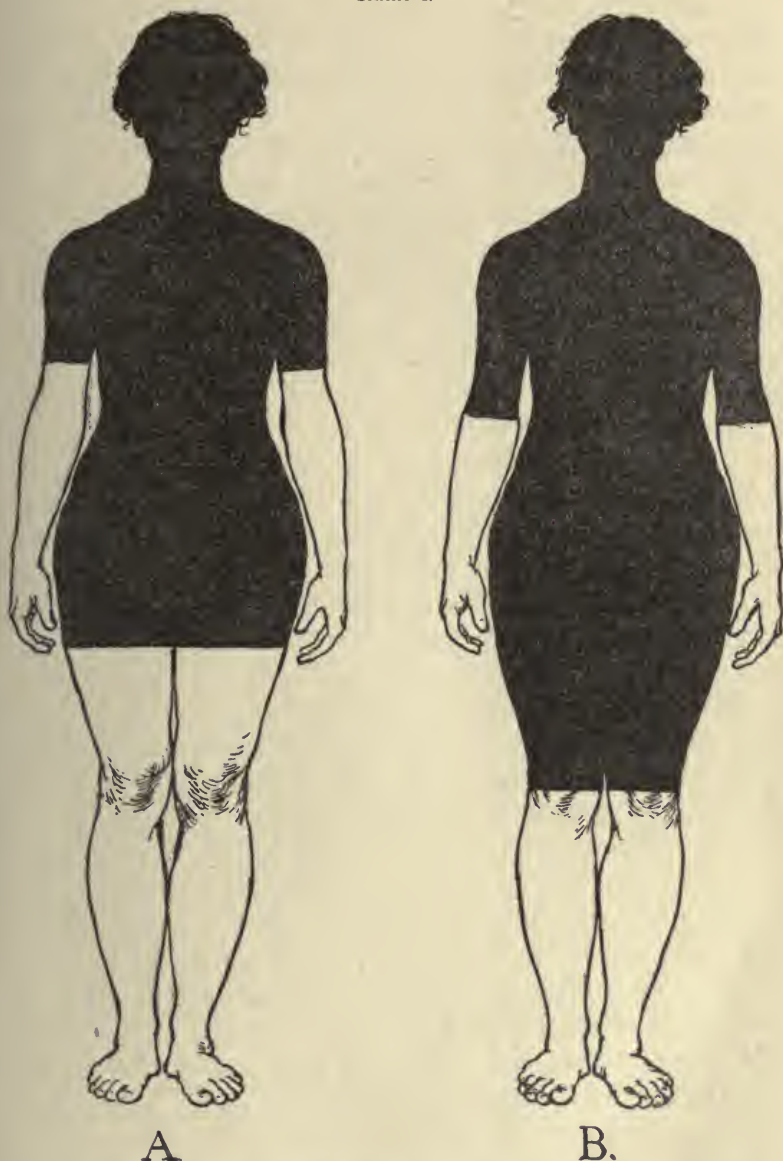
In that metastases occur both in general and in the special case only in bones which lie in the area invaded by subcutaneous nodules there is signified a relationship between the two, "between the bone deposits and the subcutaneous nodules." The dissemination probably takes place by way of the lymphatics—not by the blood-vessels—and the disease holds together without important interruptions. It permeates to the bone rather than metastasizes to it, and, via the lymphatics, along fascial planes. Much evidence has been adduced by others, and most convincingly by Handley, to indicate that the centrifugal spread of breast cancer takes place primarily in the plane of the deep fascia. If the bones are invaded by way of the lymphatic plexus of the deep fascia the first attack should fall on the spot nearest the deep fascial lymphatics—nearest the surface; in the case of the femur, at the great trochanter; of the humerus, at or below the insertion of the deltoid; and such seems actually to be the case.²

There is then a definite, more or less interrupted or quite uninterrupted, connection between the original focus and all the outlying deposits of cancer, "the centrifugal spread annexing by continuity a very large area in some cases." Thus the liver may be invaded by way of the deep fascia, the linea alba and round ligament,³ "the brain by the lymphatics accompanying the middle meningeal artery."

² Handley, loc. cit.

³ Handley furnishes convincing proof that the liver may be invaded via the linea alba and round ligament.

CHART I.



"Diagrams showing the maximal distribution areas of subcutaneous nodules and of metastases in bone in cases of mammary carcinoma. The black area in A is the area liable to subcutaneous nodules, that in B is the area within which bone metastases occur." Handley.

Cancer Cysts.—At some other time we may consider in detail the cancer cysts, but at present can only speak of the difficulty in recognizing them and the hopelessness of the prognosis if their character is not suspected by the surgeon at the operating table. “By the surgeon,” I say, for unless the operator espies the hardly discernible changes in the delicate wall of the cyst it will not occur to him that it is worth while to submit a piece for immediate examination by the pathologist. If he is able to recognize the barely perceptible thickening, the slight lack of lustre, the faintest possible difference in color and in texture, he will probably make the diagnosis without microscopic assistance. Blood-stained fluid should arouse one’s suspicions, but there may be no staining of the cyst-content. Every portion of the wall should be scrutinized, particularly the base of the not infrequent papilloma. The prognosis is quite hopeless if the diagnosis is not made at the operating table. I failed to make it in the first case and possibly in the second, although I have the impression that my suspicions were aroused in the second case, operated upon many years ago. In all the clinically undiagnosed cases the nature of the cyst was soon discovered by the microscope, and in all, more or less promptly, a second operation performed; but, alas, performed in vain. The cases saved are only those in which at the operating table the correct diagnosis was made. Further proof of the necessity of making the correct diagnosis at the time of operating is not needed. The prognosis in these cases of cancer cyst, the earliest recognizable cancers, perhaps, is excellent if the nature of the disease is perceived at the table; hopeless, so far as our statistics are concerned, if it is not. Do we require more definite proof than this that the first operation is responsible for the inefficacy of the second? The precise means by which the first renders the speedily following second operation futile is not perhaps altogether clear. The partial operation (the first) certainly disseminates the cancer, which the complete operation (the second) in the primarily diagnosed cases of cancer cyst has not in our experience done. Furthermore, dissemination takes place probably by routes not already

travelled by the cancer cells and not commonly travelled by them in the early unoperated cases. Probably by these unusual routes the disease soon reaches parts outside the domain of the operation and so escapes eradication.

The Diagnosis.—It is not expected of me in this report to touch upon the diagnosis of breast cancer; furthermore it is considered a trite subject, one to which little can be contributed. But for me interest in the diagnosis of difficult cases increases, and with it the conviction that, really, something remains to be said and done. It well repays the experienced surgeon to spend perhaps an hour in the examination of certain breasts. The diagnosis has usually been exceedingly and unfortunately simple. But women are now presenting themselves more promptly for examination, realizing that a cure of breast cancer is not only possible, but, if operated upon early, quite probable. Hence the surgeon is seeing smaller and still smaller tumors, cancers which give not one of the cardinal signs. About as difficult a case as any, excepting, of course the adenoma in a transitional stage, is a tiny retromammary adenocarcinoma or a colloid carcinoma in a breast covered with one or more inches of fat. If in such a case there should be no shortening whatever of the trabeculæ the diagnosis could hardly be made. The fat on pressure being elastic and the tumor so deep, the differential diagnosis from cyst might not be possible. But given even very slight shortening of the trabeculæ from tumor to skin, this fact might be determinable by making both breasts take the widest possible excursions on the chest wall, under the skin. The faintest conceivable trace of a difference on the two sides, in a minor pectoral crease, for example, may suffice for the diagnosis. Raising the skin over the tumor with the fingers to ascertain the relative length of the trabeculæ is too crude a method, and in no case serviceable unless the tiny growth is directly under or close to the nipple; for if the test applied in this way gives a positive result there is so much shortening of the trabeculæ that the slightest displacement of the breast would reveal it. I have occasionally noticed that of my assistants, perhaps one

or two will see a trace of asymmetry in the skin tug on extreme displacement which the others are wholly unable to make out; and I have more than once in just such case of difference of opinion performed the complete operation for very small, deep-seated cancers without exploratory incision. Frequently there is no sign but this almost imperceptible suggestion of pull, which, when the faintest possible, is of course elicited by dislocation in one direction only. This sign, however slight, is all that is needed for the diagnosis. Practice in the examination of such cases, doing one's utmost to get such evidence, is most highly rewarding. Any breast if displaced far enough will, of course, tug, in a way, on the skin; it is only under the most accurate control with the other breast that its significance in difficult cases may be estimated. It will seem to some that I am wasting many words to tell what every surgeon knows; but to me, at least, the extreme possibilities of this test were not fully realized a decade, perhaps, ago, and each year I believe it develops a little in refinement. The ability to determine elasticity, the elasticity of a small cyst, as hard, almost, as bone, comes to some earlier than to others; but to me, if it has come at all, it came only with long practice. In the breast a difficulty arises from the fact that a tense cyst makes itself felt such considerable distance in the surrounding mammary tissue, particularly if the breast is very fibrous. A nodule seemingly as large as a pea to palpation may be caused by a cyst no larger than a small pin-head, and a cyst almost microscopic may, by the pressure which it exerts in the dense fibrous tissue of the breast, occasion a definitely palpable, quite circumscribed hardness. It should impress the uninitiated to witness the ability of the demonstrator to diagnose with the fingers through considerable fibrous tissue these hardly visible cysts yielding on puncture the tiniest fraction of a drop. The general nodular feel of a fibrous mamma in situ or on a tray depends largely upon small to tiny foci of parenchyma which are most readily recognized by the finger when a little fluid (the minutest particle suffices) is retained under tension.

The firm, circumscribed pressure exercised in the effort to determine the elasticity of a tumor occasionally ruptures, I believe, the capsule of a fat lobule. In three instances, while making this test, a peculiar sensation has been communicated to the fingers which I attributed in the first instance, and with considerable apprehension, to rupture of a cystic portion of a colloid cancer which I believed to be under examination. The cause of this perfectly unmistakable sensation which must, one feels, be accompanied by a nonaudible sound (onomatopoeically, *geräusch*), we have been unable definitely to determine. It is due to the crushing or rupture of something, certainly not of a cyst, and I have noted this sign only in fat people.

The size of the breast relative to that of the other side should of course be determined; but it is important to note most carefully the relative amount of uninvolved mammary gland remaining—relative to the amount in the other breast and to the size of the new growth.

Given a carcinoma, say one-half or one-quarter as large as the palm of the hand, if this tumor has grown not at all or little at the expense of the breast—and this is ascertained by making the comparison just advised—the prognosis is relatively good; for the tumor in such case is quite surely of a definitely adenomatous type and not of the scirrhus variety.

There can be little doubt, in my opinion, that a scirrhus cancer represents only a part of what has existed. The struggle against the cancer cells, resulting in fibrous tissue production, is quite surely not always futile, and when the minute foci of cancer epithelium have been destroyed, the new fibrous tissue may in part be absorbed also. Thus the scirrhus disease may be active and metastasis take place a long time before the visible or palpable tumor is developed. It would undoubtedly be possible for the expert to discover of the scirrhus growth earlier stages than he encounters, but unfortunately the tumor must first be recognized by the patient, and a scirrhus cancer large enough to attract her attention has quite surely already gone afield. Our problem, therefore, is to discover these tumors before the afflicted one can do so. Shall we let women

know that a dangerous process may be going on which they cannot detect, and keep them in a constant state of apprehension, or shall we encourage them to seek "expert" advice which may be insufficiently expert, and expose them to the annoyance of repeated and useless examinations, each of which for only a brief period, if at all, would bring a measure of reassurance?

The Operation.—Though the area of disease extend from cranium to knee, breast cancer in the broad sense is a local affection, and there comes to the surgeon an encouragement to greater endeavor with the cognition that the metastases to bone, to pleura, to liver, are probably parts of the whole, and that the involvements are almost invariably by process of lymphatic permeation and not embolic by way of the blood. Extension, the most rapid, taking place beneath the skin along the fascial planes, we must remove not only a very large amount of skin and a much larger area of subcutaneous fat and fascia, but also strip the sheaths from the upper part of the rectus, the serratus magnus, the subscapularis, and at times from parts of the latissimus dorsi and the teres major. Both pectoral muscles are, of course, removed.

A part of the chest wall should, I believe, be excised in certain cases, the surgeon bearing in mind always that he is dealing with lymphatic and not blood metastases and that the slightest inattention to detail, or attempts to hasten convalescence by such plastic operations as are feasible only when a restricted amount of skin is removed, may sacrifice his patient.

It must be our endeavor to trace more definitely the routes travelled in the metastases to bone, particularly to the humerus, for it is even possible in case of involvement of this bone that amputation of the shoulder joint plus a proper removal of the soft parts might eradicate the disease. So, too, it is conceivable that ultimately, when our knowledge of the lymphatics traversed in cases of femur involvement becomes sufficiently exact, amputation at the hip joint may seem indicated. The operation might with advantage be considered in greater detail, and I hope in the near future to have the opportunity to do so.

As to the closure of the wound I should not care to say "Beware of the man with the plastic operation." The surgeon should familiarize himself with the principle of the one or two particular plastic operations which make the best use in the simplest manner of any redundant or easily glideable skin, as of the axillary flap, that he may be prepared in any case to utilize in combination with skin grafting such feature as seems applicable. But to attempt to close the breast wound more or less regularly by any plastic method is hazardous and, in my opinion, to be vigorously discountenanced. The oval flap, whatever the direction of its long axis, removes, so far as the cure of the disease is concerned, a circle of skin whose diameter is not greater than the short axis of the oval. I still believe in the removal of a very large circle of skin and endorse the remark of my ex-house surgeon, Dr. Follis, that the operator whose duty it is to close the wound should not be entrusted with the planning of the skin incision. Skin grafting well done consumes few minutes; as a method it adds little, if at all, to the period of convalescence except so far as very early arm movements are concerned, and nothing to the mortality. I grant that to cut the grafts well, much practice is necessary, and the skill acquired by some is so great that I intrust this part of the procedure to the dexterous house-surgeon. Thiersch grafts from the thigh are commonly cut as large as a good-sized hand. One such graft may be sufficient to cover the defect; more than two large grafts are not often required. The silver foil dressing for the grafts, used at the Johns Hopkins Hospital for so many years, seems quite ideal.

Occasionally, and happily with increasing frequency, an incision for diagnostic purposes has to be made. Great care should be exercised to make these exploratory cuts no deeper than is absolutely essential. Rarely is it necessary to carry the knife *into* a cancer, for on exposure of the subcutaneous fat the tell-tale drawing of the fibrous tissue is revealed; sometimes the fat must be cut into for a little distance. If the growth is not malignant the incision should usually pass through it.

Caustics.—I am indubitably convinced that the local and regionary recurrences after incomplete operations, which come as a rule with amazing rapidity when the knife has been used, are, to say the least, relatively late in making their appearance when chemical or actual cauterization has been employed. I have several times had occasion to operate upon cancers which had been vigorously and repeatedly treated with caustics, and to note the comparatively admirable condition, the freedom from cancer permeation, of the surrounding tissues and of the axilla; whereas, after incomplete operations with the knife the local manifestations of recurrence were almost invariably deplorable and the prognosis, of course, invariably hopeless.

It was my practice at one time in making the exploration in doubtful cases to excise a portion of the breast tumor with the Paquelin cautery to prevent the wound-inoculation which I feared might take place if the knife were used. The excision of a specimen for macroscopic or microscopic examination is never resorted to except just before operation. If the actual cautery for any reason is not used, the wound is immediately cauterized with carbolic acid. All incomplete operations for cancer should, when feasible, be made with the Paquelin or actual cautery.⁴ The Paquelin is ideal for the removal of cutaneous nævi, particularly of the melanotic variety. I doubt if any melanotic tumor of the skin should be removed with the knife.

Cancerous Axillary Glands with Non-demonstrable Cancer of the Mamma.—I have twice seen extensive carcinomatous involvement of the axilla due to mammary cancer which, latter, in neither instance became demonstrable for a considerable period after the axillary glands had attained conspicuous dimensions. In each case the "axillary tumors" had been removed, in one of them a year before and in the other per-

⁴I was greatly pleased to note, during a recent visit to Rochester, Minnesota, that Drs. William and Charles Mayo make extensive use of the actual cautery in operations upon cancers incurable by the knife, and to have them indorse the view, so long maintained by me, that there is relative immunity from local metastasis with the employment of the cautery.

haps two years prior to my first examination, which, though made in the most careful manner, failed to find the slightest evidence of cancer of either breast. In the course of a few months, thereafter, the mammary disease manifested itself in both patients.

A third patient was operated upon, for enlarged glands of the axilla about two and a half years before she consulted me concerning the local, axillary, recurrence of the disease, and more especially to be relieved of severe neuralgic pains in the arms and legs. In this woman I found a large mass of axillary glands which proved later to be cancerous, but nothing in the breast except a quite indefinite parchment-like induration at the base of the nipple which was retracted not at all or merely to a barely appreciable degree. With performance of the complete breast operation the pains in the extremities which distressed her greatly, vanished.

Disseminated Pains Which Would Seem to be Caused Occasionally by the Toxines Generated in the Course of the Growth of Cancer.—Distressing pains in the knees, the legs, the back, the arms, so severe and so located as to suggest cancerous involvement of the vertebræ have in two cases operated upon by me at the Johns Hopkins Hospital disappeared on removal of the growth which in one instance was large, ulcerous and foul smelling, in the other (the case cited at the end of the preceding paragraph), consisted merely of a large mass of glands in the axilla.

Reactionary Œdema in Mammary Cancer.—Quite recently I was privileged to see a condition of board-like œdema limited in a general way to the pectoral region of one side. There was no definitely appreciable abnormality of the mamma other than the œdema in the area of which it was included; and not until perhaps six months after the first manifestation of this œdema was there the least evidence of neoplastic disease of the breast. Then, as in my experience, is usually the case in the presence of excessive œdema of reaction, the cancer made very rapid strides.

END RESULTS OF 376 PRIMARY OPERATIONS FOR
CARCINOMA OF THE BREAST AT THE MASSA-
CHUSETTS GENERAL HOSPITAL, BETWEEN
JAN. 1, 1894, AND JAN. 1, 1904.*

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AT the request of Dr. Leconte, and of Dr. Warren, we have determined the results of operations for breast cancer, at the Massachusetts General Hospital, for the ten years prior to January 1, 1904.

This investigation was undertaken with the assent and approval of the members of the hospital staff, and with the assistance of the administrative officers of the hospital, 376 cases, or over 90 per cent. of the total of 416 primary operations performed during the ten years, have been followed to a definite end result.

As the returns came in the results were assembled in five classes, viz.: (1) Alive and well, (2) Alive with recurrence, (3) Died of operation, (4) Died without recurrence over three years after operation, (5) Died with recurrence; and from the proportion of these results the percentages were calculated. Cases dying of other diseases within three years of operation were either thrown out entirely or classed as failures; there were 28 cases of doubtful recurrence; these were cases of apoplexy, meningitis, pneumonia, gastro-enteritis and other diseases which, occurring after operation for breast cancer, raise strong suspicion of internal metastasis. It is probable that a certain number of these cases were actually free from recurrence, but to err on the side of safety they have been classed as failures.

* Author's abstract. Read by invitation before the American Surgical Association, Washington, May 8, 1907.

Of the 376 traced cases of primary operation, 64 are now alive and well at periods of from three to thirteen years after leaving the hospital. The relative freedom from disability of this group of cases is very gratifying. Almost every patient had good or perfect use of the arm on the affected side, and only one complained of a stiff shoulder, and that a case in which the wound went badly septic.

In about one-third of the cases, mention is made of a certain amount of swelling of the arm, and less frequently of the hand. It is encouraging to feel that this swelling is not invariably a sign of return of the disease.

There were 7 cases included in the group of those dying over three years after operation without evidence of recurrence: 2 died of debility and old age; 2 died of consumption; 1 died of apoplexy six years after operation after recovering from a previous apoplexy three years before; 1 died of acute renal disease, and 1 died in the hospital of pneumonia, with an autopsy to confirm the absence of recurrence.

These two groups, 64 cases alive and well, and 7 dead without recurrence, over three years after operation, form the 71 "successful" cases.

The *operative mortality* of the whole series of 416 cases was 15, or 3.6 per cent. The causes of death were: Pneumonia, 6; pulmonary embolism, 2; hæmorrhage and shock, 4; sepsis, 3.

The operative mortality was highest after palliative operations.

Following the method adopted by Dr. Halsted we have arranged this report under the following headings: (1) Extent of Involvement, (2) Variety of Cancer, (3) Duration of Disease, (4) Magnitude of Operation.

The *Extent of Involvement* we have found somewhat difficult of determination, but we have attempted to express it under the following conditions.

1. *Adherence of the tumor to the skin.* This was present in 262 cases, with 16 per cent. successful operations, and absent in 71 cases, with 32 per cent. of freedom from recurrence.

The chances of relief appear to be twice as good as when the skin is not adherent to the tumor.

2. *Adherence to chest wall* occurred in 45 cases with 11 per cent. successful results. No adherence was detected in 194 cases, with 21 per cent. free from recurrence. Again the chances of recovery appear to be nearly twice as great when the tumor is not adherent to the chest wall.

3. *Enlarged glands in the axilla* were felt before operation in 236 cases with 12 per cent. freedom from recurrence. No glands were felt in 117 cases with 29 per cent. successful results. This suggests that absence of palpable enlargement of the axillary glands is a favorable indication, in spite of the fact that the glands removed as a routine measure are almost invariably found to be malignant.

4. *Palpable enlargement of the glands above the clavicle* occurred in 40 cases, of which only 2 survive, and those were cases in which the enlarged glands were removed and found not to be cancerous on microscopic examination. No case recovered in which palpably enlarged cancerous glands were detected in the neck.

5. *Involvement of both breasts*, which occurred in 6 cases, was invariably fatal.

6. *Ulceration of the tumor* is also of bad prognostic import. Of 60 cases, in which the tumor had progressed to ulceration, 6.6 per cent. recoveries took place, while of 316 cases in which no ulceration was present, 21 per cent. were free from later recurrence.

The varying degrees of malignancy of the different varieties of cancer of the breast has received attention from many writers. Of our total of 376 cases analyzed, in all but 39 the report of a pathologist upon the tumor was available. It is probable that nearly all of the tumors were examined, but some of the reports could not be obtained from the records. One hundred and twenty-seven reports gave "cancer" only as the diagnosis, without specifying the variety.

The percentage of successful cases for the different varieties of carcinoma was as follows: 1. Medullary carci-

noma, 16 per cent.; 2. Scirrhus carcinoma, 23 per cent.; 3. Adenocarcinoma, 47.6 per cent.; 4. Colloid, 66 per cent.; 5. Paget's Disease, 12½ per cent.; 6. Cancer in the lactating breast, 28 per cent.

The numbers of cases of Colloid, Paget's and Lactation Cancer are too small to permit of very positive conclusions; although the supposed low degree of malignancy of colloid cancer is substantiated. The difference between medullary, scirrhus and adenocarcinoma, however, is striking, and in accord with previous observations. Medullary cancer is the most malignant, and adenocarcinoma is relatively benign. The malignancy of scirrhus cases in this series is perhaps greater than has been estimated by other writers; it is much more grave than adenocarcinoma, though not so serious as medullary.

Duration of the Disease.—The study of the duration yielded no conclusive results. In the individual case there is no question but that the duration is of the greatest significance, but when taken in connection with other more significant factors, such as the extent of involvement and the variety of cancer, the effects of duration seem to be obscured. Freedom from recurrence was obtained equally in cases of long and those of short duration.

The operations performed upon these cases were divided into four groups—Complete, Semi-Complete, Incomplete and Palliative.

1. *Complete operations* were performed on 160 cases; in this group are included all operations in which the whole breast, axillary contents, and sternal portion of the pectoralis major were removed; and the pectoralis minor either divided or removed. This statement of the requisites of a complete operation was accepted as the opinion of a majority of the surgeons at the hospital. Of the 160 complete operations, 16 per cent. were successful in preventing recurrence of the disease. In 26 of the 160 cases, the neck was dissected and lymphatic glands removed, but in only one case, in which the glands removed were found to be infected, was the operation a success in preventing recurrence.

The amount of skin removed with the breast has seemed to us a matter of great importance. In 67 of the complete operations, so much skin was taken that a plastic operation or skin-graft was necessary to close in the defect. The end results of these cases (19.4 per cent. free from recurrence) were better than of those in which the skin edges were readily drawn together (11.7 free from recurrence), but showed most conspicuously in the matter of recurrence in the scar; 57.6 per cent. of the plastic operations remained free from local recurrence in the scar, while only 44 per cent. of the sutured wounds were thus successful.

2. *Semi-complete operations* were performed in 75 instances. These were exactly similar to the complete operation, with the exception that the pectoralis minor was not disturbed; 25.3 per cent. remained free from recurrence.

3. *Incomplete Operations*.—Eighty-five cases, most of which were operated upon in the earlier years of this period, did not fulfill the conditions of the modern operation. In most of these the pectoralis major was not removed. In other cases part of the breast, or part of the axillary contents, were left behind. The results, however, were astonishing,—22 cases, or 25.9 per cent., remained free from recurrence.

These figures are, at first sight, a little disconcerting, but on consideration we have decided that the apparent paradox of more successful cases with the less extensive operations, is due to the selection of cases suitable for operation. Before the days of the complete operation, only the most favorable cases were considered suitable for an attempt at radical cure. As the complete operation developed, more and more advanced cases were submitted to operation, in the hope that they, too, might be saved. There are a number of surgeons in the hospital who perform a complete operation in practically every case, in order to give the patient the benefit of every possible chance of cure. Other surgeons reserve the more extensive operations for the earlier and more favorable cases. Lazarus, Barlow and Campiche, at the Middlesex Hospital, and Meissl, in the Vienna Clinic, have come in contact with the same

apparent paradox, and arrive at the same conclusion in explanation.

The advantage obtained by removal of the pectoralis minor appears to consist in the greater ease with which the upper axilla can be dissected. It is not apparent that this muscle is especially liable to infiltration.

4. *Palliative operations*, without hope of cure, were performed in only 56 (or about 15 per cent. of all the cases which came to operation). In all these cases cancerous tissue was supposed to have been left in the wound. Four cases, however, remained free from recurrence of the disease. It is possible that more of the disease was taken out in these cases than was supposed; it is not impossible, however, that a certain dosage of cancer may be recovered from spontaneously in human beings; just as undoubtedly occurs in the study of experimental cancer in mice. The operative mortality of 4 cases, or 7 per cent., is higher after palliative operations than after the most complete and extensive dissections (4 per cent.), but this is undoubtedly due to the enfeebled condition of patients with advanced cancer. At this point it may be reasonable to call attention to the fact that the cases we are reporting have not been selected in any way, but are given as they are recorded consecutively in the hospital records. Thus 85 per cent. of our cases have been subjected to an attempt at a radical cure, whereas the number of cases really entitled to expectation of benefit from a radical operation was probably much less. We would suggest that statistics of end results could be judged more fairly if the number of cases rejected as unfit for radical operation during the same period were also published.

Recurrences.—The data obtained from the study of recurrences form one of the most interesting features of cancer statistics.

There were 126 cases in which it is known that local recurrence appeared in the scar, and 138 in which it is known that none occurred. Thus 52 per cent. or over one-half of the cases were free of local recurrence, and would have been cured

if internal metastasis had not been already present, or did not, as seems possible in certain instances, result from the manipulation of the operation.

The date at which recurrence first appeared could be established with certainty in only a few of the cases in this series. The duration of life, however, gives some light upon this point,—41 of the total of 290 cases of recurrence lived over three years after operation, and 13 of these cases never showed at any time a recurrence in the scar. It is clear that the statement that a case survived three years after operation, without evidence of local recurrence, does not preclude the possibility of such a case dying later of internal metastasis.

Four authentic cases of "*late recurrence*" occurred in this series of cases. Two had local recurrence in the scar, which did not appear until eight years and eight years and five months, respectively, after operation. One was free from all sign of recurrence for seven years, and then developed metastasis in the spine, and another, well for six years and nine months, developed evidence of recurrence in the abdomen. Adding these 4 to the 13 of the preceding paragraph, we have 17 cases which did not show any sign of recurrence at three years, but died later with recurrence. To express this otherwise, 88 cases passed the three-year period without recurrence, but of these 17 (19 per cent.) later showed metastasis—exactly the percentage found by Schröder from a study of the cases at the Rostock Clinic.

SUMMARY.

I. Out of 416 cases of primary operations for cancer of the breast at the Massachusetts General Hospital from 1894, 1903 inclusive, 376 were traced to a conclusive end result at an average period of eight years after operation.

II. Sixty-four cases were alive and well and 7 died without recurrence over three years after the operation.

III. Counting in the operative mortality, there were 320 attempts at radical cure, 67 of which, or 20.9 per cent., were successful.

IV. During this same period palliative operations were performed on 56 patients (15 per cent.) and 52 cases were discharged untreated.

V. Cases in which the tumor was ulcerated, or was adherent to the skin or to the chest wall, and cases in which the axillary glands were palpably enlarged, gave notably less promising results than when these conditions did not exist.

VI. No case with palpably enlarged cancerous glands above the clavicle, and no case of cancer of both breasts, was cured.

VII. Medullary carcinoma was more grave than that of the scirrhous type, and adenocarcinoma and colloid were relatively of a far less malignant type.

VIII. The duration of the disease, other than in the individual case, exerted little influence on prognosis.

IX. Extensive operations with wide removal of skin gave the greatest freedom from local recurrence. Removal of the pectoralis minor appeared to be of slight significance. Incomplete operations on early cases yielded better results than extensive operations on cases which were well advanced.

X. Recurrence in the scar occurred in less than one-half of the cases. Internal metastasis was most frequent in the lungs, mediastinum, in the axillary and supraclavicular glands, the liver and the spine.

XI. Seventeen out of 88 cases or 19 per cent. of those passing the three-year limit without evidence of recurrence, showed recurrence later, and 4 cases developed recurrence six years or more after the operation.

FINAL RESULTS IN 164 CASES OF CARCINOMA OF
THE BREAST OPERATED UPON DURING THE
PAST FOURTEEN YEARS AT THE AUGUSTANA
HOSPITAL.*

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IN order to condense the study of these cases sufficiently to prevent this report from becoming altogether unwieldy it has seemed best to make the following tabulations, which were compiled by my associate, Dr. N. M. Percy, from the case histories of the hospital.

The present condition of 98 patients was determined partly by correspondence with patients and with their physicians, and partly by personal examinations.

From 63 cases no information has been obtained as yet, but only 20 letters have been returned unopened, consequently it is fair to suppose that further information can be obtained concerning the condition of some of the 63 cases not heard from.

Of the 98 cases concerning which we have received reports, 54 cases are still living, and all of these with two exceptions are at the present time free from recurrence.

One patient, case No. 38, had a carcinoma of both breasts, which were removed by primary operation in 1895 elsewhere. In 1897 she had a recurrence in the left axilla, which I operated on December 7, 1897. This side has remained well since. In 1899 she had a recurrence in the right axilla, which was removed elsewhere, and which has just developed a second recurrence.

A second case, No. 45, operated on September 19, 1898, for carcinoma of the breast, remained well until six months ago, when she noticed a swelling the size of a walnut, which has not been definitely diagnosed, although it is likely that it is a recurrence.

* Read before the American Surgical Association, May, 8, 1907.

I have not personally examined this patient since she left the hospital.

The following table gives the number of living cases from which we have definite reports :

Duration of time since operation	{	1 year 9 cases
		2 years 11 cases
		3 years 5 cases
		4 years 7 cases
		5 years 4 cases
		6 years 5 cases
		7 years 4 cases
		8 years 1 case
		9 years 3 cases
		10 years 1 case
		11 years 2 cases
		12 years 0 cases
		13 years 2 cases
Total		54 cases

Of the 54 cases heard from, ten complain of swelling or stiffness of the arm.

An interesting fact observed in our series of cases is shown by the following table of deaths.

It was found that but few of the very advanced cases which were considered quite hopeless at the time of operation lived more than one year after the operation, making the number that died directly after the operation from shock, together with those that lived less than one year, 25, or about 15 per cent. :

DEATHS.

Died of shock	5 cases
Died within 1 year	19 cases
Died within 2 years	6 cases
Died within 3 years	6 cases
Died within 4 years	1 case
Died within 5 years	2 cases
Died within 6 years	1 case
Died within 7 years	1 case
Died within 8 years	0 cases
Died within 9 years	0 cases
Died within 10 years	0 cases
Died within 11 years	1 case
Died within 12 years	0 cases
Died within 13 years	0 cases
Died within 14 years	1 case
Total	43 cases

ANALYTICAL TABLE OF CASES OF CARCINOMA OF BREAST OPERATED UPON AT THE AUGUSTANA HOSPITAL.

Number.	Hospital No.	Age.	Involvement of				Date of operation.	Operation.	Date of last communication of patient.	Result.
			Ax. Gl.	Cer. Gl.	Skin.	Muscle.				
1	265	45	X	.....	.....	.....	Excision of breast and axillary glands	.....	Died 10 months later
2	350	49	.....	.....	.....	.....	Excision of breast	.....	.....
3	711	40	X	.....	.....	.....	Excision of breast and axillary glands	None	.....
4	714	62	X	.....	.....	.....	Excision of breast and axillary glands	None	.....
5	787	56	.....	.....	.....	.....	Excision of breast	None	.....
6	799	44	.....	.....	.....	.....	Excision of breast	None	.....
7	961	50	X	.....	.....	.....	Excision of breast and axillary glands	None	.....
8	1069	45	X	.....	.....	.....	Excision of breast and axillary glands	.....	Recurrence in 3 months. Died 6 months later
9	1224	61	X	.....	.....	.....	Excision of breast and axillary glands	None	.....
10	1293	47	X	X	X	.....	Excision of breast, axillary, and cervical glands	.....	Died 6 weeks later of carcinoma of liver, pancreas, and kidneys
11	1319	39	.....	.....	.....	.....	Excision of breast	None	.....
12	1373	44	.....	.....	.....	.....	Excision of breast	April 16, 1907	Had recurrence 1 year later. Doctor applied paste causing necrosis Perfectly well since
13	1373	36	X	.....	X	.....	Excision of breast and axillary glands	.....	Had rapid recurrence
14	1850	31	X	.....	.....	.....	Excision of breast and axillary glands	April 24, 1907	No trouble since first illness
15	1970	82	.....	.....	.....	.....	Excision of breast	None	.....
16	2133	63	.....	.....	.....	.....	Excision of breast	None	.....
17	2187	45	X	.....	.....	.....	Excision of breast and axillary glands	None	.....

CARCINOMA OF THE BREAST.

18	2351	47	.....	.....	Sept. 6, 1895	Excision of breast and axillary glands	April 15, 1905	No recurrence in 3 years, when she died of some other trouble
19	2621	44	.....	.....	Jan. 21, 1896	Excision of breast	None	
20	2750	66	×	.....	Feb. 17, 1896	Excision of breast and axillary glands	None	
21	2702	39	.....	.....	Feb. 17, 1896	Excision of breast	None	
22	2705	42	×	×	Feb. 18, 1896	Excision of breast and axillary glands. Skin grafted	.....	Died 9 months after operation apparently from involvement of internal organs
23	2863	52	×	×	May 9, 1896	Excised axillary and cervical glands. Excision of breast and pectoral muscles	.....	Never seemed to gain much strength and died about 4 months after operation
24	3001	38	.....	.....	June 24, 1896	Excision of breast	None	
25	3110	46	.....	.....	Aug. 10, 1896	Excision of breast	None	
26	3292	57	×	.....	Oct. 13, 1896	Excision of breast and axillary glands	April 16, 1907	No recurrence. Died of apoplexy, April 12, 1907
27	3328	37	.....	.....	Oct. 29, 1896	Excision of breast	April 16, 1907	Perfectly well since
28	3367	37	×	.....	Nov. 16, 1896	Excision of breast and axillary glands	None	
29	3373	56	×	×	.....	Inoperable. Applied calcium carbide	None	No relief
30	3548	60	.....	.....	Feb. 5, 1897	Excision of breast	None	
31	3705	50	.....	.....	March 31, 1897	Excision of breast	None	
32	3745	59	.....	.....	April 18, 1897	Excision of breast	April 17, 1907	No recurrence in 5 years, when she died of nephritis
33	3799	25	×	.....	May 11, 1897	Excision of breast and axillary glands	None	
34	3945	46	×	.....	July 5, 1897	Excision of breast and axillary glands	None	
35	4034	63	×	.....	July 31, 1897	Excision of breast and axillary glands	None	
36	4095	36	×	.....	Aug. 24, 1897	Excision of breast and axillary glands	None	
37	4395	57	×	.....	Dec. 1, 1897	Excision of breast and axillary glands	April 22, 1907	No recurrence. Fairly good health
38	4410	29	×	×	Dec. 7, 1897	Recurring case. Excision of pectoral and minor muscles and axillary glands	April 21, 1907	Both breasts removed. Primary operation 1895. Recurred left axilla 1897. Recurred right axilla 2 years later, which was removed 18 months ago. Now has another recurrence in right axilla

ANALYTICAL TABLE OF CASES OF CARCINOMA OF BREAST OPERATED UPON AT THE AUGUSTANA HOSPITAL.—Continued.

Number.	Hospital No.	Age.	Involvement of				Date of operation.	Operation.	Date of last communication of patient.	Result.
			Ax. Gl.	Cer. Gl.	Skin.	Muscle.				
39	4783	48	×	.....	.....	.....	Excision of breast and both pectoral muscles and axillary glands	None	
40	4909	39	.....	.....	.....	.....	Excision of breast	None	
41	5055	38	×	.....	.....	.....	Excision of breast and axillary glands	April 19, 1907	No recurrence. Never felt better than she does now
42	5156	58	×	.....	.....	.....	Excision of breast and axillary glands	April 15, 1907	No recurrence in 7 years, when she died of some other trouble
43	5281	48	×	.....	.....	.....	Excision of breast and axillary glands	None	
44	5362	44	×	.....	.....	.....	Excision of breast and axillary glands	Examined April 8, 1907	No signs of recurrence. General health good
45	5397	45	×	.....	.....	.....	Excision of breast and axillary glands	April 18, 1907	Felt poorly for 4 years after operation. Since then very well. Some stiffness of arm from shoulder to elbow. 6 months ago noticed swelling size of walnut. Did not state location
46	5416	55	×	.....	.....	.....	Excision of breast and axillary glands	.....	Died of cancer two years after operation
47	5460	50	×	.....	.....	.....	Excision of breast and axillary glands	None	
48	5484	50	×	.....	.....	.....	Excision of breast and axillary glands	None	
49	5525	53	×	.....	.....	.....	Excision of breast and axillary glands and pectoral muscles	None	
50	5541	34	×	.....	.....	.....	Excision of breast and axillary glands and pectoral muscles	None	
51	5637	44	×	.....	.....	.....	Excision of breast and axillary glands and pectoral muscles	None	
52	5684	42	.....	.....	.....	.....	Excision of breast	None	
53	5822	41	×	×	×	.....	Excision of breast and pectoral muscles and axil. and cer. glands.	.....	Died of shock on 4th day

CARCINOMA OF THE BREAST.

54	5830	25	.....	.....	.....	Excision of breast	None	.....	Had recurrence in scar 18 months later
55	5887	62	.....	.....	.....	Excision of breast and pectoral muscles and axillary glands	None	.....
56	6113	26	X	.....	.....	Excision of breast and pectoral muscles and axillary glands	None	.....
57	6171	28	X	.....	.....	Excision of breast and pectoral muscles and axillary glands. Skin graft	None	.....	Had rapid recurrence and died about 4 months after operation.
58	6253	38	X	.....	.....	Excision of breast and pectoral muscles and axillary glands	None	.....
59	6552	42	X	.....	.....	Excision of breast	None	.....
60	6631	50	X	.....	.....	Excision of breast and pectoral muscles and axillary glands	None	.....
61	6773	48	X	.....	.....	Excision of breast and pectoral muscles and axillary glands	None	.....
62	6905	35	X	.....	.....	Excision of breast and pectoral muscles and axillary glands	None	.....
63	6968	46	.....	.....	.....	Excision of breast and pectoral muscles and axillary glands	April 15, 1907	.....	Perfectly well. Can use arm nearly as well as other side
64	7071	64	.....	.....	.....	Excision of breast and pectoral muscles and axillary glands	April 26, 1907	.....	Operation successful. Never troubled since
65	7109	55	X	.....	.....	Excision of breast and pectoral muscles and axillary glands	None	.....
66	7211	44	X	.....	.....	Excision of breast and pectoral muscles and axillary glands	April 18, 1907	.....	No recurrence. Considerable swelling and disability of arm for 3 years, but since then no trouble
67	7350	34	X	.....	.....	Excision of breast and pectoral muscles and axillary glands	None	.....
68	7394	67	.....	.....	.....	Excision of small nodule from old scar, size of pea	None	.....	Recurrent case. Had breast excised 6 months previously. Skin recurrence in line of incision
69	7427	39	.....	.....	.....	Excision of breast and pectoral muscles and axillary glands	.....	.....	Died of recurrence 3 years later

ANALYTICAL TABLE OF CASES OF CARCINOMA OF BREAST OPERATED UPON AT THE
 AUGUSTANA HOSPITAL.—Continued

Number.	Hospital No.	Age.	Involvement of				Date of operation.	Operation.	Date of last communication of patient.	Result.
			Ax. Gl.	Cer. Gl.	Skin.	Muscle.				
70	7528	31	×	.....	.....	.....	April 24, 1900	Excision of breast and pectoral muscles and axillary glands	None	
71	7530	77	×	.....	×	.....	April 24, 1900	Excision of breast and pectoral muscles and axillary glands	.....	Died of shock on 4th day
72	7554	37	×	.....	×	.....	April 29, 1900	Excision of breast and pectoral muscles and axillary glands	.....	Had rapid recurrence and died about 6 months after operation
73	7717	40	×	.....	×	.....	June 5, 1900	Excision of breast and pectoral muscles and axillary glands	None	
74	7749	48	×	×	×	.....	June 12, 1900	Excision of breast and pectoral muscles and axillary glands	None	Died of shock next day
75	7968	66	×	.....	.....	.....	August 9, 1900	Excision of breast and pectoral muscles and axillary glands	.....	Died of shock same night
76	8083	44	×	.....	.....	.....	Sept. 8, 1900	Excision of breast and pectoral muscles and axillary glands	April 15, 1907	Arm in good health. Has not been bothered again
77	8103	61	×	.....	.....	.....	Sept. 11, 1900	Excision of breast and pectoral muscles and axillary glands	None	
78	8123	38	×	.....	×	.....	Sept. 16, 1900	Excision of large area skin. Skin grafting	.....	Recurrent case
79	8141	65	.....	.....	×	.....	Sept. 20, 1900	Excision of nodule in scar	.....	Primary operation 18 months previous. Recurrent nodule in scar. Lived 3 years after this; 4½ years after previous operation
80	8154	50	.....	.....	.....	.....	Sept. 23, 1900	Excision of breast and axillary glands	None	
81	8350	37	×	.....	.....	.....	Jan. 1, 1900	Excision of breast and pectoral muscles and axillary glands	April 16, 1907	No recurrence to present time; operation successful. No X-ray

CARCINOMA OF THE BREAST.

82	8575	35	X	.....	Jan. 9, 1901	Excision of breast and pectoral muscles and axillary glands	April 19, 1907	No return of disease. Perfectly well since operation
83	8648	57	X	.....	Jan. 23, 1901	Excision of breast and pectoral muscles and axillary glands	April 20, 1907	Perfectly well since operation. Very useful arm
84	8742	43	X	.....	Feb. 5, 1901	Excision of breast and pectoral muscles and axillary glands	April 18, 1907	Examined personally. No signs of recurrence. No oedema of arm
85	8838	39	.....	.....	March 6, 1901	Excision of breast and pectoral muscles and axillary glands	None	
86	9038	46	X	.....	April 18, 1901	Excision of breast and axillary glands	April 16, 1907	No return of disease. Has experienced considerable discomfort with arm. But nothing serious
87	9147	29	.....	.....	May 17, 1901	Excision of breast and pectoral muscles and axillary glands	1 year ago perfectly well	Two years later recurrence in line of incision, axilla, and cervical region. All disappeared under X-ray treatment
88	9222	56	X	.....	June 3, 1901	Excision of breast and pectoral muscles and axillary glands	.....	Had recurrence in axillary glands of opposite side in 3 months. Died 6 months later
89	9331	76	X	.....	June 26, 1901	Excision of breast and pectoral muscles and axillary glands	None	
90	9538	31	X	.....	Aug. 13, 1901	Excision of breast and pectoral muscles and axillary glands	None	
91	9542	38	X	.....	Aug. 31, 1901	Excision of breast and pectoral muscles and axillary glands	None	
92	9753	34	X	.....	Oct. 2, 1901	Excision of breast and pectoral muscles and axillary glands	.....	Died a few months later, apparently from some internal recurrence
93	9793	67	X	.....	Oct. 5, 1901	Excision of breast and pectoral muscles and axillary glands	.....	Died May, 1905. Had X-ray treatment for 3 years
94	9800	42	X	.....	Oct. 7, 1901	Excision of breast and axillary glands	.....	Died of recurrence, April 1, 1903. Took X-ray for 1 year
95	9841	70	X	.....	Oct. 19, 1901	Excision of breast and axillary glands	None	
96	9904	60	X	.....	Oct. 31, 1901	Excision of breast and axillary glands	.....	Recurred 1 year after operation. Recurrence disappeared under X-ray. Recurred 2 years later. Died 3 years after operation
97	9952	41	X	.....	Nov. 15, 1901	Excision of breast and pectoral muscles and axillary glands	1 year ago	Well at that time.

ANALYTICAL TABLE OF CASES OF CARCINOMA OF BREAST OPERATED UPON AT THE AUGUSTANA HOSPITAL.—Continued

Number.	Hospital No.	Age.	Involvement of				Date of operation.	Operation.	Date of last communication of patient.	Result.
			Ax. Gl.	Cer. Gl.	Skin.	Misc.				
98	10167	69	X	.....	X	.....	Jan. 10, 1902	Excision of breast and pectoral muscles and axillary glands. Skin graft	.....	Had rapid recurrence and died 4 months later
99	9985	32	X	.....	.....	.....	Nov. 18, 1902	Excision of breast and axillary glands	.....	Died of recurrence 2 years later. Had many X-ray treatments
100	10390	48	X	.....	X	.....	Feb. 28, 1902	Excision of breast and pectoral muscles and axillary glands	April 12, 1907	Perfectly well. Took X-ray treatment for 1 year
101	10441	67	X	.....	.....	.....	March 10, 1902	Excision of breast and pectoral muscles and axillary glands	None	
102	10656	67	X	X	X	.....	June 23, 1902	Excision of breast and axillary glands. Inoperable. No improvement	.....
103	10933	66	X	X	X	.....	June 23, 1902	Excised recurrent mass in skin and axillary and cervical glands	.....	Primary operation 6 years previous. Not heard from since second operation
104	11064	52	X	.....	.....	.....	July 21, 1902	Excised breast and pectoral muscles and axillary glands	.....	Had other breast excised for carcinoma 2 years previous. X-ray for 1 year after first operation
105	11437	64	.....	.....	.....	.....	Sept. 29, 1902	Excised breast and pectoral muscles and axillary glands	.....	Died of recurrence in May, 1903
106	11658	54	X	.....	.....	.....	Nov. 22, 1902	Excised both breasts for carcinoma	.....	Died of cancer of stomach 1 year later
107	11790	41	.....	.....	.....	.....	Dec. 8, 1902	Excised breast and pectoral muscles and axillary glands	April 15, 1907	Took 60 X-ray treatments after operation. No recurrence. Great deal of pain in shoulder
108	12015	33	X	.....	.....	.....	Jan. 21, 1903	Excised breast and pectoral muscles and axillary glands	.....	18 months after operation had recurrence in ilium, from which she died. Had X-ray for 1 year following operation
109	12098	57	X	.....	.....	.....	Feb. 6, 1903	Excised breast and pectoral muscles and axillary glands	April 13, 1907	No recurrence. Great deal of edema of arm. X-ray for 1 year

110	12130	44	×	.....	×	×	.....	×	.....	×	.....	×	.....	×	.....	×	.....	×	.....	Excised breast and pectoral muscles and axillary glands	Feb. 13, 1903				
111	12141	41	×	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Excised breast and pectoral muscles and axillary glands	Feb. 15, 1903				No recurrence. Great deal of oedema in arm
112	12384	52	×	×	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Excised breast and pectoral muscles and axillary glands	April 1, 1903				Died of recurrence a few months after operation
113	12423	56	×	.....	×	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Excised breast and pectoral muscles and axillary glands	April 10, 1903				No signs of recurrence. Considerable oedema of arm
114	12424	47	×	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Excised breast and pectoral muscles and axillary glands	April 10, 1903				
115	12469	75	×	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Excised breast and pectoral muscle and axillary glands	April 17, 1903				Died 1 year after operation. No local signs of recurrence
116	12740	54	×	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Excised breast and pectoral muscles and axillary glands	June 8, 1903				Died 3 years later from pneumonia. No signs of recurrence
117	12866	64	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Excised breast and pectoral muscles and axillary glands	June 30, 1903		None		
118	12982	58	×	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Excised breast and pectoral muscles and axillary glands	July 24, 1903		None		
119	13017	57	×	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Excised breast and pectoral muscles and axillary glands	July 30, 1903				Died of cancer in chest 6 months later
120	13019	43	×	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Excised breast and pectoral muscles and axillary glands	July 31, 1903				Perfectly well since operation
121	13354	40	×	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Excised breast and pectoral muscles and axillary glands	August 26, 1903				Perfectly well. Had few X-ray treatments
122	13396	47	×	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Excised breast and pectoral muscles and axillary glands	Oct. 9, 1903				X-ray for 3 months. One year later carcinoma developed in other breast. This was removed. Well now
123	13415	45	×	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Excised breast and pectoral muscles and axillary glands	Oct. 12, 1903				30 X-ray treatments after operation. Slight swelling of arm. Otherwise well
124	13423	30	.....	.....	.....	×	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Excision of breast and fascia of pectoral muscle and axillary glands	Oct. 12, 1903				
125	13905	50	.....	.....	.....	×	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Excised small nodule from old scar	Jan. 24, 1904				Recurrent case. Primary operation Jan. 30, 1903. Had several slight recurrences after second operation, which were cauterized with arsenic. Healed after this

ANALYTICAL TABLE OF CASES OF CARCINOMA OF BREAST OPERATED UPON AT THE AUGUSTAN HOSPITAL.—Continued

Number.	Hospital No.	Age.	Involvement of				Date of operation.	Operation.	Date of last communication of patient.	Result.
			Ax. Gl.	Cer. Gl.	Skin.	Muscle.				
126	13990	44	X	.....	.....	.....	Excised breast and pectoral muscles and axillary glands	.....	Died 18 months after operation of carcinoma
127	14733	39	.....	.....	.....	.....	Excised breast and pectoral muscles and axillary glands	April 11, 1907	X-ray for 3 months after operation. Perfectly well now
128	14971	62	X	.....	X	X	Excised breast and pectoral muscles and axillary glands	None	
129	15004	43	X	.....	X	X	Excised breast and pectoral muscles and axillary glands	Jan., 1907	Recurrent case. Had portion of breast removed 3 months previous. Again had recurrence. X-ray and serum treatment. Well at present
130	15229	95	.....	.....	.....	.....	Excised breast and pectoral muscles and axillary glands	April 12, 1907	Perfectly well
131	15388	39	X	.....	.....	.....	Excised breast and pectoral muscles and axillary glands	None	
132	15398	35	X	X	X	.....	Excised breast and pectoral muscles and axillary glands	.....	Had rapid recurrence and died April 25, 1905
133	15440	60	X	.....	X	.....	Excised breast and pectoral muscles and axillary glands	April 10, 1907	No return of disease. General health very good
134	15533	70	.....	.....	.....	.....	Excised breast and pectoral muscles and axillary glands	April 12, 1907	Examined personally. No sign of recurrence
135	15774	45	X	.....	X	.....	Excised breast and pectoral muscle and axillary glands. Skin grafted	.....	Died Oct. 16, 1905, apparently from carcinoma inside of chest
136	15782	51	X	.....	.....	.....	Excised breast and pectoral muscles and axillary glands	May 4, 1907	Perfectly well

137	15080	45	X	.....	.....	March 1, 1905	Excised breast and pec- toral muscles and ax- illary glands	April 18, 1907	Took long time to regain strength. Perfectly well now
138	16182	35	.....	.....	.....	May 1, 1905	Excised breast and pec- toral muscles and ax- illary glands	None	
139	16253	72	.....	.....	.....	May 24, 1905	Excised breast and pec- toral muscles and ax- illary glands	April 14, 1907	About a month after operation a small nodule appeared above clavicle. Has remained same ever since. No pain
140	16346	40	X	.....	X	June 5, 1905	Excised breast and pec- toral muscles and ax- illary glands	April 15, 1907	Has taken 27 X-ray treatments. No recurrence.
141	16351	46	.....	.....	.....	June 5, 1905	Excised breast and pec- toral muscles and ax- illary glands	None	
142	16464	55	.....	.....	.....	June 23, 1905	Excised breast and ax- illary gland, left pec- toral muscles	April 14, 1907	No recurrence. General health has not been so good in years
143	16813	45	X	.....	.....	August 23, 1905	Excised breast and pec- toral muscles and ax- illary glands	April 12, 1907	No signs of recurrence
144	16824	39	X	.....	X	August 25, 1905	Excised breast and pec- toral muscles and ax- illary glands	.....	Died 8 months later from carcinoma in chest
145	17212	44	X	.....	.....	Oct. 23, 1905	Excised breast and pec- toral muscles and ax- illary glands	April 15, 1907	Perfectly well, except some swelling of arm
146	17247	57	X	.....	.....	Oct. 27, 1905	Excised breast and pec- toral muscle and axil- lary glands	None	
147	17401	45	X	.....	.....	Nov. 22, 1905	Excised breast and pec- toral muscles and ax- illary glands	April 21, 1907	Perfectly well except at times has stiffness in arm
148	17515	54	X	.....	X	Dec. 11, 1905	Excised breast and pec- toral muscles and ax- illary glands	.....	Had rapid recurrence, and died July 22, 1906
149	17556	44	X	.....	.....	Dec. 18, 1905	Excised breast and pec- toral muscles and ax- illary glands	April 18, 1907	Some numbness in arm. Otherwise well
150	17558	38	.....	.....	X	Dec. 20, 1905	Excised breast and pec- toral muscles and ax- illary glands	.....	Died about 10 months later of carcinoma
151	17606	50	.....	.....	.....	Dec. 26, 1905	Amputation of arm and clavicle	.....	Recurrent case. Primary operation June, 1905. Died of shock
152	17656	57	X	.....	X	Jan. 3, 1905	Excised breast and pec- toral muscles and ax- illary glands	Examined April 12, 1907	There was evidence of local recurrence. This removed by actual cautery. Wound not completely healed. Still takes X-ray

ANALYTICAL TABLE OF CASES OF CARCINOMA OF BREAST OPERATED UPON AT THE AUGUSTANA HOSPITAL.—Continued

Number.	Hospital No.	Age.	Involvement of				Date of operation.	Operation.	Date of last communication of patient.	Result.
			Ax. Gl.	Cer. Gl.	Skin.	Muscle.				
153	17883	73	×	.....	.....	.....	Excised breast and dissected axilla	Examined April 3, 1907	Perfect result. No signs of recurrence
154	17907	48	×	.....	.....	.....	Excised breast and pectoral muscles and axillary glands	April 22, 1907	No signs of recurrence. Has pain in arm if she uses it too much
155	18694	52	×	.....	.....	.....	Excised breast and pectoral muscles and axillary glands	April 28, 1907	No return of former disease. X-ray 3 times a week for 5 weeks
156	18752	39	×	.....	.....	.....	Excised breast and pectoral muscles and axillary glands	March 4, 1907	No recurrence. Some contraction of scar in axilla
157	18979	55	×	.....	.....	.....	Excised breast and pectoral muscles and axillary glands	April 30, 1907	Perfectly well. Has had 24 X-ray treatments
158	18981	56	.....	.....	.....	.....	Excised breast and pectoral muscles and axillary glands	April 18, 1907	No signs of recurrence. Arm somewhat stiff
159	19033	49	×	.....	.....	.....	Excised breast and pectoral muscles and axillary glands	April 15, 1907	Perfect result X-ray treatment for 4 months
160	19258	47	×	.....	.....	.....	Excised breast and pectoral muscles and axillary glands	April 13, 1907	Took X-ray treatment for 5 weeks. Feels perfectly well
161	19636	64	.....	.....	.....	.....	Excised breast and pectoral muscles and axillary glands	.....	Died Feb. 2, 1907, from extension of carcinoma into chest
162	19799	65	×	.....	×	.....	Excised breast and pectoral muscles and axillary glands	.....	First operation Feb., 1900. Rapid recurrence. Second operation Oct. 19, 1900. In 1901 another recurrence, which disappeared under X-ray treatment. Present recurrence began 1 year ago
163	19904	54	×	.....	×	.....	Excised mass in old scar and cauterized base of wound with actual cauterization	.....	Had recurrence 10 years later, which was excised May 23, 1899. Had recurrence 1 year later. Took X-ray treatments until Oct., 1903, when she became bed-fast and died a short time afterwards
164	.....	48 ¹	.....	.....	.....	.....	Excised breast	.....	.....

Cases not heard from, 63.

Of the 44 patients whose deaths have been reported, only 39 died either as a result of the operation or from recurrence.

The following five cases died of other causes than carcinoma without recurrence:

CASE 18.—Age 47, died three years after operation from some acute disease not stated in the letter reporting her death. No signs of recurrence.

CASE 26.—Age 57, died ten years and six months after operation from apoplexy. No signs of recurrence.

CASE 32.—Age 59, died five years after operation from nephritis. No signs of recurrence.

CASE 42.—Age 58, died seven years after operation. No signs of recurrence.

CASE 116.—Age 54, died three years after operation from pneumonia. No signs of recurrence.

The following case seems to have especial interest:

CASE 12.—Age 44, was operated upon March 12, 1894. One year later had recurrence in scar. Doctor applied a paste causing necrosis of the wound. This healed completely, and patient has been perfectly well since. Now thirteen years and two months since operation.

It has seemed proper to use X-ray treatment systematically in all cases after operation. This, however, was not always possible in patients living in the smaller country towns.

Cases which had X-ray Treatments.—All cases operated during the past six years had X-ray exposures during the patient's stay in the hospital. Of the cases heard from, 22 took X-ray treatment after leaving the hospital.

The following cases seem to be sufficiently interesting to justify especial abstracts of their histories:

CASE 87.—Age 29. Operated May 17, 1901. Six months later she had a recurrence in the line of the incision, with numerous nodules in the skin, a recurrence in the axillary and cervical glands, and apparently a carcinoma in the cranial cavity causing a marked protrusion of the right eye. All of these disappeared

under X-ray exposures. The patient was last heard from one year ago. She was perfectly well at this time, five years after the operation.

CASE 96.—Age 60. Had recurrence one year after operation. This disappeared under X-ray exposures, but recurred two years later, from which she died.

CASE 125.—Age 50. Operated upon January 24, 1904. Following this had recurrence in scar. Was given vigorous X-ray exposures with very little benefit. Arsenic was applied to wound, causing necrosis of considerable amount of tissue. Wound healed completely. Patient perfectly well now.

CASE 129.—Age 43. Operated upon September 9, 1904. Had primary operation three months previous, when only a portion of the breast was removed. Had second recurrence a few months later. Under X-ray exposures and the treatment by hypodermic injections of a proprietary remedy recurrence disappeared and she is now perfectly well.

CASE 163.—Age 54. Primary operation February, 1900. Rapid recurrence. Second operation October, 1900. A few months later a second recurrence, involving the axilla and the cervical lymph glands and the tissues of the scar, making further operative treatment apparently hopeless. This disappeared under X-ray treatment and remained well for four years. Third recurrence began one year ago. This was excised December 10, 1906. Has had X-ray treatment most of the time during the past five years. Examined May 20, 1907, and found well.

CASE 164.—Age 48. Operated upon May 23, 1889. Had recurrence ten years later, which was excised May 23, 1899. Recurred one year later. Took X-ray treatments continually for three and one-half years, when she died of carcinoma.

A review of this series of cases, although incomplete, seems to show that if the very complete operation which is now generally practised is employed in these cases reasonably early, there is much reason for expecting a fair percentage of permanent cures.

END RESULTS FOLLOWING OPERATIONS FOR CARCINOMA OF THE BREAST.*

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IN discussing the results to be obtained from operation upon carcinoma of the breast there are various factors to be carefully weighed. Considering these in their natural order we should first be concerned with the period of duration of the disease and the rapidity of its progress, next with the extent of involvement of the various structures and the character of the carcinoma and finally with the radical nature of the operation performed for its removal.

It is not always possible to determine the period of duration of the disease. Inasmuch as in its early stages carcinoma is entirely devoid of pain, it is frequently a matter of accident that the tumor is discovered. In one of my cases the patient dreamed that she had a tumor of the breast and the next morning on awakening was startled to find on placing her hand upon the gland that a tumor was present.

The rapidity with which the disease progresses is of paramount importance. I think that it will be conceded without dispute that there is as much difference in the virulence of cases of carcinoma as there is in acute infectious fevers. In some instances of the latter, the fever will progress so mildly as to scarcely disturb the patient, while in other instances it will overwhelm the individual with such fury as to be fatal within twenty-four hours. Acute cases can be of scirrhus as well as medullary character.

October 9, 1901, a woman forty-one years of age, the mother of two children both of whom she had nursed and never having

* Read at the meeting of the American Surgical Association May 8, 1907.

had any disturbance of the breasts because of lactation, presented herself for examination. Ten days before she had discovered a hardness in the right mammary gland. I found a tumor the size of a hen's egg in the right breast, occupying the outer upper quadrant; freely moveable and non-adherent. In the axilla there were many glandular masses which were hard and somewhat fixed to the skin. It did not seem possible that this condition could have been of but ten days' duration. At the operation not only the skin covering the mammary gland but that of the axilla was freely removed as well as the axillary contents and both pectoral muscles. The axillary mass was found to be larger than the primary growth. She made a rather slow recovery inasmuch as it was impossible to cover the entire surface at the operation and some of the healing therefore was by granulation. A recurrence in the axilla was discovered January 17, 1902. This was removed five days later by operation. Union this time was by first intention. February 7, 1902, that is a little more than two weeks after her second operation, she began to suffer from pains in the abdomen, chest and back. Early in March twitching occurred in both lower extremities. On March 11 there was complete paralysis of sensation and motion below the level of the seventh dorsal vertebra. The patient died April 23, 1902, within six months of the first evidence of the disease. Microscopic examination of the tumor showed it to be a scirrhus carcinoma.

Another equally virulent scirrhus cancer occurred in a woman fifty-two years of age, operated upon November 18, 1899. She had known of the presence of the growth but two days and yet upon examination the entire gland was found to be implicated, the skin adherent, the nipple retracted, and the corresponding axillary glands palpable. A very wide excision of all of the diseased area including the skin, mammary gland, pectoral muscles and the axillary contents was performed. The patient made a rapid recovery, the wound healing by first intention. She left the hospital on the sixteenth day after operation in good general condition. Three months later there was not only recurrence in the scar at the junction of the middle and lower third but over the entire chest and on the back small shot-like nodules were to be felt as well as nodes in the supraclavicular spaces. Similar nodules appeared in various parts of the body, rapidly increased

in size as well as number; the cachexia grew profound and the patient succumbed to the disease in August, 1900.

In this class of cases it matters little what operation is selected or how early it may be performed, the evident virulence of the infection renders a permanent cure impossible. As far as I am aware there is nothing which either the surgeon or the pathologist can discover at the time of operation which will make it possible for him to determine the degree of malignancy of the affection aside from the rapid course the disease has pursued up to the time of operation.

There is another class of cases which show their tenacity and the patient's susceptibility to carcinoma by repeated outbreaks in different parts of the body.

On June 19, 1895, I curetted the uterus of a woman forty years of age, and found carcinomatous disease of the fundus. Not until the next spring did she consent to hysterectomy. In May, 1898, she discovered a tumor in the depth of her right breast. Amputation of the gland was not permitted until September 18, 1898. The tumor, about $1\frac{1}{2}$ inches in diameter, did not involve the skin and was quite moveable. There were numerous glands to be felt in the axilla and after removal of the breast the pectoral muscles, sub-pectoral and axillary glands the patient apparently made a very good recovery. Glandular metastases discovered in the posterior triangle of her neck on the right side and in the axilla in January, 1900, were again removed. On June 7, 1900, there was a recurrent nodule in the scar tissue on the chest and this was cut out. She remained well until January, 1902, when there was another recurrence in the cicatrix and involvement of the supraclavicular glands of the opposite side of the neck. In removing them I followed the chain down until I found it to be continuous with the glands in the mediastinum. From this time on she suffered greatly from dyspnoea, laryngeal stridor and a racking cough. There was implication of the left recurrent laryngeal nerve. In December, 1902, orthopnea was marked. She died January 9, 1903, fully eight years after the first evidence of carcinomatous disease.

On March 10, 1897, I performed hysterectomy for carcinoma

of the uterus on a woman thirty-nine years of age, from which she made a very satisfactory recovery. September 23, 1899, she presented herself to me with a hard tumor in the lower outer quadrant of the left breast associated with enlarged axillary glands. The entire breast with its overlying skin, the axillary glands and the pectoralis major were removed. She had no recurrence of the carcinomatous disease either in the breast or pelvis but developed cancer of the stomach from which she died January 2, 1901.

In still another case I amputated the right breast in March, 1891, and without evidence of any local recurrence she returned to me in June, 1892, with a similar disease of the left breast. This was likewise amputated. In January, 1895, a spinal metastasis occurred and the patient gradually became paralyzed in both upper and lower extremities and died of the spinal recurrence December 21, 1895.

This group of cases in which carcinoma manifests itself in different organs of the body and in which the new outbreak of the disease occurs without return at the primary site indicates that in a certain class of cases we cannot lose sight of the personal equation, as evidently some individuals possess a pronounced susceptibility to cancerous disease.

That advanced age is not a matter of great import in determining the prognosis is evident in the following two cases:

The first was a woman eighty years of age, who had known of the presence of the tumor for two weeks. Radical operation was performed on June 30, 1904. The axillary space was thoroughly cleared out, the pectoralis major was removed, and in just two weeks' time she left the hospital, primary union having followed operation. She died one year later of conditions incident to her vascular condition and without recurrence of the cancer. The pathologist's report in this case was scirrhus carcinoma.

In the second case I operated upon a woman seventy-eight years of age who had been aware of the presence of the tumor but ten days. Here also there was well advanced atheromatous degeneration. She did not die until five years after operation, when her death was caused by apoplexy. At the time of operation

the patient was already suffering from cerebral changes incident to the vascular disease. She complained of tingling and numbness of her extremities and suffered from dizziness and aphasia. Ten months after operation there was a slight recurrence in the scar. This was treated by the application of a caustic paste which removed the diseased part. In the course of six weeks it had entirely healed. The patient had no subsequent recurrence.

This is the only instance in which I did not use the knife for the removal of the recurrent growth.

On the contrary, I embodied in a paper read before the Medical Society of the State of New York at its annual meeting in 1896 some statistics obtained from a gentleman whose wife was treated at a so-called cancer cure institution by means of caustic applications. Among those receiving the same treatment in this institution were fifteen patients with carcinoma of the breast. The end result of the treatment was obtained in each case. In no instance was there any benefit, but each and every one died of the cancerous affliction after months of torture.

I had occasion to operate upon a religious sister in May, 1890, for carcinoma of the breast of one year's duration during which period she had been treated by a self-styled cancer specialist with caustic plasters, only to produce a sloughing condition of the breast. A prompt recovery followed removal of the breast, the axillary contents and part of the pectoralis major. A letter received from her physician, Dr. Hancock of Jeffersonville, Indiana, April 22, 1907, *i.e.*, seventeen years later, reports her to be in good health with no recurrence of cancer.

There can be no doubt that the removal of recurrent growths may be followed by lasting cures.

A patient was operated upon by me August 24, 1896, for scirrhus of the right breast of some months' existence. There were marked glandular metastases in the axilla. Local recurrence in the scar tissue and neighboring glands appeared twenty-one months later. The recurrent growths were removed by

operation May 18, 1898, and since then the patient has had no return, has enjoyed perfect health, and has the full use of her arm.

Whether sex is a factor to be considered in the ultimate prognosis of malignant diseases of the breast I am unable to say. I have had but 3 cases of malignant tumor of the male breast, each of them recurring and in the end causing death.

I have been greatly disappointed in my efforts to obtain information in regard to many of the patients upon whom I have operated. Of 71 cases reported upon and which were operated more than three years ago, 35 are still living; 33 died of metastases and 3 within a year after operation of other diseases.

As has been stated, some of the most acute recurrences have been in cases of the scirrhus type.

In our pathologic studies some attention has been given to the investigations of the presence of mitotic figures to determine whether evidence of active cell division implied the probability of early recurrence. This has not been found to be the case. For example, in one specimen of scirrhus mitotic figures were found to be rare in the breast tumor, but numerous in the lymph nodes. There was evidence of spinal metastases eight months after operation, death occurring two months later. In another scirrhus carcinoma of a breast removed May 27, 1903, mitotic figures were very abundant, but the patient is at present in the full enjoyment of health, having never had the slightest recurrence.

During the past ten years I have employed the incision suggested by Dr. Halsted and have followed his technique except as to the removal of the supraclavicular glands in all cases. The latter step has only been undertaken when there has been apparent invasion of the neck. The axillary space has been thoroughly cleaned out, the pectoralis major and sometimes the pectoralis minor have been removed. After making the skin incision, the axillary space is first cleared and an attempt made to remove everything en masse. The great advantage of being able to see the field of operation clearly

at every step of the operation cannot be too highly appreciated.

For the past two years, when it has been possible to do so, the patients have been given weekly X-ray treatments for at least three months after their recovery from the operation.

During the decade preceding the last ten years I was guided by the principles enunciated by the late Samuel W. Gross in the paper presented to this association at its meeting in 1881. A circular incision was made around the breast and extended into the axilla. The axillary fat with the glands buried in its substance was removed, together with the upper layer of the pectoralis major. In cleaning the axilla by this method one had to depend largely upon the sense of touch, and hence there was always a degree of uncertainty as to whether all invaded structures were thoroughly removed. That this result was obtained in many instances, however, there can be no doubt.

In 1890 I operated upon 3 religious sisters, one in May, another in June and still another in November. In only one of these cases has there been a recurrence. This was in March, 1906, that is, sixteen years after the operation, when there appeared in the abdomen numerous nodules presumably involving the various abdominal viscera. They were hard and fixed. She died September 2, 1906. No autopsy was permitted.

This brings up the question of what we are to consider a cure. I think it must be conceded that the three-year limit usually put upon these cases is altogether too short to determine the end result. While in most instances a patient remaining entirely well for three years is quite apt not to suffer from further recurrence, the exceptions to this rule are by no means rare.

A woman operated upon by me December 19, 1888, when in her thirty-seventh year of age and in whom a scirrhus carcinoma of the breast had been present for about a year, showed no further signs of malignant disease until the spring of 1901. She died June 17, 1901, of malignant invasion of the liver, the

autopsy showing this organ to have been converted into a mass of malignant nodules of varying size from a pinhead to that of a large marble. All of the other organs seemed to be free from malignancy.

Withal, however, as we review the results of operative procedure undertaken for carcinoma of the breast, we can warrant the assertion that the present operative technique developed as it has been along the lines of pathologic research has fully verified our expectations and justifies the statement that except in the very acute cases a timely operation radically performed will completely remove the carcinomatous disease and prevent recurrence in the majority of cases.

THE END RESULTS FOLLOWING OPERATIONS FOR CARCINOMA OF THE BREAST.

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I HAVE assumed in preparing this article that one is expected to confine his observations to patients upon whom he has operated and to give the results of his personal experience. It has been utterly impossible for me to obtain "the end results" in such a large number of cases operated upon in the charity wards of the hospitals that it seems necessary to omit any reference to patients who could not be followed after they left the hospital. I have therefore omitted from consideration all patients except those private cases whose subsequent histories could be accurately obtained either from personal observation, or by correspondence with their family physicians. One cannot present a complete list even of this class of cases, either because some of the patients have removed to new localities or the physician who referred the patients to me may have died or removed from his original location.

The histories of the patients herewith reported are complete up to April 1, 1907, and I am sure that each statement is based upon authentic information. A tabulated statement is appended for convenience of reference. No case is reported which has not passed the three-year limit or has died before the expiration of that period of time. It is possible that the statistics herewith given are somewhat better than has been the average in my work. I believe this to be true, because the patients grouped in this report represent the more intelligent class of people, as well as those best able to care for themselves.

The complete histories of 35 patients with carcinoma of the breast are presented herewith. Twenty-two, or 62.85 per cent., are dead from recurrence of the disease, while 12

SYNOPTICAL TABLE OF CASES OF CARCINOMA OF THE BREAST.

Number.	Name.	Time between discovery and operation.	Breast affected.	Segment of breast involved.	Rapidity of growth.	Glandular involvement at time of operation.	Time of recurrence.	Sites of recurrence.	Time between operation and death.	Alive.
1	Mrs. B.	15 months.	R.	Upper, outer.	Slow.	Extensive.	6 months.	Axillary glands op. breast skin.	2 y., 2 m.	Alive.
2	Miss S.	1 year.	R.	Whole breast.	Rapid.	Very extensive.	3 months.	Axilla and stomach.	6 months.	
3	Mrs. F.	3 months.	R.	Upper, outer.	Rapid.	Extensive.	3 months.	Local and neck.	2 years.	
4	Mrs. D.	1 year.	R.	Upper, outer.	Slow, 10 m.	Extensive.	3½ months.	Axilla, liver and pleura.	4 months.	
5	Mrs. A.	1 year.	L.	Upper, inner.	Rapid, 2 m.	Slight.	9 months.	Local and spine.	12 months.	
6	Mrs. B.	3 years.	R.	Upper, outer.	Slow.	Extensive.	4 weeks.	Brain.	5 weeks.	
7	Mrs. B.	6 weeks.	R.	Upper, inner.	Very rapid.	Extensive.	6 months.	Liver and stomach.	14 months.	
8	Mrs. C.	20 years.	L.	Upper.	Very slow.	Well marked.	1½ years.	Liver.	22 months.	
9	Mrs. K.	active 1 yr.	R.	Lower, middle.	that rapid.	Well marked.	14 months.	Axillary glands.	.....	Well, 10½ yrs.
10	Mrs. V.	6 months.	R.	Lower, middle.	Rapid.	None.	.....	.....	.....	Well, 10 years.
11	Miss K.	1 year.	R.	Outer, middle.	Slow.	Well marked.	13 months.	Opposite breast.	.....	8½ after 1st; 7 after 2 oper.
12	Mrs. R.	9 months.	R.	Outer, middle.	Medium.	Well marked.	18 months	Abdominal viscera.	22 months.	
13	Mrs. P.	3 months.	L.	Upper, outer.	Rapid.	Very extensive.	1 year.	Spine.	18 months.	
14	Mrs. P.	6 months.	R.	Upper, outer.	Rapid.	Slight.	2 years.	Scalp.	3½ years.	
15	Mrs. W.	5 weeks.	R.	Lower, middle.	Rapid.	Well marked.	3-4 years.	Chest.	5 years.	
16	Mrs. M.	6 months.	R.	.....	.....	Slight.	3½ years.	.....	.....
17	Mrs. G.	18 months.	R.	Central.	Slow.	Slight.	4½ years.	Local.	.....	Well, 6 years.
18	Mrs. T.	2 years.	R.	Lower, inner.	Slow.	Slight, extensive.	1 month.	Stomach.	6 months.	Well, 4 y., 3 m.
19	Mrs. H.	2 years.	R.	.....	Slow.	Well marked.	None.	Axilla.	.....	Well, 5 years.
20	Mrs. W.	4 months.	R.	Upper, outer.	Rapid.	Absent.	.....	Liver, kidney, left breast.	.....
21	Miss F.	1 year.	R.	Upper, outer.	Rapid.	Very extensive.	1½ years.	.....	2 years.	
22	Mrs. DeC.	3 months.	R.	Lower, outer.	Rapid.	Slight.	.....	.....	.....	Well, 3½ years.
23	Mrs. B.	3 years.	R.	Upper, outer.	Slow.	Well marked.	3 months.	Local and lung.	1 year.	
24	Mrs. B.	8 months.	R.	Upper, outer.	Rapid.	Extensive.	.....	.....	.....	Well, 3½ yrs.
25	Miss H.	1 year.	L.	Whole gland.	Rapid.	Very extensive.	9 months.	Not known.	15 months.	
26	Miss S.	2 years.	R.	Whole gland.	Slow.	Slight.	5 months.	Not known.	9 months.	Well, 3 y., 1 m.
27	Mrs. P.	15 months.	L.	Whole gland.	Medium.	Very extensive.	.....	.....	.....	Well, 3 years.
28	Mrs. W.	5 months.	L.	Whole gland.	Rapid.	Slight.	.....	.....	.....	Well.
29	Mrs. R.	6 months.	R.	Lower, outer.	Rapid.	Slight.	.....	Lung, skin local.	7 months.	With recurrence
30	Mrs. S.	8-10 months.	R.	Lower, outer.	Rapid.	Very extensive.	4 months.	Above clavicle.	.....
31	Mrs. McN.	10 years.	L.	Lower, inner.	Slow.	Very extensive.	1½ years.	.....	.....
32	Miss F.	active 1 yr.	R.	Whole gland.	Very rapid.	Very extensive.	4 months.	Local lung, other breast.	7 months.	
33	Mrs. K.	1 year.	R.	Middle, outer.	Rapid.	Well marked.	8 months.	Spine.	1 y., 8 m.	
34	Miss M.	1½ years.	R.	Upper, outer.	Rapid.	Slight.	4 months.	Op. breast, stomach.	1½ years.	
35	Mrs. W.	1 month.	Both.	Lower, outer (L.), middle, outer (R.).	Rapid.	Marked on left side.	.....	.....	.....	Well, 5½ years.

are alive and well from three to ten and one-half years after operation (34.28 per cent.). One is alive after more than three years, but she is at present afflicted with an inoperable recurrence to which she will undoubtedly succumb in the near future.

The radical operation, with removal of both pectoral muscles, but without cleaning out of the supraclavicular region, was performed thirty times. The breast was removed and the axilla cleared out without removal of the pectoral muscles seven times. (The two additional operations are accounted for by the fact that the remaining breast became involved in two patients and these were subsequently removed.) Ten of the 30 patients upon whom the radical operation was done have recovered ($33\frac{1}{3}$ per cent.), while 4 of the 7 upon whom the simpler operation was done are now alive and well (57.15 per cent.). These figures are misleading because in two instances a simple operation was done upon the remaining breasts after radical operations had been done upon the opposite ones. It is rather remarkable that both of these patients recovered and have remained well—one seven and one-half years, and the other five and one-half years after removal of the second breast.

These statistics seem to prove that recurrences and deaths from carcinoma of the breast are unusual after the patient has remained well for three years after the operation. In but 3 of the cases has death from carcinoma occurred after three years; these lived respectively five, four and three and one-half years.

Three patients developed recurrences or metastases after three years; these appeared in four and three-quarters, three and one-half, and three and one-half years after operation. One of these cases is alive and well one year after the removal of a local recurrent growth. The author has met with one fatal recurrence in the axilla fourteen years after the breast had been removed.

These very late recurrences open up the question as to what should be called a recurrence and what should be regarded

as a new development of carcinoma. A discussion of this question is not in order under the present circumstances because all such developments must be regarded as recurrences so far as the purpose of this discussion is concerned.

Two or more operations were performed upon 8 of the 35 patients, the secondary operations having for their object the removal of local recurrences of the disease. Three of these are alive and well more than three years after the last operation.

Twenty-one of the 35 patients operated upon had known of the existence of a tumor in the breast for one year or longer. One patient had had a lump in her breast for upwards of twenty years, but it had remained quiescent until one year preceding the operation. Another lady had known of the existence of a tumor in her breast for ten years, but there were no signs of activity until about six months before the operation. In each of these patients the tumor grew rapidly during the active period and malignancy was well marked. Fourteen of the patients who had known of the existence of a tumor for one year or more died ($66\frac{2}{3}$ per cent.). One is alive with an inoperable recurrence, and 6 (28.5 per cent.) are alive and well more than three years after operation.

Eight patients knew of the existence of a tumor from six to twelve months prior to operation. Four (50 per cent.) are alive and well; four (50 per cent.) are dead.

Six had been aware of the presence of a tumor for a period of less than six months. Two ($33\frac{1}{3}$ per cent.) are alive and well; four ($66\frac{2}{3}$ per cent.) are dead.

The figures seem to indicate that one may not be able to judge of the prognosis very accurately merely by the length of time the patient has known of the presence of a tumor in the breast. It must always be borne in mind, however, that a patient's statement on this point is not apt to be very accurate. When this testimony comes from the family physician, or from members of the patient's family it assumes much greater importance. The time given by the patient is always short of the real period of existence.

One remarkable case was that of a lady who had known of the existence of a tumor in her breast for two years. She consulted her local physician and he removed part of the breast, the incision not being sufficiently wide of the involved tissues to prevent an early recurrence. I made a radical operation one year later, and then removed a local recurrence nine months after the second operation. The patient is alive and well four and one-half years after the third operation (Case XIX).

Recurrence above the clavicle took place in but 2 of the 35 cases. This was less frequent than were recurrences in the opposite breast (5 cases).

Lymphoedema of the arm supervened in 5 of the patients. Three of these died in less than three years; one is alive but with extensive recurrences, and very extreme lymphoedema (Case XXX). The swelling gradually disappeared under treatment in the remaining patient (Case XX).

The function of the arm is good in all of the surviving patients. None of them complain of weakness or inability to use the member.

Twenty-eight of the patients comprising the material for this report were married, 7 were spinsters. Ten of the married and 2 of the single women recovered (36 and 28.6 per cent. respectively).

Statistics based upon this very limited number of cases indicate that the location of the primary growth has some bearing upon the prognosis. Central growths and those located in the lower third of the breast give a much larger percentage of recoveries than do growths located elsewhere.

The average duration of life after operation (in fatal cases) was twenty months; the extremes being five years, and five months.

The average time of recurrence was fourteen and one-quarter months—the extremes being fifty-six and three months.

An estimation, such as the above, based upon the mere existence of cancer of the breast without any consideration of the actual conditions present at the time of operation will

give a very fair idea of the average results obtainable in the general run of cases, without any elimination of cases unsusceptible of cure through operative measures. One may, however, in fairness exclude from these statistics those cases in which operation was simply undertaken as a palliative measure, and thus obtain a better idea of what results may be accomplished in cases more carefully selected. This more careful discrimination is only possible through more careful education of physicians and of the general public. Fourteen of the 35 cases in this report were beyond the possibility of cure through operation, and in each of these cases operation was undertaken with the hope of prolonging life or to remove offensive, ulcerated breasts. If we subtract these 14 cases and estimate our mortality upon the cases in which there was a reasonable hope of success we then have 21 patients, 12 of whom recovered—a percentage of recovery of about 57.6.

The matter of prognosis in an individual case will always remain a doubtful one, even though the surgeon has had a very considerable experience with this class of cases. Seemingly favorable cases sometimes progress to a fatal termination, whereas one is sometimes pleasantly surprised by having an unpromising case go on to recovery.

The most potent factor bearing upon prognosis is the character of the growth. The richly cellular, rapidly growing, soft, succulent carcinomata are much less amenable to surgical treatment, even when seen early in the course of the disease, than are the more fibrous, slowly growing, hard varieties of the disease. A successful outcome is not probable in the former variety unless operation is undertaken very, very early, because secondary foci of development are planted soon after the primary growth makes its appearance.

One is justified in looking upon the operative treatment of cancer of the breast as being far from an ideal method of treatment, even with the extensive removals practiced at the present time. The hope for the future lies in better prophylaxis and in a better knowledge of the nature of the disease.

CARCINOMA OF THE BREAST.*

A STUDY OF THE PATHOLOGICAL CONDITIONS AND THEIR
RELATION TO THE QUESTION OF RECURRENCE.

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My hospital cases have been included in the report made from the Massachusetts General Hospital. The following report concerns only my private cases down to the year 1904. In this series were many advanced cases in which the operation was a desperate effort to prolong life. There was no selection of cases, operation being done in every case that offered except in one where the co-existence of advanced heart disease and a large adherent carcinoma led to palliative efforts with the X-ray. The cases were all carefully studied pathologically and the after history has been closely followed. There were forty-two cases. All recovered from the operation and of these nine are entirely free from recurrence. The time elapsed since operation in these nine cases has been in 1 case 4 years, 1 case 5 years, 1 case 7 years, 1 case 8 years, 2 cases 10 years, 1 case 11 years, 1 case 14 years, 1 case 19 years.

Five other cases are still living though they have had a recurrence of the disease. One of these was operated three years ago, three of them were operated four years ago, and one five years ago.

The remaining twenty-eight cases have died of the disease. Of these seventeen died in one year. Two lived two years. One lived three years. Two lived four years, and six lived five years.

Of the nine cases that are well without recurrence the pectoral muscles were removed in two. In the remaining seven the breast and axillary contents were removed without removal of the muscles.

* Read before the American Surgical Association, May 8, 1907.

TABLE I.—NON-RECURRENT CASES

No.	Age.	Name.	Extent of involvement.	Duration.	Date of operation.	Magnitude of operation.	Variety of carcinoma.	Time elapsed.
1	About 50	Miss H. ....	.....	Some months.	Nov., 1888.	Breast removed and axilla cleaned out.	Paget's disease.	19 years.
2	54	Mrs. S.	Nodule size of horse-chestnut. No glands in axilla.	10 years.	Dec., 1893.	Entire breast, axilla cleaned out and connective tissue between breast and axilla removed.	Scirrhus cancer. No infected glands found.	14 years.
3	60	Miss S.	Small nodule.	Recent discovery.	Apr., 1896.	Breast removed and axilla cleaned out.	Scirrhus cancer. No infected glands found.	10 years. Died in 1906 of pneumonia.
4	About 36	Sister A.	Chronic fibrous thickening; one point size of pea showed scirrhus cancer.	Just discovered.	July, 1896.	Whole breast and axillary contents removed.	Scirrhus cancer. No infected glands found.	11 years.
5	52	Mrs. W.	Small nodule in breast.	Some weeks.	July, 1897.	Breast removed and axilla cleaned out.	Carcinoma of adenomatous type. Two lymphatic glands show metastasis.	10 years.
6	About 55	Mrs. B.	Irregular rounded growth 2.5 to 3 cm. in diameter. Skin not involved. No glands in axilla.	Recent discovery.	Apr., 1899.	Breast and axillary contents removed.	Plexiform medullary cancer. No infected glands.	8 years.
7	About 67	Mrs. M.	Nodule deep in upper outer quadrant 1.5 cm. in greatest diameter. No glands in axilla.	Recent discovery.	Feb., 1900.	Breast removed and axilla cleaned out.	Adenocarcinoma of mild type. No affected lymph nodes found.	7 years.
8	32	Mrs. P.	A dense nodule about 2 cm. in diameter. Commencing infection of lymph nodes.	Few months.	Oct., 1902.	Breast and pectoralis major removed, axilla cleaned out, dissection carried as far as subscapular vessels.	Early cancer of tubular type of alveoli. One lymph node affected.	5 years.
9	About 45	Mrs. W. ....	.....	.....	Apr., 1903.	Breast and axillary contents removed with pectoralis major and minor and all glands and tissue up to clavicle.	Carcinoma. Lymph nodes enlarged.	4 years.

In the five cases still living with recurrence the muscles were removed with the breast and axillary contents.

Of the twenty-eight cases that have died the muscles were removed with the breast and axillary contents in twelve cases.

In the remaining sixteen cases the breast and axillary contents alone were removed.

Nature of Growth.—In the nine non-recurrent cases the disease was usually of a mild type. In Case 1 it started as a Paget's disease of the nipple and at the time of removal a cancerous nodule was appearing in the breast beneath. Three of the other cases had carcinoma of adenomatous type. Three had small scirrhus cancers.

One had a small plexiform medullary carcinoma and in one case of unmistakable carcinoma the pathological report has been mislaid and cannot be found. In six of these cases careful search failed to show any infected lymph nodes. In the other three moderate infection of lymph nodes was found. In two cases, Nos. 1 and 7, of the non-recurrent series, a little epithelioma of the face co-existed with the breast cancer. In Case 1 after fifteen years a second epithelioma appeared on the opposite side of the face.

In the thirty-two cases where the disease recurred the pathologist failed to report condition of glands in three cases. In the remaining twenty-nine cases there were but three cases in which at the time of the first operation the pathologist reported a failure to find infected glands.

From this it will be seen that the instances of non-recurrence were in cases of localized disease which had not or had only just begun to invade the lymphatic system. On the other hand in the recurrent cases, with but three exceptions the lymphatic system was already seriously involved. It is interesting to note that in two of these three cases in which infected lymph nodes were not found there was no local recurrence nor involvement of neighboring lymphatics, but the symptoms pointed to a distant internal secondary growth. In the third of these cases the recurrence was in the supraclavicular glands.

Case 19 was interesting from the fact that this patient

TABLE II.—RECURRENT CASES.

No.	Age.	Name.	Extent of involvement.	Duration.	Date of operation.	Magnitude of operation.	Variety of carcinoma.	Recurrence.	Result.
1	28	Mrs. P.	Lump as large as hen's egg over edge of sternum skin adherent. Glands in axilla.	2 to 3 years.	1885.	Breast and axilla.	Border line between medullary and scirrhus cancer. Infected glands found.	Local recurrence.	Died. No date.
2	About 42	Mrs. G.	Tumor beneath nipple, which was retracted and hard. Axillary glands.	6 months.	May, 1889.	Breast and axilla.	Cancer with implication of axillary glands.	Operated again in Oct., 1889. Local recurrence in axilla.	Died in 1890?
3	48	Mrs. H.	Small nodule in outer part involving skin, 2 pea-sized nodules near by. In axilla small mass of medullary-looking glands.	4 months.	March, 1890.	Breast and axilla.	Scirrhus cancer of breast and axillary glands.	Probable.	Died in 1892 in England of pleurisy.
4	About 60	Mrs. S.	Nodule size of pecan nut. Glands in axilla.	3 months.	1890.	Breast and axillary contents.	Scirrhus cancer. Glands in axilla affected.	Probably first in lung.	Died in 1891 of recurrence
5	60	Mrs. L.	Dense retracting nodule outside of nipple.	Just noticed.	Oct., 1891.	Breast removed. Axilla dissected.	Medullary cancer. No infected glands found.	Oct., 1905. Operation for recurrence. Supracarvicular.	Died in 1897 from recurrence.
6	.....	Miss F.	Large retracting nodule. Axillary glands much enlarged.	.....	Nov., 1891.	Breast removed. Axilla dissected.	Cancer. Enlarged and infected axillary glands found.	Dec., 1894. Probably in medias thum.	Died in 1895.
7	60	Mrs. H. . . . .	.....	.....	July, 1892.	Breast removed. Axilla dissected.	Carcinoma.	Feb. and July. Operation for recurrence.	Died?

8	40	Miss B.	Nodule beneath nipple entire thickness of breast and through into fascia. Glands in axilla.	Some months.	Sept., 1892.	Breast removed. Axilla dissected.	Carcinoma. Numerous infected glands in axilla.	Small cancerous part removed from axilla in 1897.	Died.
9	About 50	Mrs. M.	Nipple retracted. Implication of lymph glands.	8 months.	1894.	Breast removed. Axilla dissected.	Diffuse scirrhus cancer with implication of the lymphatic glands.	Recurrence in liver and elsewhere.	Died one year later.
10	54	Mrs. G.	Large retracting nodule. Axillary glands enlarged.	9 months.	1894.	Breast removed. Axilla dissected.	Cancer. Glands infected.	Operation for glands above clavicle in 1895.	Operation in angle of jaw. Died in 1895.
11	.....	Mrs. D.	Contracted nodule size of large cherry beneath nipple. Several glands in axilla.	.....	.....	Breast removed. Axilla dissected.	Medullary cancer with secondary implication of lymph glands.	Operation for recurrence Mar., 1898. Probably in chest.	Died one year after recurrence.
12	48	Mrs. H.	One small nodule of carcinoma in middle of breast.	Recently discovered.	March, 1896.	Breast and entire axillary contents removed.	Typical carcinoma.	1st in pectoralis muscle Apr. 1897. Nodules removed at different times. Metastases to stomach and brain.	Died in April, 1901.
13	60	Mrs. M.	Diffuse fibrous thickening gland. Small retracting nodule near nipple. Gland in axilla.	Few weeks.	June, 1896.	Breast and axillary contents removed.	Scirrhus cancer, small infected gland found.	Sept. 1896. Nodules removed.	Died in fall of 1897.
14	45	Miss P.	Diffuse and ill-defined growth occupying considerable part of breast.	Recently noticed.	Dec., 1897.	Breast removed and axilla dissected.	Medullary cancer. Numerous lymph glands infected.	September, 1899. In chest.	Died in 1899.

TABLE II.—RECURRENT CASES.—Continued

No.	Age.	Name.	Extent of involvement.	Duration.	Date of operation.	Magnitude of operation.	Variety of carcinoma.	Recurrence.	Result.
15	58	Mrs. L.	Extensive hard mass in middle of breast.	Some months.	July, 1898.	Breast removed and axilla dissected.	Carcinoma with metastases in axillary fat tissue.	Recurrence within a year. Local and general.	Died in 1899.
16	45	Miss G.	Large nodule in breast and pectoral glands in axilla.	Some months.	Sept., 1898.	Breast removed and axilla dissected.	Typical carcinoma. Small nodule of carcinomatous tissue found in neighborhood of large artery.	Recurrence in pleura.	Died October, 1899.
17	50	Mrs. P.	Diffuse infiltrating growth occupying greater part of pectoral mammae. Axillary glands enlarged.	Some weeks.	Jan., 1901.	Breast and costal portion of pectoralis major completely removed and axilla dissected.	Medullary cancer with lymphatic and probably venous infection.	July, 1904, in edge of sternum or rib.	Died August, 1906.
18	52	Mrs. A.	Diffuse thickened area occupying about 6 cms. in generally fibrous breast. Lymph nodes in axilla.	Just noticed.	Oct., 1901.	Breast and costal portion of pectoralis major removed. Axilla dissected.	Scirrhous cancer with secondary infection of the lymph nodes.	Operation for recurrence in skin May and Oct., 1902, 1903, 1904.	Died in Mar., 1906.
19	71	Mrs. B.	Small breast with retracted nipple, 2 flat elevated infiltrations from skin. Other breast removed in 1872.	Some months.	Feb. 1902.	Breast and pectoralis major removed. Axilla dissected.	Scirrhous cancer with secondary infection of skin	Dec., 1904. Many suprascapular glands.	Died October, 1906.
20	48	Mrs. E.	Beneath nipple retracting fibrous growth about 2 cms. in greatest extent.	.....	April, 1902.	Breast and both pectoralis muscles removed. Axilla cleaned.	Scirrhous cancer and secondary infection of axillary lymph glands.	Soon.	Died in Oct., 1902.

21	About 68	Miss N.	Dense nodule 1.5 cm. in diameter. No glands in axilla.	.....	June, 1902.	Breast and pectoralis major and minor removed. Axilla cleaned.	Cancer of scirrhous type. No infected lymph nodes found.	Recurrence probably in spinal column, 1904.	Died soon after in 1904.
22	About 58	Mrs. R.	Diffusely fibrous breast and in it a dense nodule 2 cms. in diameter. Glands in axilla.	Some months.	Oct., 1902.	Breast with pectoralis major and minor removed. Axilla dissected.	Scirrhous cancer and secondary infection of axillary lymph nodes.	June, 1903. Local recurrence.	Died.
23	About 50	Mrs. B.	Hard, diffuse, ramifying growth. Axillary glands.	Some weeks.	Dec., 1902.	Breast with pectoralis major and minor removed. Axilla dissected.	Diffuse adenocarcinoma with infection of axillary glands.	Aug., 1904. Several large glands in neck.	Died in 1907.
24	42	Mrs. H.	A hard nodule about 2.3 cms. in diameter.	10 months.	Dec., 1902.	Breast with axillary contents removed with sternal portion of pectoralis major.	Adenocarcinoma of rather a scirrhous type with commencing axillary infection.	May, 1907. Recurrence along axillary vein and at root of neck.	Living.
25	75	Mrs. S.	Breast almost entirely occupied by a hard tumor. Axilla contained several hard nodules.	3 months.	March, 1903.	Breast and pectoralis muscles removed. Axilla cleaned.	Medullary carcinoma with secondary involvement of lymph channels and pectoralis muscle.	July, 1903. Local recurrence.	Died in Dec., 1904.
26	51	Mrs. D.	Hard tumor 4 cms. in diameter and second nodule 1.5 cm. near axilla border. Several glands in axilla.	.....	March, 1903.	Breast and pectoralis muscle removed. Axilla cleaned.	Carcinoma. Several infected nodules found in axilla.	July, 1906. Arm much swollen. Much pain.	Living.
27	About 63	Miss H. ....	.....	.....	April, 1903.	Breast and pectoralis major and minor removed. Axilla cleaned.	Carcinoma.	Sept., 1905. recurred; nodules in skin and lymph node removed in 1905 and twice in 1906.	Living.

TABLE II.—RECURRENT CASES.—Continued

No.	Age.	Name.	Extent of involvement.	Duration.	Date of operation.	Magnitude of operation.	Variety of carcinoma.	Recurrence.	Result.
28	About 58	Mrs. C.	Tumor about 4 cms. in diameter beyond limit of mammary gland in direction of axilla.	Some weeks.	June, 1903.	Breast and pectoralis muscles removed. Axilla cleaned.	Typical carcinoma. A small metastasis in one lymph gland.	First in Sept., 1905. Operation in 1905 to 1906.	Living.
29	65	Mrs. S.	Outer side of nipple hard tumor 10-15 cm. in diameter, not adherent. Several nodules in breast.	2 years.	Oct., 1903.	Breast removed with pectoralis muscles. Axilla cleaned.	Adenocarcinoma with involvement of axillary glands, gland under pectoralis muscle.	Dec., 1904. Much pain in chest both sides.	Died.
30	57	Mrs. DeW.	Large pendulous breast with hard lump in upper part. Glands in axilla.	7 months.	Jan., 1904.	Breast removed with pectoralis muscles. Axilla dissected.	Scirrhus cancer with cancerous axillary lymph nodes.	Aug., 1904. Local recurrence.	Died.
31	About 65	Miss C.	Ulcerated surface over tumor about size of 5-cent piece. Several enlarged glands in axilla.	.....	Jan. 1904.	Breast and pectoralis major removed, pectoralis minor cleaned on both surfaces. Axilla dissected.	Scirrhus carcinoma. No infected glands found.	Jan., 1907. Suspicious rheumatic pain and cachexia. No local recurrence.	Living.
32	About 36	Mrs. H.	Indurated growth about 3 cm. in diameter. Breast tissue everywhere enlarged and fibrous. Several large lymph nodes.	Few weeks.	Feb., 1904.	Breast and pectoralis major and minor removed and tissue in subscapular and subclavicular regions dissected. Axilla cleaned.	Medullary cancer with gen. epithelial proliferation. Secondary infection of lymph nodes.	May, 1906. Beneath clavicle.	Died January, 1907.
33	.....	Mrs. B.	Outer portion breast occupied by diffuse hard growth infiltrating the tissue in all directions. Glands in axilla.	.....	July, 1894.	Breast and pectoralis major and minor glands removed from apex of axilla and surface of subscapula.	Diffuse medullary carcinoma with involvement of axillary glands.	Recurred locally soon.	Died 1905.

had had the other breast removed thirty years before for what was believed to be a cancer; and this belief was strengthened by the fact that recurrent nodules had been removed on three occasions since; the last one fourteen years before the second breast developed the disease. Unfortunately no microscopical examination had been made of any of these specimens.

From this study it appears that in this small series of cases the question of recurrence depended more on the character of the growth, and the degree of involvement of the lymphatic system than upon the thoroughness of removal. If the disease had affected many lymphatic glands it was sure to recur even after a thorough removal of all of the muscles and axillary contents. On the other hand, in the nine cases that did not show a recurrence the lymphatic involvement was slight in all while in seven out of the nine the muscles were not removed.

These facts give us a basis for a somewhat greater accuracy in prognosis, but should not be used as arguments against extensive radical operations; for it is impossible in any given case to tell how far the cancer cells have penetrated the surrounding lymphatics and the chance of getting ahead of the disease is improved when the efferent lymphatics have been removed to as great a distance as possible.

In Case 12 the nodule in the breast was small and so situated in the centre of the gland that I felt safe in leaving the pectoral muscles. The recurrence occurred in the muscle thus mistakenly spared, and since that experience I have removed the muscle in all cases.

Attention should, I think, be directed to the danger of recurrence from the self inoculation of the wound with cancer cells set free during operation. This danger is to be reckoned with when a doubtful growth has been cut into for the purpose of establishing the diagnosis before proceeding to its thorough removal. If the lymphatic channels between the breast and the axillary glands or the muscles have been cut across during operation there is danger that during subsequent manipulations cells contained in those channels may be pressed out into the wound. The possibility of this occurring is a reason for

removing breast, muscle and axillary contents in one mass and for keeping the dissection outside of the lymphatic distribution as far as possible. When a cancer has been cut into for purpose of diagnosis the opening should be tightly closed before further operation is undertaken and every precaution should be taken by changing instruments, etc., to avoid inoculation.

Irrigation of the wound may be used on such occasion as an additional safeguard, and in cases where the operation has gone close to the cancer or through suspicious tissues, I have applied tincture of iodine to the surface of the wound after the manner more commonly employed in the presence of tuberculosis; and this procedure has seemed to me to prevent a quick recurrence when such appeared otherwise inevitable.

X-ray Treatment of Mammary Cancer.—In one case, above alluded to, an inoperable cancer was treated by the X-ray for nearly two years, and it was the opinion of those who watched the patient that the growth was checked and delayed by this treatment. In Case 18, several little nodules appeared in the skin six months after operation. These were promptly removed, but others soon appeared and were again removed only to be followed by still others. The X-ray treatment was then adopted, and under it several nodules disappeared and further reappearance was distinctly checked. For three years under intermittent periods of X-ray treatment the disease made little appreciable progress, but then evidence of deeper trouble in the chest and back appeared and she died four years and a half after the operation.

Case 27 is another in which the X-ray seemed to have a decided effect in retarding the growth. It is now my practice to give each patient a course of X-ray treatment immediately after the operation with the idea of destroying any bits of cancer that may have escaped removal. For this the exposures to the X-ray are made twice a week for three or four months after operation. The cases treated in this way have occurred within the past three years, and are not included in this report, as the time elapsed is too short to judge of results.

END RESULTS FOLLOWING OPERATIONS FOR CARCINOMA OF THE BREAST.

BY LEWIS STEPHEN PILCHER, M.D.,

OF BROOKLYN, NEW YORK,

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IN the present communication I wish to emphasize more especially results obtained in cases in which, at the time of operation upon the breast, the lymph nodes above the clavicle were already infected, and the supraclavicular spaces were cleared out in addition to the typical operation upon the thorax and axilla. I do this especially because of the frequency with which I have met expressions of skepticism from men of large clinical experience, as to the value of extending operative attack above the clavicle; their skepticism being based upon their apprehension of the great probability that when the supraclavicular nodes were appreciably affected, the infection had already extended into the mediastinum, so that even after the removal of the supraclavicular masses the operation would necessarily still be incomplete.

No one for a moment would dispute the increase of gravity of prognosis in a case of breast carcinoma in which the transmitted infection had reached the supraclavicular lymph nodes, but that this should always render the prognosis practically hopeless is not in accordance with clinical experience. When, therefore, my colleagues say to me that they never invade the supraclavicular region in their work for breast carcinoma, I am influenced to inquire whether they are not thereby permitting a certain proportion of cases to proceed to a continuance of carcinomatous development which a further extension of their work of eradication might have prevented.

In a study of my results in operations for breast carcinoma, published in 1900, I found that in 10 of the cases in which enlarged supraclavicular nodes were discovered and

removed, 3 remained free from recurrence. These I have been able to follow to the present time, May, 1907. One case has since died from cardiac failure at the age of seventy-five, more than seven years after operation, without recurrence of cancer. The two other are still living, free from recurrence, nine and seven years, respectively, having elapsed.

During the six years, 1901-1906, inclusive, 34 additional cases of breast carcinoma have come to operation at my hands; 5 of these were manifestly and unavoidably incomplete operations, the benefit was but partial and temporary and the steady advance of the disease was uninterrupted; one of these died on the table.

In eleven instances, application for relief had so promptly followed the discovery of the presence of the disease, that in my judgment it was proper to limit the operative attack to the clearing out of the axilla and the removal of the pectoral muscles with the affected breast and its overlying skin. The results in these cases have been so extraordinarily good that I almost hesitate to record them, for they entirely reverse all my previous experience and preconceived opinion; nine out of the 11 have thus far remained free from recurrence, periods of four years, three and a half years, two years, eighteen months in 5 instances, and six months, respectively, having elapsed. In the remaining 2 it is reported that there is now a lump in the other breast, the nature of which has not been determined. My reference to these cases is simply *en passant*.

It is the remaining group of cases, 18 in number, in which the evident extension of the disease at the time they first presented themselves was great enough to awaken apprehension of possible infection of the lymph nodes above the clavicle that I wish to dwell upon more particularly. In these cases, in four instances glandular masses in the neck were distinctly palpable before any section of the overlying coverings was made. Of the 14 cases in which the examining finger could not appreciate the presence of diseased nodes in the neck, the section revealed nevertheless that in 11, infected nodes were present, and that in only 3 of the number, appreciable disease

was not recognizable upon section. As to the end results in these cases:

Of the 3 cases in which the neck was opened and the supraclavicular region cleaned out without the discovery of any noticeably infected glands in the neck, all have remained well to date, at periods of five years, one and a half years, and one year, respectively.

Of the 4 cases in which the supraclavicular glands were palpable *ante operationem*, 1 case died three months after operation without further external manifestation of disease, but by progressive asthenia doubtless due to internal carcinoma, the operation evidently having been an incomplete one.

The second case one year later had developed multiple recurrent nodules in the thoracic region; these were kept under control by X-ray treatment for two years. At the end of four years she had developed a growth in the remaining breast, and was subjected to a complete operation for its removal; later, she developed intrathoracic metastases from which she died five years after the primary operation.

In the third case, a suspicious nodule developed upon the thorax within the first year after operation; this disappeared under the influence of the X-ray, and the patient thereafter remained in good health for two years, at the end of which time she died, as reported from pneumonia. The case is not altogether free from the suspicion of a carcinomatous element in the pulmonary condition.

The fourth case remains well, without suggestion of recurrence, two years after operation.

The 11 remaining cases in which the neck was opened and infected glands found to be present, although they were not palpable until after the neck was opened, belong likewise, though in a less degree than those first mentioned, to the group of neglected cases which experience has shown may be expected to differ greatly in the operative results obtained from the early-attended cases.

Among the 11 women the length of time that had been allowed to elapse after the presence of the growth was known

before accepting operation for removal, was two years in 1 case, between one and two years in 4 cases, six months in 4 cases, and one month in 2 cases only. It has been possible to follow the later history of all but one. One died from myocarditis seven weeks after the operation, leaving 9 cases to be accounted for; of these, 3 developed speedily both regional and distant metastases, the removal plainly having been incomplete, and they all died within the year; a fourth was reoperated at the end of a year for a recurrent nodule in the lateral thoracic region; no further external metastases became manifest in this case, but carcinoma of the liver developed, resulting in death three years after the primary operation; a fifth case remained well for four years, but during the fifth year—the present year—there have developed both supraclavicular and thoracic recurrences,—she is still living. Four cases still remain free from recurrence, at periods of three years, three years, two years, and one year, respectively, since operation.

In two previous papers, in 1902 and 1905, respectively, I have dwelt upon the importance of opening the base of the neck as a part of the routine operative procedures in cases of breast carcinoma. Even the limited experience contained in the comparatively small number of cases included in my own statistics, is sufficient to indicate that in a considerable proportion of cases the supraclavicular nodes become early infected, so that operations for the removal of carcinoma originating in the breast must often be incomplete if the base of the neck be not cleared of its nodes, as well as the axilla. The point of suspicion—the key to the whole situation, in many cases—is the triangle at the junction of the subclavian and internal jugular veins, where rest the node or nodes which guard the entrance to the mediastinal lymphatic paths and to which run not only the lymphatics which pass up under the clavicle from the axilla, but also an inconstant but not infrequent set of ducts which run up on the front of the thorax from the mammary region to the base of the neck, down into which they dip after running over the inner end of the clavicle.

When the neck is opened, this jugulo-subclavian triangle is first to be exposed, explored and cleaned, and from it, outwards, the lymphatic-bearing tissue can be best systematically dissected out *en bloc*.

So dense is the deep fascia at the base of the neck that, together with the overlying adipose tissue and skin, it forms a covering which renders infected nodes difficult to detect by palpation until they have attained quite a size. When such nodes have become distinctly palpable or visible, the presumption is that the infection is of long standing and of considerable extent. They are of ominous portent and fully justify the gravest prognosis. That even then the infection may still be confined to the accessible supraclavicular group, so that their extirpation may ensure a complete removal of all carcinoma-bearing tissue, has been demonstrated in enough instances to encourage surgical attempts in all but the plainly hopeless cases. Of more importance, however, is the practical recognition of the probability of the presence of infection of the supraclavicular nodes in every case of breast carcinoma of much duration or extent, and the incorporation into the general plan of operative attack, in all such cases, of an incision into the base of the neck and a systematic removal of all possibly infected tissue, even though there may be no distinct evidence to sight or touch before such incision, of the presence of such infection.

VERY LATE RECURRENCES AFTER OPERATION FOR CARCINOMA OF THE BREAST.

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WHEN Volkman more than twenty-five years ago established the triennium as the time limit for recurrence after operations for cancer, it was with the knowledge that it may return at a later period. Investigations have recently been made, especially on the Continent, by Labhardt, Koenig, Poulsen, Schroder, and Wunderli of the subsequent history of cases that have passed the three-year limit. Their facilities for such investigations have been unusual by reason of the registration laws which through official sources permit the following up of cases to the very end. From these investigations it will appear that of those who have safely passed the three-year limit about 20 per cent. succumb later to recurrence in loco or to visceral, bone or gland metastases. It would seem, therefore, that before a permanent cure can be said to have been obtained an immune period of five or six years must have been passed. But, as we shall see later, even long after this time, local glandular or visceral metastases may appear.

The mortality of even very extensive breast operations has been steadily reduced until now they can hardly be classed with the major operations. Synchronously the number of patients who remain well after three years or more has increased. The average of patients who pass the three-year limit in the hands of most surgeons who perform radical operations is but a little under 30 per cent. A three-year cure of over 40 per cent. is certainly exceptional unless conservatism is manifested in the selection of cases deemed suitable for complete operation. The age of the patient, the degree of glandular involvement, the size and rapidity of the tumor growth

and, above all, its cell elements will greatly effect the prognosis as to recurrence. Experience has taught us in the individual case to foretell with reasonable accuracy how lasting the relief afforded by operation may be.

It is altogether probable that a fair part of the improved end results latterly achieved is due to the fact that the public has for over twenty years been educated to the importance of early interference in breast cancer. It is now exceptional in the experience of anyone to encounter an ulcerated or even adherent mammary cancer, and a primary inoperable case in well settled communities is indeed *rara avis*. In advanced cases the post operative prognosis is still extremely bad. Of 31 ulcerated breast cancers Wunderli reports only 2 living after three years.

To ascribe the improved results altogether to the radicalness of the operation, I believe to be fallacious. My first case of breast amputation is still living and well after twenty-nine years, and I have two living and well operated on twenty-six and twenty-two years ago respectively. In the last of these a very severe wound erysipelas threatened the life of the patient. It goes without saying that in each of these cases the pathologic diagnosis of cancer was made. In none of them was more than an amputation with incomplete evacuation of the axilla done.

This is not in any way to be construed as advocating recession from the practice of widest possible excision now in vogue by almost everyone, but as some basis for hope even in those exceptional cases in which for one reason or another a very extensive operation is contra-indicated. On the contrary, the radical operation of to-day, if properly done, reduces considerably the danger of local recurrence, although it of course in no way can affect metastases already existing. How long these metastases may lie dormant will be seen later. The danger of the modern operation is in the inoculation of the wound by the needless manipulation of the tumor mass by an inexperienced or clumsy operator. Almost everyone who does surgery at all feels himself competent to do a breast operation,

which to do properly, in my judgment, is one of the difficult feats of surgery. I believe that I have seen relatively more cancers en cuirasse follow speedily after the radical than the older methods of operation. I also believe that if surgeons would more generally clean out the axilla as the first step of the operation, the results would be better, although I have no statistics upon which to base this view.

However much wide excisions have reduced the probability of local recurrence, this will always continue to be an obstacle in the way of getting much better results. From the statistics of seven German clinics where it was possible to follow the cases, I have figured out that local recurrence takes place in about 58 per cent. of the cases, and that of these again in 62 per cent. the recurrence appears during the first year; in 11 per cent. in the second year and only in 5 per cent. in the third year. In these percentages are included metastases in the axillary and cervical lymphatics which form but a small proportion of the total number of cases. The great preponderance of recurrences takes place in the scar or in the skin in its immediate vicinity. These facts, clearly elementary in character, are only mentioned as a predicate to the statement that after the third year freedom from local recurrence, although not assured, may at least be confidently hoped for.

Recurrences after this time become less and less frequent. Of 20 cases collected by Margraff, 12 took place in the third and fourth year, 4 in the fifth and sixth year, 2 in the seventh or eighth year, and 2 in the ninth and eleventh year. Of 17 recurrences from the clinic at Rostock, 5 took place in the fourth year, 4 in the fifth, 3 in the sixth, 3 in the seventh, and 1 each in the eleventh and thirteenth year. The latter to me seems a doubtful case since without local recurrence the cancer developed in the inguinal glands and the patient succumbed to abdominal metastases.

In the preparation of this paper I have had communications from sixty-two fellows of the society with mention of thirty-seven cases of recurrence after six years. No less than eighteen of my colleagues in the association who responded

had not seen or did not recollect cases which had recurred after five years. It is self-evident that these reports fall far short of scientific accuracy, but in a general way, from the very wide experience which they reflect, they emphasize the fact that after that period recurrences are certainly unusual.

Of late recurrences, Warren, Larson, Bevan, and Senn each report a case of eight years; Shepherd 1 of nine and one of eleven, the latter in the supraclavicular glands; Ochsner 1 of eleven years; Bell 1 of ten years; Bloodgood 1 of fifteen years; Moore 1 of twelve years; M. H. Richardson two of seven and 1 of eight years; Vanderveer 1 of twelve years and six months; McLaren 1 of thirteen years, exitus of general carcinoma; Pilcher 3 of five or six years; Coley 1 of seventeen years; Armstrong 1 of fifteen years; Bull 1 in loco after eight years and 1 of general metastases after nineteen years. Curtis has recently reported 5 cases of late carcinomatous metastases. Of 27 cases kindly abstracted for me by Harrington from his service, there was 1 dying eleven years after operation from cerebral hæmorrhage without local recurrence. The patient was seventy-five. There was no reason for believing that the apoplexy was due to hæmorrhage. There was no case of late recurrence.

Willy Meyer communicates a case of gastric cancer appearing six years after breast amputation without local recurrence, and Tiffany one of intestinal and omental cancer, twelve years after breast operation without local recurrence. Finney had 1 of cancer of the rectum seven years after the operation without local recurrence, and Jacobson communicates 2 cases of abdominal carcinoma developing thirteen and sixteen years after the primary operation. In neither case was there local recurrence. In the one case multiple metastases were found in the liver without any other organic abdominal disease. Halsted reports 1 case of cancer of the pleura developing eight years after the operation without recurrence in the scar, and Mayo 1 of cancer of the other breast which developed seven years after the first operation.

My personal experience with late recurrences or metas-

tases has been limited to a few cases. There may have been others of which I have no knowledge.

Mrs. S. L., aged forty-eight. Cancer of the right breast. Amputation with removal of axillary lymphatics in April, 1881. Continued well for four years when symptoms of cancer of the spine developed, to which she succumbed six years after the operation.

I have seen a second case of metastatic spinal cancer in a woman of forty. The symptoms developed about eighteen months after the primary operation for breast cancer. The patient died ten months after the inception of the spinal symptoms. There was no local recurrence.

In a personal communication DaCosta mentions a case of spinal cancer which developed nine years and ten months after an operation by the younger Gross, who was a pioneer in the practice of wide excision of breast cancers. There was no local recurrence.

A doubtful case was that of Mrs. L., on whom a radical breast operation was done at the Jewish Hospital January 31, 1897. She continued well for nearly six years when without local recurrence cerebral symptoms developed. Their onset was sudden and consisted of right hemiplegia and aphasia. There was no loss of consciousness. The patient lived four months. I would exclude this from the list of metastases and consider it one of ordinary cerebral embolism were it not for the following case recently in my service at the Cincinnati Hospital.

The patient, a lad of nineteen, entered with a rapidly growing periosteal sarcoma of the upper end of the right humerus. On the day before the one set for operation the patient complained of intense headache, became comatose within twenty-four hours and died thirty hours after the onset of the cerebral symptoms. There was no paralysis of the extremities. The autopsy revealed a metastatic growth as large as an olive in the left cerebellar hemisphere. A hæmorrhage had broken through the growth under the pia and into the fourth ventricle. Similar pigmented metastases were found in the lung, the spleen, the kidneys and one in the right pararenal fat.

Of cancer of both breasts I have had two cases. In one the second breast was removed four years and two months after the first operation. Recurrence ensued within a year.

The second case was that of a woman of forty-two, the mother of four children. The right breast and axillary glands were removed at her home in Peru, Ind., in June of 1887. In 1894 the left breast was removed for scirrhus. Sixteen months after this operation a cancerous growth was removed from the axilla of the side first operated upon. There has been no recurrence since and now the patient is enjoying the best of health.

Of the appearance of carcinoma in other organs after breast operations, I have had but one case and even in this the later history did not come directly under my observation. It was that of a woman of forty-eight who developed a cancer of the uterus seven and a half years after the first operation. Her physician could not persuade her of the independent nature of the uterine cancer and she refused operation.¹

A remarkable case as to the length of the interval between operation and recurrence is that which follows:

I first saw Mrs. F. in March, 1904. She was then sixty-three years of age. She had given birth to five children. In May, 1883, Prof. T. A. Reamy at his private hospital removed the right breast for carcinoma of the scirrhus type. The axillary glands were not invaded and the operation consisted of wide excision of the breast without opening the axilla. A microscopic examination confirmed the clinical diagnosis. The patient remained well until four months before her visit to me, when she observed a painless lump in the scar. The tumor grew rapidly from its first appearance.

Her condition at the first examination was one of perfect health except for the cancer recurrence in the region of the right breast. The scar, very irregular and broad, was a little over

¹ In May, 1893, the writer removed a round-celled sarcoma from the left axilla of a man seventy-three years of age. Without any local recurrence, a tumor developed on the outer side of the left arm, which I removed in May, 1907. The tumor proved to be a melano sarcoma.

6 inches in length and had evidently formed after healing by granulation. Here an irregular nodular tumor of stony hardness and adherent to the muscle was found. The skin over it was purplish in spots, adherent to the mass and quite glistening. The tumor could just be covered with the palm of the hand. Except for the patient's statement, which there was no reason to question, nor by reason of her very superior intelligence was there cause for doubting the accuracy of the observation, it did not seem possible that such rapid growth could have taken place in four months. The axillary glands were not at all involved. On April 2, 1904, at the Jewish Hospital the entire scar together with the tumor and the sternal part of the large pectoral muscle was removed. By plastic operation and slight skin grafting the wound was closed. The axilla was not disturbed. An examination of the specimen showed it to be a scirrhous recurring in the scar. On April 23, 1905, two recurrent nodules were removed from the site of the scar left from the second operation. Local recurrence did not take place. Death resulted on April 9, 1907, from intra-thoracic cancer which had caused intense dyspnoea. There was no pleural effusion. Her physician, Dr. W. H. Kelley, informed me that ten days before her death a large mass could be felt in the region of the liver. On account of the condition of the patient no effort was made to accurately localize it. No autopsy was made.

So far as I have been enabled to glean from a rather extensive investigation of the literature, this case presents the longest interval of freedom from recurrence hitherto reported. The interval between operations was one month less than twenty-one years. In a personal communication Deaver informs me that he has knowledge of one case which had recurrence twenty years after the removal of the breast. Matas writes me that he saw a woman seventy-six years old who had a tumor appear in the cicatrix of an operation for breast tumor performed by another surgeon about twenty-five years before. The axillary glands which had not been removed at the first operation were not involved.

Tiffany speaks of a case recurring from time to time during a period of twenty-one years. The first operation was

done by Sir James Paget. Death resulted from cancer en cuirasse.

The summing up of the cases communciated to me and my own shows 37 developing seven years or more after the first operation for cancer of the breast. Of these 26 were clearly local recurrences and 11 were doubtful. Among the local recurrences I included those in which the regional lymphatics of the axilla, the neck or the thorax were involved. Perhaps even some of the abdominal recurrences, unless clearly primary in the viscera, may be due to retro-infection of the lymphatics. Of the cancers of the other breast there were 3 cases. To classify these as recurrences is hardly logical. The same is true of the cases of cancer of the rectum, of the stomach and of the uterus. With predisposition and environment unchanged, a primary growth may certainly occur in any organ after many years without reference to a growth elsewhere removed years before. Late metastases without local recurrence, as in a case of Bull's of ten years in the brain, of cancer of the spine after ten years and of the liver after thirteen years without local recurrence and without any recent primary growth in any other viscus, must on the other hand clearly be classified with the metastatic recurrences. Of clean local recurrences 10 occurred during the seventh and eighth years, 2 after the ninth, tenth, eleventh, twelfth and fifteenth years, and 1 each at varying intervals from fifteen to twenty-five years. Even in these late recurrences the tumor growth was in the scar or its immediate vicinity and it is worthy of record that in some of the cases of longest standing there was no axillary involvement even at the time of the recurrence. This might cast some doubt upon the nature of the growths as to cancer, although the very fact of recurrence bears out the correctness of the clinical diagnosis of the primary tumors and the pathologic findings when made. Especially in cases where the absence of axillary lymph node involvement is noted, the suspicion of a chronic mastitis or of some form of abnormal breast involution would seem justified. But here again the recurrence speaks for the malignancy of the initial growth.

The explanation of these late local recurrences is largely speculative. The trend of opinion is that since, irrespective of the length of the interval they recur with great uniformity in the scar or the skin about it, they must result from cell deposits left at the first operation where they have remained latent. Clearly as this is opposed to our notions of the activity of the cancer cell, recent investigations, notably by Peterson, have shown that retrograde changes can take place in cancer nodules chiefly through the agency of giant cells and that the operation fosters this process. If and when this process fails, recurrence ensues.

In conclusion, I am inclined to believe that all supposed very late recurrences in the scar are not such in reality, for there is one factor worthy of consideration. It is that scar tissue with its epithelial covering and deformed glandular tissue in its vicinity is subject to diseases of its own and that among them cancer is not uncommon. Why should it not occur, therefore, *de novo* in the scar of an old breast operation just as it occurs in the cicatrix of a healed gastric ulcer or in that of a torn cervix?

CARCINOMA OF THE BONES FOLLOWING CARCINOMA OF THE BREAST.*

BY HENRY R. WHARTON, M.D.,

OF PHILADELPHIA,

Surgeon to the Presbyterian and Children's Hospitals.

MRS. F., aged sixty-one years, consulted me in January, 1906, in regard to a tumor involving the left breast, which had been giving her some uneasiness for several months. Upon examination I found a distinct mass in the substance of the breast, which I considered carcinoma, and advised its removal. The breast was removed with axillary glands in February, 1906, and the patient made a good recovery. Three months after the removal of the growth the patient complained of pain in the lumbar region of left side, extending into the left thigh; this pain was intermittent. She passed out of my observation in June, when she went away for the summer, but returned to my care in October. She stated that she had suffered quite severely at times during the summer from pain in the lower lumbar region and thighs. At this time she was not able to walk well without the aid of crutches. Walking became more difficult, and she finally was compelled to abandon it entirely, although she was able to sit in a chair. After sitting for a time she complained of pain in lumbar region. Examination of the back showed no kyphosis, but there was tenderness on pressure over the lower lumbar vertebræ and sacrum and pain over the trochanters. The pain also extended to the thighs as far as the knee joint. There was no paralysis of the lower extremities and the knee jerks were normal. There was no loss of power in the bladder or rectum. The pain was intermittent and was described as acute at times and sometimes dull in character. The temperature was slightly elevated for a few weeks before the patient's death. There was no evidence of any recurrence of the growth at the seat of operation.

After repeated examinations and a careful study of the case it was thought probable that her symptoms were due to a sec-

* Read before the Philadelphia Academy of Surgery, April 1, 1907.

ondary carcinomatous growth in lumbar vertebræ or sacrum. Dr. H. A. Hare, who saw the patient with me upon two occasions, was inclined to this diagnosis. During the last month of her life the patient was kept comfortable by the use of a moderate amount of morphia. Death occurred suddenly from angina pectoris on January 7, 1907.

Autopsy.—The lower lumbar vertebra was found much softened, and cord and dura were thickened. Report of the microscopical examination of the fifth lumbar vertebra, cord and dura, made by Dr. A. G. Ellis, was as follows:

“Sections from the fifth lumbar vertebra show at points marked erosion and disappearance of the osseous structure which remains only in the form of isolated, irregular fragments. In these areas is a new growth made up of spheroidal epithelial cells and an irregular fibrous stroma. The nuclei of the former react well to stains, the protoplasm is in many instances granular and fragmenting. In a few areas are fairly distinct alveoli bounded by fibrous tissue and containing masses of the described cells. Tissue of this type surrounds many of the fragments of bone and extends into the overlying soft parts.

“Sections from the spinal dura in the region of this vertebra (4) show at one circumscribed point a decided thickening. Here the membrane is twice the thickness of the remaining portion, the increase being entirely due to fibrous tissue, epithelial elements being lacking. This area corresponds to the thickening of the dura noted macroscopically at the extreme lower end of the removed portion.

“*Diagnosis.*—Fatty degeneration of heart; scirrhus carcinoma of lumbar vertebra; chronic productive pachymeningitis of overlying dura.”

Dr. B. F. Curtis¹ reports a case of carcinoma of the vertebra following removal of the breast for carcinoma. In this case, seven months after removal of the breast, loss of power over the bladder and rectum was observed, the knee reflexes were lost, and there was paralysis of the parts below the line of the umbilicus. There was also kyphosis in the mid-dorsal region. Pain was not severe. Laminectomy was performed, and upon exposing the cord it was found congested; the sixth dorsal vertebra was softened and projected slightly into the spinal canal. The pressure symptoms were not relieved by the operation. The patient died sixteen days after operation.

Primary carcinoma of bone is extremely rare, whereas

¹ N. Y. Med. Record, 1898, vol. i, p. 347.

secondary metastatic carcinoma of this tissue is not uncommon. The occurrence of metastatic carcinoma of bone, following primary carcinoma of the breast, is well recognized. The infection may occur months or years after the removal of the primary tumor. The character of the secondary tumor always corresponds to that of the primary one. The infection of the bone may occur by direct extension of the growth to this tissue when it originates in tissues adjacent to the bone, as is not infrequently seen in involvement of the ribs in recurrent carcinoma of the breast.

The development of carcinoma in bone distant from the primary growth results from the localization of carcinomatous emboli, and is said to occur at that portion of the bone subjected to the greatest traction or pressure. Carcinomatous infiltration of bone causes diffuse lacunar absorption, rendering the bone soft and easily bent or broken. There may also be present at the seat of infiltration a tendency to the development of new bone tissue; this condition has been described as osteopathic carcinosis.

According to von Recklinghausen, the bones most frequently, the seat of secondary metastatic carcinoma are the vertebræ, femur, ribs, humerus and cranial bones. The vertebræ are said to be not infrequently the seat of carcinomatous infection from carcinoma of the breast, but my personal observation of a large number of cases has shown only one case in which the vertebræ were involved. On the other hand, Dowd² reports 29 cases operated upon for carcinoma of the breast, in 5 of whom symptoms of spinal metastasis developed. It should, however, be noted that no autopsies were recorded in any of these cases.

My experience with secondary carcinoma of the bone, following carcinoma of the breast, located at points not adjacent to the primary growth, has been confined to the following cases:

CASE I.—Carcinoma of the lumbar vertebræ in the case previously reported.

² ANNALS OF SURGERY, 1898, vol. i.

CASE II.—Carcinoma of the left clavicle in a woman of fifty years, which developed five months after the removal of the left breast. In this case the patient complained of pain in left clavicle, which was fractured while turning in bed. In this case a marked tumor developed at the seat of fracture before her death, which occurred two months subsequently.

CASE III.—A woman, aged forty-five, removal of breast for carcinoma, in whom six months subsequently there were no signs of local recurrence, but the patient complained of pain in both femora. One morning while sitting in a chair both femora were fractured, apparently by muscular action. This patient before her death, which occurred two months later, developed a tumor of the right humerus and one of the left parietal bone.

CASE IV.—Woman of fifty years, who had had right breast removed for carcinoma, who, eight months after the removal of the breast, fractured her right femur while turning in bed, and developed a large spindle-shaped tumor at the seat of fracture. Death occurred several months after the appearance of the tumor of the femur.

CASE V.—Woman, aged fifty-five years, who while walking in her room felt the left leg give away under her, and she fell to the floor. When I saw her a few hours later I found a marked tumor at the middle of the left femur, mobility and crepitus were marked. Upon questioning her, she said she had for some months suffered from pain in the left femur and a painful tumor of the left breast which had never been operated upon. Upon examination of the breast I found a firm tumor involving the left breast, adherent to the skin, which presented the typical pig-skin induration. This patient died several months later of pulmonary metastasis.

The most prominent symptoms of metastatic carcinoma are localized pain, which may be dull or acute in character, and thickening of the bone at the seat of infection. The former is most common, and should direct attention to the occurrence of this affection. In this affection of bone, operative procedures offer little chance of relief, although in cases involving the spine, where pain and pressure symptoms are marked, as in the case reported by Curtis, it would seem justi-

fiable to resort to operation, if only for temporary relief of the symptoms. In cases involving the long bones, the possibility of fracture, which adds greatly to the patient's discomfort, should not be overlooked, and the patient should as far as possible be carefully guarded against the occurrence of this accident.

THYMUS GLAND TREATMENT OF CANCER.*

A PRELIMINARY REPORT WITH A PRESENTATION OF A CASE OF INOPERABLE
CANCER WITH GREAT RELIEF OF SYMPTOMS.

BY FREDERICK GWYER, M.D.,

OF NEW YORK, N. Y.,

Surgeon to Bellevue Hospital.

THE case herein reported was referred to me by Dr. A. E. Isaacs of this city on April 1, 1907. The essential history of the case is as follows:

Mrs. B., aged forty-eight. Married. Noticed the first appearance of a cancer in the left breast in 1899. She was operated on by Dr. Ellsworth Eliot, Jr. A second operation was performed by Dr. Eliot in June, 1906. A recurrence seems to have taken place immediately after, and she was treated for about three months by X-rays without result.

About two or three months ago she noticed the disease had involved the supraclavicular glands on the same side. She eventually consulted Dr. Isaacs who considered it to be an inoperable case and referred the patient to me.

At her first visit, which was on April 1, 1907, I found the following conditions:

1. Pain in the shoulder region, in the arm, and in the breast region and scar, so great as to prevent sleep at night.
2. One or more glands just above the breast scar. A matted mass of glands beneath the clavicle, filling and bulging the subclavicular space.

A mass of glands above the clavicle with several isolated glands in the neck region. The supraclavicular mass was about the size of a hen's egg, matted together and painful to the touch.

Several glands in the right side of the neck and some of considerable size in the right axilla.

3. The shoulder and arm showed marked swelling extending

* Paper read and case presented at the meeting of the New York Surgical Society on Wednesday, May 8, 1907.

to the dorsum of the hand which was puffy. The patient was disinclined to move the arm from sense of weight and pain.

Treatment was begun on the date mentioned and continued until April 25, 1907. The patient within forty-eight hours reported diminished pain and ability to sleep. The swelling of the glands, shoulder and arm began to subside and she moved and used her arm more freely.

On April 27, 1907, her temperature, which had been normal until then, shot up to 102 degrees F. and continued elevated until May 4, 1907, reaching at times as high as 104 degrees F. It subsided and became normal on the date last mentioned. A peculiarity noticed was that the pulse was at no time above 90 and always of good character.

During the fever she had pain, at times intense, at the free border of the ribs on the left side, and the spleen seemed moderately enlarged. She was confined to her bed. During this time the patient was cared for by Dr. John Block, whose treatment was mainly observation. Quinine was given in doses of 20 grains a day without effect. Salol was being administered during the last days of the fever.

During the period of fever, about nine days, there was continued diminution in the size of the glands.

She has been free from fever since May 4, 1907, nearly free from pain, is slowly regaining her appetite and strength, and to-night shows, of all the different masses of glands, only two slightly enlarged above the left clavicle and two above the right. The swelling of the arm and shoulder region has disappeared. The amount of reaction is shown by her weakness and a loss of 10 pounds in weight in ten days. In verification and as additional testimony, I herewith give a letter just received from Dr. Isaacs:

NEW YORK, May 7, 1907.

Dear Doctor Gwyer:

I have seen Mrs. B—— today and report herewith the results of my examination:

The practical disappearance of the supraclavicular glands is the most notable feature, as the enlargement of and pain in these glands was the most prominent symptom when you began your treatment. You will recall that at that time they formed a visible mass, about the size of a small chicken's egg to the feel, with a more or less boggy infiltration of the adjacent tissues. This mass has practically entirely disappeared, with the small reservation I will mention later. I want to remark here the conditions on

my previous examination, while she was under your treatment and before her attack of fever. At that time, the previously existing bogginess had disappeared, the tumor itself had reduced to about half its original size, and in place of the homogeneous oval-shaped mass previously felt, there could now be appreciated three distinct enlarged glands almost separated from one another. To go back to the present condition, the small reservation I want to make as to the entire disappearance of the mass, is that there is yet to be felt on deep palpation, behind the clavicle, some small irregularities that give the impression to the palpating finger that they might be the broken down remains of some of the glands; they have not the smooth feel and globular outline usual to enlarged lymphatics.

The next feature of note is the entire disappearance of the œdema, pain and general loss of function of the arm, forearm and hand. There is now practically no difference between the two upper extremities, whereas previously the œdema, etc., were quite marked.

The character of the tissues on the anterior chest wall, above and below the scar and in the axillary space, is markedly changed. Whereas it was hard and brawny before, almost pitting on pressure, with some infraclavicular and axillary glands indistinctly palpable, and skin immovable on underlying chest wall, it is now soft and normal with no swelling and no appreciable glands.

The supraclavicular gland on the opposite side is yet palpable but decidedly smaller than it was. The woman is quite weak, I suppose as the result of her recent severe and protracted spell of fever, but she is gradually recovering her strength. There is quite some tenderness yet on pressure over the parts which had been affected, especially where there seems to be any remains of the process, as in the supraclavicular regions on both sides.

Very truly yours,

A. E. ISAACS.

It is not claimed that the patient is yet cured, but it may be fairly claimed, I think, that the cancerous process has been arrested and its clinical evidences greatly reduced. And there is ground to hope for the ultimate cure of the patient.

Treatment will not be resumed until the patient is strong enough to stand another period of autointoxication and elimination.

The treatment given in this case, and in others to be touched on, was the thymus gland, either dried and ground to powder, or as a watery extract of the nucleoproteids and other elements. The dose of the powder varied from one to four drams three or four times a day, with sodium phosphate half an ounce once a day for eliminatory purposes. Meat was

permitted sparingly, but milk, eggs, starches, sugars and some fats were allowed in the diet.

In addition to the above case I have another, of X-ray burns of the hands, in which cancer developed and was repeatedly removed, which I have treated intermittently for the last year. There has been no return of the disease, the color of the skin has become normal, its resistance to irritation increased, and the precancerous changes which were so noticeable during the previous five years have not reappeared.

Another case, from Drs. Hotchkiss and Hawkes, cancer of the penis, with recurrence in the groin, a hopeless case, had received morphine as desired; after treatment with thymus was begun, the patient was fairly free from pain and the growth showed a decided diminution before his death.

Another case, from Dr. Tilton, cancer of the larynx, with secondary involvement of the neck glands, inoperable, showed under treatment a marked diminution in size of the glands. Breathing was so bad the patient was sent in to Bellevue for immediate tracheotomy. He improved so much under thymus treatment that tracheotomy was not performed until a month later when, and owing to a streptococcus infection occurring, his trachea filled with pus and debris and he eventually succumbed. He too was fairly free from pain after medication was begun. Dr. Tilton permits me to state that he considered the reduction of the glands very remarkable.

Another case, from Dr. W. G. Thompson, cancer of the rectum, inoperable, has been under treatment for six days. Before treatment, morphine was administered for pain which was great. Since treatment was begun there has been no pain and an examination to-day by Dr. Frink my house surgeon, and myself, shows a diminution of the growth as evidenced by a larger lumen, and a slightly greater mobility of the mass. The patient feels well and sits up in bed.

Another case, from Dr. Hitzrot, adenocarcinoma of the breast, operation by Dr. Bolton, recurrence in the supraclavicular and other glands, has just been started on treatment and in four days the glands of the neck show a slight reduction and

the marked œdema of the upper extremity and which extends to the dorsum of the hand, is softer than it was. She reports that half an hour after taking each dose of thymus there is a feeling of fulness amounting to an aching pain in the affected regions; this feeling lasts from one to one and a half hours. Another symptom, one which I have observed in other cases, is that while her appetite is good, it is more easily satisfied.

Another case, from Dr. Isaacs, removal of the breast, recurrence in the supraclavicular glands, inoperable, improved under treatment while it lasted. The patient was impatient and uncontrollable and the case was under observation but a short while.

Of course I fully recognize that the treatment in these cases has been too brief to demonstrate anything except the local improvement which has taken place during it, and I mention them only to show that improvement, to illustrate certain associated features, and it is hoped as a basis for subsequent report.

I have used the dried thymus gland of the calf, and also a watery extract of the gland containing the nucleoproteids and an amylolytic enzyme. This enzyme, which is in quantity and powerful, seems not to have been discovered before, as I can find no record of it in my extensive reading. It will be taken up further in a future communication.

The glands were received fresh, fat removed, cut up and dried at a low temperature by a forced draft of air; then ground and sifted to a uniform powder. This was administered stirred in water about an hour before meals.

The watery extract may be prepared from the dried gland as follows:

To eight ounces of a solution of sodium chloride (four grains to the ounce) add a dram of the dried powder, and a little thymol. Frequently agitate for one hour. Strain and filter as rapidly as possible. After filtering twice, acetic acid 50 per cent. C.P. is added, using a 20 per cent. solution, with stirring, until a point of acidity is reached which gives good

floculi on standing a minute or two. The precipitate is separated by filtration and redissolved in a solution of sodium carbonate (three-quarters of a grain to the ounce of water), using about one and a half ounces of the solution. This solution is filtered twice, and to it is added acetic acid to acidity and good precipitation.

The precipitate is again separated by filtration and redissolved in a solution of sodium carbonate (one grain to the ounce of water), using two drams of the solutions and adding thymol. This final solution is filtered three times or more and with a crystal of thymol will keep good in a refrigerator for an unknown time. Each dram of the solution represents the products from half a dram of the dried gland. The process for the production of an ounce of the extract takes about six hours. Distilled water should be used and the solutions kept cool during manipulation.

This solution I have given by mouth and by hypodermic in doses up to one dram. Hypodermically it shows no tendency to cause local irritation.

As this is merely a preliminary paper, it is not my desire at this time to give my theory as to the cause of cancer, nor why I consider the thymus gland should be supposed to be effective in the treatment of cancer. The theoretical side of the question and my experimental work will be given in a future paper.

I would keep to the practical side and may say that I have found the use of the thymus gland in cancer will produce the following results:

1. Diminish or eliminate pain.
2. Diminish the size of the growth.
3. Its use is followed by better digestion, by more regular action of the bowels, and improvement of the general condition as evidenced by a clearer skin and eyes, greater energy, and a general sense of health and well being.

I have some reason to hope that the use of the thymus gland will have a wider range of action than in the treatment of cancer and will include sarcoma and some other new

growths, and some diseases due to faulty metabolism or senility.

The only use of the thymus gland in the treatment of disease of which I can find any record is, its use first by Mikulicz with some success in the treatment of goitre.

Too much care cannot be used in the selection of the thymus glands, and in the preparation of the powder and extract; at a later date I will give further particulars on this subject.

The dosage is still experimental and a great deal of care must be exercised in its administration, for I have reason to believe that it is a very powerful agent. I would advise the greatest caution in its use and at present can only give general directions to that end.

It would seem that the amount of action and reaction depends on the amount of diseased tissue and its situation.

I have taken as large doses for as long a time as I have ever given them, with nothing but good results. This might represent the non-cancerous or slightly cancerous type.

In the case shown, the diseased tissues were in quantity and without ulceration, and all elimination was of necessity through the emunctories. The dose in such a case should be small and the patient carefully watched. It is possible that once the disintegration is started, it may get beyond our control and I can imagine a case with such an amount of cancerous tissue to be eliminated, that under treatment an autointoxication of such severity might ensue as to prove fatal.

I think it necessary to utter this warning because in the two fatal cases, Hotchkiss's and Tilton's, with the rapid reduction of the tumor coincided a rapid loss of strength and an early death which suggested a suddenly increased toxæmia.

Cases of surface cancer and especially those which are ulcerating seem to stand more medication with greater safety.

It is very necessary that, during treatment, every help be given towards elimination: The bowels kept slightly loose by phosphate of soda, the kidneys active by plenty of fluids, and the skin active by frequent baths.

I would still advise operation in all operable cases. Also in so-called inoperable cases, for the removal of as much diseased tissue as possible, so that there will be a minimum amount to be absorbed and eliminated. Such a course will not only be safer but will I think shorten treatment and give greater chance of success.

I think it will be found that the rapidity of cure will be in direct proportion to the rapidity of development. Skin cancer and others of slow growth will be slow of cure. The more rapidly growing cancers will be more rapidly cured but with correspondingly greater reactions and dangers during treatment.

I think the treatment offers much to those with small cancers, to those with moderate amount of cancer who absolutely refuse operation, and to many of those with cancers classed at present as inoperable and incurable and which have not been helped by other means. Every case treated so far has been considered as beyond operation and beyond hope of cure.

It is right that I should be somewhat enthusiastic regarding this method of treatment, but I would urge the importance of slow judgment as to its merits and only ask that it be tried and that it be not condemned because it fails to cure every case, and particularly those cases in which the disease is very extensive, and the vitality very low; such cases in short as are likely to be the majority of those first offered for treatment because of the impracticability of subjecting them to operation.

I anticipate that many cases will show improvement but eventually die; but with increased experience with the treatment we can, I think, prognose with some degree of certainty.

No fee has been charged the patients treated and they have understood that the result of treatment was problematic.

As the preparations are not yet on the market,¹ and the

¹ Upon inquiry I find that there are two firms who have had preparations of the thymus gland in the market for some time. I have not tried these preparations.

work is still experimental, I would be glad, within the limits of my time, purse, and facilities, to receive and treat any cases which members of this society are good enough to send me; the proviso being that the patients accept the treatment and its results and report back to those sending them, at stated intervals.

NOTE.—Since the above paper was read before the New York Surgical Society, criticisms have been made that its publication would be premature, that it would be inferred that I presented a case as cured by thymus treatment, and that I presented the treatment as a positive cure for cancer.

If the paper is read carefully I think it will be found to contain no such claims. I do not claim to have cured a case as yet, nor do I as yet know that the thymus treatment will cure cancer.

The paper is a preliminary report of my work with the thymus gland; it gives the actual results so far obtained, and I consider my presentation of it warranted. My object is to bring the subject to notice and to offer it as an invitation to further investigation by clinicians and laboratory workers.

PERITONEAL TUBERCULOSIS.*

BY PARKER SYMS, M.D.,

OF NEW YORK,

Surgeon to Lebanon and to Sydenham Hospitals.

IN 1889 I discovered accidentally that simple laparotomy might effect a cure in cases of tubercular peritonitis. I had a patient who presented an obscure abdominal condition and for purposes of diagnosis an exploratory laparotomy was performed. On opening the abdomen it was discovered that the patient suffered from tubercular peritonitis, principally involving the mesentery and the mesenteric glands. One gland was removed for microscopic examination and the abdomen was closed without further surgical interference. The case was regarded as hopeless, but from the time of operation the patient made a progressive and rapid improvement and became apparently completely well. He remained so for about two years, when the disease started afresh.

In a paper, entitled "The Influence of Laparotomy on Tuberculosis of the Peritoneum,"¹ read before the New York Surgical Society, in November, 1890, this case was reported and I also reviewed all the preceding literature on the subject, and set forth the various theories concerning this remarkable phenomenon. At that time there was no theory which seemed to explain the fact that laparotomy does effect a cure in a large percentage of cases. Up to that time there had been many cases recorded, but with few exceptions the operations had never been done for the purpose of affecting a cure of tubercular peritonitis, but they had been performed for the purpose of diagnosis or else under the mistaken idea that the surgeon was operating upon some other condition.

In 1890 Koenig had tabulated a set of 131 operations in

* Read before the New York Surgical Society, March 13, 1907.

this condition ² and to Koenig belongs the credit of first advocating simple laparotomy as the proper surgical procedure in these cases. My paper, read in 1890, embraced the following conclusions:

1. That the danger of the operation is very slight; at present the death rate is but 3 per cent.

2. That sepsis is not so likely to occur in these peritonæa as in laparotomy in healthy ones, on account of the pathological changes which have taken place in the membranes.

3. That tubercular infection of the wound does not occur.

4. That disinfections are useless and that drainage should not be used, as it is likely to result in a permanent sinus.

5. That in unsuccessful cases the operation at best does no harm. Most of the patients who have died at a time remote from the operation, have succumbed to general tuberculosis or to tuberculosis of some other organ.

6. That established, not advanced pulmonary tuberculosis, is an indication for and not against the operation; for the improvement gained enables the patient to better resist the phthisis, and if this latter is but incipient, recovery may take place.

7. That laparotomy is the proper form of treatment for these cases. In some unknown way it exerts a most beneficial influence upon the disease, resulting in cure in a large proportion of cases and in a marked improvement in nearly all.

Nine years later, I carefully reviewed the subject and found that an immense amount of work had been done in this line, surgeons having eagerly taken up the procedure, but, notwithstanding the mass of clinical reports, practically nothing new had been added. There was still no satisfactory explanation of the phenomenon and nothing new of importance had been proposed in the way of treatment. Laparotomy was considered as the curative procedure by most surgeons and clinicians and as the preferable mode of treatment; but by the end of that decade a reaction set in, many becoming antagonistic to the surgical treatment of this malady, some claiming that more patients would get well under medical treatment than

after operation. Some went so far as to claim that laparotomy is never indicated in cases of tubercular peritonitis. One of the most notable publications in favor of the medical treatment and antagonistic to the surgical was that of Borchgrewink,³ in 1891.

In the same year Fenger⁴ wrote a review of the subject, quoting from Teleky,⁵ Frank,⁶ Bottomley,⁷ and Borchgrewink.⁸

Fenger gave the views of the advocates and opponents of laparotomy and endeavored to reach some definite conclusions based upon a study of the literature and personal experience. His views seemed to accord with those of Borchgrewink, whom he quoted as follows: "That laparotomy is well tolerated in strong patients in whom fever is absent and their condition of nutrition good, speaks for a spontaneous disappearance of the tubercular process. Laparotomy, however, in patients with fever, when the tuberculosis has a progressive character, must diminish what slight power of resistance such a patient has remaining. This power of resistance may thus yield and death follow; or it may, by concurrence of fortunate circumstances, rebound and the patient recover in spite of the operation. That form of peritoneal tuberculosis which exists without fever, or with only slight fever, runs in itself a favorable course. In such cases laparotomy is unnecessary. In progressive tuberculosis the operation is dangerous and should be abandoned."

Borchgrewink based his conclusions on a study of 40 cases. Of 22 operative cases, 8 were light, 6 moderately severe and 8 severe. Fourteen, or 63.6 per cent., recovered, and 8, or 36.4 per cent., died. Of 17 patients treated without operation, 14, or 82 per cent., recovered and remained well for two or three years.

The publications of Borchgrewink and Fenger excited renewed interest in this subject and there were many important contributions resulting therefrom. The opinions and conclusions arrived at vary so much that there is an unfortunate lack of unanimity, and it is the object of this paper to place in review numerous contributions on the subject and to attempt

to formulate a consensus of opinion which may be a guide to the proper treatment of tubercular peritonitis.

Elestratov⁹ reviewed the statistics of a number of writers and found that 31.6 per cent. of 136 cases recovered under medical treatment and that 78.3 per cent. of 240 cases recovered after operation. He judged that the tubercular peritonitis which runs a stationary or chronic course, with little fever and with little or no ascites and but slight disturbance of nutrition, is capable of spontaneous and permanent recovery. On the other hand, when the original tubercular foci can be demonstrated in the mesenteric glands, intestines, or uterine appendages, he thinks that surgical intervention is urgently called for.

Shattuck¹⁰ analyzed the histories of 98 cases of tubercular peritonitis treated in the medical and surgical wards of Massachusetts Hospital from 1889 to 1900. Of 46 cases treated without operation, 7 died in the hospital, while of 52 surgical cases, 6 died in the hospital. The mortality at the time of discharge from the hospital was 13.2 per cent., while the mortality of the same series of cases, after a lapse of from two to eleven years, was 47.3 per cent. The ultimate mortality under medical treatment was 68 per cent. and under surgical treatment 37.5 per cent.

The therapeutic lessons derived from this analysis are as follows:

1. Tubercular peritonitis may be followed by apparently complete recovery, even if complicated by tuberculosis elsewhere, either under (a) purely medical treatment; (b) tapping; (c) incision.

2. As in other forms of internal tuberculosis, the best obtainable hygienic surroundings are all-important, consequently no patient should be kept in the hospital longer than is necessary, especially if more and better air can be secured outside, with proper care and food.

3. We are warranted in trying medical treatment for a time, especially under first-rate hygienic conditions, tapping the abdomen if there is sufficient fluid to cause discomfort.

4. If the patient under a month or six weeks of medical

treatment fails to improve, or in even less time, if he seems to be losing ground, surgical treatment should be advised.

Miles F. Porter ¹¹ presented a paper on the study of the literature of the subject and a personal experience in the operative treatment of 12 cases. He does not ascribe recoveries to the operation alone, but believes the operation to have a decided curative effect. In his opinion, the ascitic form yields the best results and the ulcerating or caseating the worst. Porter suggests the exposure of the open peritoneal cavity to the actinic and X-rays.

Veit ¹² reviewed the literature and expressed the view that tubercular peritonitis may get well spontaneously, even if not very frequently. He ascribes failure after operation in many instances to tuberculosis of other organs. He advises laparotomy without drainage in acute cases as soon as difficulties arise, and in chronic cases in which spontaneous recovery does not take place after a reasonable observation.

Thøenes ¹³ reported 33 operative cases from Kümme's clinic. Of 16 cases with ascites, 3 died, or 18.7 per cent.; 10 were discharged cured. (Three of these 10 were later operated upon for some other condition four, eight and eleven years after the original laparotomy, when no trace of tuberculosis was found.) Of the 3 cases remaining in the hospital, 2 recovered subsequently. Of 17 cases of the dry variety, 12 or 70.6 per cent., died, 3 were cured, and 2 improved. The ascitic variety shows the best results; laparotomy in the dry variety proved disastrous.

In a later article,¹⁴ Thøenes analyzed 80 cases from the Eppendorf Hospital and the surgical clinic of Göttingen. These cases were followed for some time after they left the hospital. His investigations established the fact that while a number of cases will recover under medical treatment, or without any treatment at all, there are many in which internal medication fails and subsequent laparotomy proves of decided value. He regards advanced complications of the lungs, larynx and intestines, as well as septic conditions, contraindications to operation. He believes that procedures such as the removal

of primary foci are only permissible when they can be done without the breaking up of dense adhesions. He compared the medical and surgical results in a collection of cases and found 48 per cent. of lasting cures in 82 cases treated medically, and 54 per cent. of lasting cures in 244 cases treated surgically. This would indicate that the results after medical treatment are not so good as those after operation and that one should resort to laparotomy without continuing medical treatment more than a few weeks, unless there should be marked benefit shown.

Schwarz¹⁵ reported 30 cases treated by laparotomy, of which 21, or 70 per cent., were cured. One case was well ten years after operation; 4 seven years after, 4 five years, and 7 three years after. None of the fatal cases died as the result of operation. In 4 cases he was able to demonstrate a cure at subsequent operations for some other conditions.

Dœrfler¹⁶ reported 32 cases. He employs conservative treatment as long as the amount of exudate does not threaten life, as long as there is but slight fever and as long as the general condition remains fair. He operates if there be hectic fever, if ascites increases, or if the patient is losing strength. He advises early operation in acute cases, associated with high or persistent fever. He tries aspiration first; if that fails, he performs laparotomy. He is in favor of drainage after laparotomy. He considers the ulcerating form hopeless.

Friedlander¹⁷ cannot believe that so serious and chronic a process as tuberculosis can be influenced by so short an intervention as laparotomy. He used statistics to prove that laparotomy favors the occurrence of fæcal fistulæ. He cautions against breaking up of adhesions, but advocates laparotomy in the presence of palpable undulating masses and uncysted collections of pus and stagnating secretions.

Fairchild¹⁸ advises laparotomy where an intra-abdominal focus is suspected or diagnosticated. In the ascitic variety, he recommends laparotomy if the hygienic treatment has failed. In the fibrous form, he advocates the same. He considers laparotomy useless in the acute form with ascites and

high fever. Where there is much matting together of the intestines, he thinks laparotomy will be unsuccessful.

Guthrie¹⁹ reported 41 cases. Fourteen were operated on, with 7 deaths; 27 were treated medicinally, with only 4 deaths. He recommends tapping in chronic cases with ascites. He believes laparotomy beneficial only because it does away with the fluid.

Pagenstecher²⁰ advocates operation in the chronic stage and in those cases in which the uterine adnexa are the primary foci. He does not believe in operation in the dry variety and in the encapsulated form of the disease.

Rotch²¹ wrote a very important article with an analytical study of the cases which had occurred in the Children's and Infants' Hospital of Boston, Mass., during the eighteen years preceding. Rotch is in favor of operation. He feels that operation should not be done during the first year of infancy because then tubercular peritonitis is usually a part of a general miliary tuberculosis. He feels that the ascites shows a less advanced form and a more active process, which is favorable from a prognostic standpoint. He considers the fibrous form less favorable, especially if ascites is absent. In the ulcerative, caseous form, it is usually found that there is tuberculosis elsewhere, especially in the bronchial lymph glands and lungs, which acts as the primary focus of infection; hence these cases are not benefited by laparotomy. He would advise laparotomy in the primary form, even if the peritonitis is secondary to a mesenteric gland, which should be removed.

The following passages are well worthy of quotation:

"There have, of course, been cases of tubercular peritonitis which have recovered spontaneously, but the fact that this result can occur does not indicate, as has been suggested by some writers, that we should not operate, but should wait and see whether such spontaneous recovery would take place.

"The danger of localized tubercular peritonitis, which we know can get well, becoming disseminated and thus producing a general tuberculosis or a localized tuberculosis of the lung or brain, is undoubtedly a great one, and knowing that

if this dissemination does take place the child will in all probability die, it seems much more reasonable to operate before such dissemination has taken place, than to wait until it is too late. It is also well known that, first, in individual cases of localized tuberculosis, we are unable to say whether such cases will recover spontaneously or will become a general tuberculosis; and second, that an exploratory laparotomy, when performed by an expert, is known to be of little danger, especially in the earlier stages of the disease, when the child has not yet become markedly reduced in strength and vitality. Is it not better, then, to give the child the benefit of the chance, and when we are reasonably sure that tubercular peritonitis is present in a child over one year of age, and when there are no evident signs of tuberculosis elsewhere, or possibly only in the mesenteric lymph-nodes, is it not better to make an exploratory laparotomy at once?"

Zesas²² reviewed a long list of articles on the subject and reported two surgical cases of his own. He does not believe in waiting for spontaneous recovery, with all its uncertainties.

Ochsner²³ advocates drainage for laparotomy in the ascitic form. He cautions against breaking up adhesions and against rough manipulation of the tissues, particularly of the intestines. In the absence of the ascites, the diseased tissues may be removed, if the section is made through healthy tissue. He tabulated 32 cases treated in one hospital and later he recorded 8 more cases. From his experience, he drew the following conclusions:

1. In the absence of fluid, the diseased tissues can be removed with safety if the section is made in healthy tissues.
2. In the presence of ascites, remove it thoroughly and drain.
3. Avoid injuries of the peritoneum (abrasions).
4. Adhesions should not be disturbed.
5. The more gentle the handling of tissue, the better the results.
6. The diseased pelvic organs tolerate handling better than the intestines.

Eichberg²⁴ claims the percentage of recoveries for all ages without operation to be greater than with operation. He recognized the fact that cases with ascites form an exception, but he holds that these are cases which tend to spontaneous cure. In the discussion which followed, so eminent a clinician as Tyson of Philadelphia said, "To treat it medically is to temporize; in other words, that there is but one treatment that is likely to lead to satisfactory results and that is surgical."

Halstead of Chicago²⁵ advocated laparotomy in a majority of cases. Most of the cases cured by laparotomy he claims to be of the acute miliary form.

Köppen^{26 27} believes in operation when the exudate becomes troublesome and the general condition does not radically improve. He advises removal of the exudate by laparotomy and washing out the abdomen with a saline solution.

H. W. Freund²⁸ believes in conservative treatment for mild cases, but in surgical treatment for severe cases. He argued against the skepticism of Borchgrewink, which he said experience has contradicted.

Schraum²⁹ reported 45 cases in children. The operated cases showed the best result. He considers the prognosis best in the exudate form.

Murphy³⁰ in his classic article described four varieties of tubercular peritonitis, *i.e.*,

1. Disseminated, exudative, miliary, non-confluent, serous (ascitic) variety.
2. Nodular, ulcerative, or perforative (the least frequent variety).
3. Adhesive, fibroplastic, cystic, partition or obliterative variety.
4. Suppurative, circumscribed, or general mixed infection.

He recognizes four essential features in the treatment of peritoneal tuberculosis: First, to remove or shut off the source of supply of new tubercular debris; second, to remove the products of the infective process from the peritoneum; third, to increase the tissue proliferation for the encapsulation of the foci already present; fourth, to avoid mixed infection. He

says that all treatments which have availed have succeeded on these lines.

Murphy believes surgery to be a benefit in the disseminated serous, and in the nodular, ulcerating varieties, but in the adhesive variety, surgery is of little avail.

He lays special stress on the necessity of removing or shutting off from communication the original focus of the disease, as the fallopian tubes, vermiform appendix, etc.

McMurtry^{31 32} thinks in those cases of marked acuteness, characterized by high temperature and rapid pulse, both with and without effusion, operation generally fails to arrest the active progress of the disease. Nevertheless, the hopeless character under any other form of treatment and the harmlessness of method under aseptic precautions, justifies, he believes, the operation in every case, especially if there is effusion and diagnosis is not absolutely positive. Thorough removal of the invaded structures is usually followed by permanent cure.

L. Miserochi³³ reported 14 cases cured by medical treatment alone. He had more cases, but mentioned only those in which the interval had been long enough to speak of a permanent cure. In 8 of his cases there was ascites. By the use of iodine internally and externally the ascites was absorbed and the palpated nodules retrogressed.

Charles H. Mayo,³⁴ and abstract,³⁵ removes the original lesion, leaving the peritoneal condition to cure itself. He closes the abdomen without drainage. He believes cases should be selected; in some patients the condition is such as to render operation extremely hazardous, as well as futile. In males the incision is made over the vermiform appendix; in women it is so arranged as to explore the pelvis. He reported 59 operations by the older method,—*i.e.*, without removing the original focus. Of these there were 42 cured, 15 improved, and 2 died. Of 58 operations for removal of tubercular tubes, there were 56 recoveries and 2 deaths. Of 27 cases of tubercular appendicitis (appendectomies) there was no death.

Schömann³⁶ formerly did laparotomy in selected cases. Now he believes he gets better results by puncture and injection

of 5 per cent. glycerine emulsion of iodoform. He treated 7 cases and regarded them all as cured in the course of from three to ten weeks' treatment. Some of the patients required repeated injections.

Wm. J. Mayo³⁷ in his article "Surgical Tuberculosis in the Abdominal Cavity with Special Reference to Tubercular Peritonitis," reviewed post-mortem statistics, viz.: "In St. Mary's Hospital, Rochester, Minn., from October 1, 1894, to October 1, 1904, a period of ten years, there had been 6,408 abdominal operations performed. Of this number, 5,687 were intraperitoneal, and 184, or about 3 per cent., were for some variety of tuberculosis. Localized intestinal tuberculosis occurred 21 times; 13 cases were primary and 8 were uncertain."

He discussed the various forms of intestinal tuberculosis: "Tuberculous disease of the appendix we have found as a localized process 29 times, with no deaths, in 1,888 operations for appendicitis." . . . "Tuberculosis was found localized in the Fallopian tubes 44 times without tubercular peritonitis, the tubal lesions being securely walled off." . . . "In other words, between the ages of twenty and forty years, tubercular peritonitis is certainly very much more frequent in females and, so far as direct sources of infection are concerned, the tube is the one which may explain the difference in frequency. There were 89 cases of tubercular peritonitis, with 3 deaths."

"The clinic of this hospital is drawn largely from a fixed agricultural community and the majority of cases operated on who left the hospital improved, but failed to stay well, returned for further treatment. A considerable percentage did not maintain the improvement, and, in the course of years, patient after patient would return with relapse of the peritoneal condition or some other form of tuberculous infection. Some returned for further operation as many as four and five times. It became evident that, in a considerable percentage of cases there was some source of reinfection of the peritoneum after apparent cure."

“ Having under observation a small number of patients in whom simple laparotomy had failed to permanently cure tubercular peritonitis, we began to do a radical operation, performing hysterectomy with removal of ovaries and tubes.” He found this to be too radical because the uterus and ovaries showed no disease.

“ By patience and care, we found it possible to enucleate tuberculous tubes in 26 cases of tuberculosis of the peritoneum. In practically all these cases the peritoneal involvement was the greatest in extent near the seat of local infection; this has been generally noted and heretofore ascribed to gravity. It is more likely to be due to proximity to the seat of infection.”

“ In many instances the region of the greatest distribution of tubercular peritoneal nodules could be shown near the appendix.” “ While simple abdominal incision and drainage has failed to cure all the cases, it did cure many and usually gave relief for a time, and if re-infection could be prevented, the cure might be expected to be permanent in a much larger number.”

“ Can we prevent relapse? Certainly we can in many instances. Of the 26 radical tubal operations we have made on cases of tuberculous peritonitis, 25 recovered; of these, 7 had been operated on by simple laparotomy from one to four times previously. In not a single patient as yet has another operation become necessary, and, as contrasted clinically with a preceding group of equal number, the favorable results are most striking.”

“ In tubercular peritonitis in women, we evacuate the fluid and then place the patient in the Trendelenberg position, packing off the general abdominal cavity in the usual manner. The pelvic organs, appendix and cæcum are examined. If the Fallopian tubes, appendix and cæcum are diseased they are removed.” No drainage. In men, the incision is placed to the right of the median line over the appendix.”

“ The treatment of tubercular peritonitis should embrace not only the treatment of the peritonitis which is symptomatic, but the removal of the source of infection which, in the majority

of cases, will be found in the Fallopian tubes, appendix or intestine."

Göschel³⁸ in his experience found that about 23 per cent. of ascitic cases and only 10 per cent. of cases of adhesions were cured by operation; that children recovered spontaneously in about one-third of the milder uncomplicated cases. He advises that "laparotomy always helps, sometimes cures, and never harms."

F. F. Lawrence³⁹ advocates operation; he believes in drainage and thinks that the primary focus should be removed.

S. Lloyd⁴⁰ reported 21 cases. His experience and opinion formed from literature makes him feel that operation gives the best chance to the patient.

G. Faludi⁴¹ believes in laparotomy in the ulcero-caseous and fibro-adhesive varieties in children, and in the ascitic form, after hygienic and dietetic treatment have been tried without success; or in cases where it cannot be tried he believes the serious tubercular affection of other organs to be a contra-indication.

D. MaCartney⁴² advocates laparotomy. In cases of doubt he insists on exploratory operation.

T. Guthrie⁴³ believes in laparotomy. In the ascitic form, he thinks aspiration may be of value in some cases. In the caseous and ulcerative form, operation is contraindicated and frequently in the adhesive form.

John B. Boucher⁴⁴ considered the etiology, pathology, diagnosis and treatment of the disease, and quoted Murphy as follows:

"The surgical treatment of tuberculosis of the peritoneum involves the following propositions: 1. To remove or shut off the source of supply to the peritoneum of new tuberculous debris. 2. To remove the products of the infective process from the peritoneum. 3. To increase the tissue proliferation for the encapsulation of the foci already present. 4. And to avoid mixed infection. Serous variety gives the best results. Dry and ulcerative variety is followed by high mortality and little is accomplished by surgery. In the localized suppurative

form, the operative result is quite favorable, while in the suppurative multilocular cystic variety but few recover."

The literature reviewed above practically embraces the reports of all the work which has been done in this field of medicine during the period of modern surgery. There has been a vast amount of clinical work and scientific research, but some phases of the question stand exactly as they did when I wrote my first paper on this subject in 1889. To-day it is as true as ever that laparotomy *per se* will affect a cure in certain cases of tubercular peritonitis; that is to say, this cure is brought about by merely opening and closing the abdominal wall; and to-day we are as ignorant of the reason why this remarkable phenomenon takes place as we were when it was first discovered and demonstrated. On the other hand, much has been learned in the last ten years of the rationale of the treatment of tubercular peritonitis. For instance, we have learned that operations should not be undertaken during the first year of infancy; we have learned that surgery offers but little hope in the adhesive variety of the disease; we have learned that the serous variety offers the best prognosis under the various forms of treatment and that the surgical treatment of this variety offers the best results obtainable in this disease, but the most important lesson we have learned is that the scientific operation of to-day is the one which has for its foundation the removal of the original focus of the disease, as tubercular Fallopian tubes, vermiform appendix, mesenteric gland, etc. Perhaps William Mayo has made this clearer than any of the contributors to this subject when he detailed a number of cases in which repeated operations had been done under the older method, recurrence taking place and finally laparotomies had been performed, with removal of the original foci, and the patients have remained well.

The skepticism toward the surgical treatment of this disease, as particularly championed by Borchgrewink, has not prevailed. Statistics have proved that cases treated by operation have done better than similar series of cases treated without operation. On the other hand, much has been added to our

knowledge of the disease by the writings and thoughts of these men. We realize the importance of hygienic treatment; we realize the impropriety of operating on all cases of tubercular peritonitis; we realize that laparotomy should not be performed when the peritoneal trouble is only one phase of a more or less general tuberculosis.

Before closing, I wish to thank my colleague, Dr. Henry Roth, for he rendered me the greatest assistance in compiling and analyzing the voluminous literature on this subject.

If the next few years shall add as much to our knowledge of this subject as was learned during the last decade, it will certainly be a great blessing to humanity, for we may look forward to a constant improvement in the results of treatment in this serious malady.

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ACUTE DIFFUSE GONORRHŒAL PERITONITIS.*

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SINCE the discovery of the gonococcus by Neisser in 1879 and its isolation by Bumm in 1885, it has become known as one of the most important of the pathogenic bacteria. From Cushing I quote the following: "Few organisms, not even the bacillus typhosus, rival it in the number of suppurative sequelæ which may follow a primary infection. Its occurrence in the conjunctivæ, and in the iris, the bones,¹ the joints, bursæ and tendon sheaths, its occasional demonstration as the cause of endocarditis and pericarditis, pleuritis and phlebitis and the recent observations from the blood, show that its possibilities for metastatic complications are as numerous as are those arising from the spread of infection by direct continuity of surfaces."

In 1886 Saenger reported two cases of puerperal peritonitis which on account of the striking clinical evidence may be regarded as those of gonococcal origin. His cases cited were two multipara infected with gonorrhœa by their husbands—one nine and the other twenty-one days after delivery.

In the discussion which followed the report of the cases, in the absence of bacteriological proof Bumm was inclined to doubt the gonorrhœal cause of the peritoneal inflammation, and asserted that the gonococcus could live only in the superficial layers of mucous membrane. As a proof of his assertion he stated that he had many times attempted to produce suppuration by injecting subcutaneously cultures of gonococci, but had as yet failed in every instance to produce an abscess.

* Read before the Metropolitan Medical Society, Feb. 26, 1907.

¹ Cupler, R. C.: Gonorrhœal Osteomyelitis, ANNALS OF SURGERY January, 1907.

Kaltenbach was inclined to disagree with Bumm, and mentioned the formation of the urethral stricture as a reasonable proof that the gonococcus extended its exploits deeper than the mucous membrane.

During that year and the two following years, cases of peritonitis of gonorrhœal origin were reported by Loven, Hatfield, Huber, Penrose and Stevens. All these occurred in children infected with gonorrhœal vulvo-vaginitis, and are not conclusive owing to the lack of demonstrating the gonococcus in the peritoneal cavity.

More convincing, however, is the case reported by E. Ceppi,—that of a woman twenty-nine years of age, who had previously been healthy, with the exception of having had a vaginal discharge for one year. She was suddenly taken sick with chills, fever, abdominal tenderness and distention, and was vomiting bile. Laparotomy was performed, and several abscesses were opened. These and the cervical canal showed presence of the gonococcus.

In 1891, at the meeting of the German Gynæcological Society in Bonn, Bumm emphasized his views more than ever and vehemently denied the possibility of the gonococcus existing in any other tissue excepting the mucous membrane.

At this same meeting, Wertheim presented his report of interesting, painstaking and conclusive experiments undertaken and conducted by himself, the results of which proved conclusively that the gonococcus alone, without the presence of other pyogenic bacteria, could produce suppuration in a serous cavity like the peritoneum.

He had injected gonococci with their culture media into the peritoneum of mice, rats, guinea pigs, rabbits and dogs, and produced purulent peritonitis which would reach its acme in about three days. All the animals experimented upon recovered, and he demonstrated the presence of the gonococci in the peritoneum, in the lymphatics and in the superficial muscular layers and their sheaths.

Wertheim noted that the peritonitis produced by the gonococcus was accompanied by an appreciable greater exudate than

that produced by other organisms, and concluded that in view of the susceptibility that the human being has for gonorrhœa, and in view of the results of his experiments on animals less susceptible to this infection, he had proven indubitably the possibility of its existence in the human being.

A few months later, he was able to further substantiate his conclusions by a female patient, age twenty-five, whom he was called to operate upon. The patient was a nullipara, and was suffering with pelvic pains and a leucorrhœa for three years. She was admitted for operation with symptoms of acute peritonitis. Laparotomy revealed pus discharging from the right tube. Cultures taken from peritoneal exudate showed gonococci.

The original assertions of Bumm were now proven as untenable.

Subsequently several cases are found to be reported in the literature of this subject. That gonorrhœal peritonitis can exist in the male is shown by cases reported by Challan, Mermet, McCosh, Van Zeisel, Horwitz, and Jadahsson.

In 1895, L. Frank published what might be considered the first case of gonococcal peritonitis, with bacteriological proof, as such published in this country. He had operated upon a prostitute seventeen years of age for acute pyosalpinx. During the operation the right tube had ruptured and soiled the peritoneum. In spite of the employment of irrigation and drainage, she developed a septic peritonitis within twenty-four hours, and died two days later. Cultures taken from the peritoneal cavity during the autopsy showed only gonococci.

Of the cases reported none are fortified by more convincing bacteriological proof than two cases reported by Harvey W. Cushing in 1899. He had operated upon two females, respectively twenty-five and eighteen years of age, at the Johns Hopkins Hospital, for peritonitis, and in the first obtained smears from the peritoneal exudate, showing gonococci, and from the second he also obtained gonococci in pure culture.

The writer should like to narrate here the report of a similar case operated upon by him in August, 1906:

R. J., age seven and a half years, school girl, was admitted to Beth Israel Hospital August 22, with history as follows:

Previous history negative.

Present History.—One week ago mother noticed that child was chafed about the genitals and that she had a vaginal discharge. The family physician, Dr. J. Rosenblueth, was consulted, and he, after instructing the mother how to prevent infection of the other children in the family, prescribed douches of a weak permanganate solution. Three days later the child suddenly became feverish and complained of being ill. Her temperature was $102\frac{1}{2}$, pulse 140. She complained of no pain, and there was no abdominal tenderness. An enema was administered and was followed by a movement. The douches were now discontinued. Twelve hours later vomiting set in. The temperature and pulse remained about the same, the tongue was coated, and she complained of pain in the epigastrium. There was absence of tenderness and rigidity.

Three doses of calomel, $\frac{1}{8}$ grain each, were followed by vomiting. The following morning the child had several loose passages and had some pain in the left iliac region. Vomiting still persisting. The following, or the fourth day of illness, she felt better, and attempted to get up and about. At midnight vomiting set in again. Enemata were again administered but were not retained. The abdomen became distended and very hard. With increasing severity of the symptoms and the abdominal tenderness of the left side more marked, her condition became alarming and the following morning she was sent to the hospital. About this time it was noticed that the vaginal discharge had diminished.

Examination upon Admission.—General appearance is that of a very sick anæmic little girl. Temperature 100.6, respiration 34 and thoracic in character, pulse 130. Abdomen uniformly distended and tympanitic, but the rigidity of the recti was not marked. General abdominal tenderness more marked in umbilical and splenic regions. No tumor could be made out nor increase in tenderness in the right iliac region.

There was a clear picture of general peritonitis, and it did not appear to me as one of appendicitis nor intussusception. An examination of the vulva revealed a purulent discharge which was immediately examined and found to contain gonococci.

Blood Examination.—Leukocytosis, 12,800; polynuclear, 62 per cent.; (small mononuclear, 19 per cent.; large mononuclear, 2 per cent.); transitional, 1 per cent., and eosinophiles, 16 per cent.

Diagnosis.—General peritonitis, probably gonorrhœal in origin.

Operation.—Ether, drop method on open Esmark inhaler. Abdomen opened through Kammerer incision $2\frac{1}{4}$ inches in length over right rectus. Upon opening the peritoneal cavity some seropurulent fluid escaped. The intestines appeared very much distended and injected. The appendix was slightly injected, but otherwise appeared normal and not adherent. Several collections of purulent fluid were found between the intestines, one of which was located near the splenic region.

The pelvis contained a large abscess and the tubes felt thickened, but owing to the extreme distention of the intestines, could not be exposed. On several coils were deposits of lymph. Cultures and smears were taken by Dr. I. Strauss, pathologist of the hospital. Much of the fluid contents of the peritoneal cavity was mopped up with sterile dry sponges. The appendix was removed.

A small cigarette drain was inserted to the stump of the appendix, and another into the pelvis, and the remainder of the wound sutured. The bowels were moved at end of twenty-four hours, after which vomiting ceased. In addition to stimulation, she was given two injections of Torrey's anti-gonococcus serum, obtained through the kindness of Dr. Strauss. There was nothing noted after the injection of the serum which might have any bearing upon the course of the disease. The temperature was normal at end of the first week; all drainage was discontinued on the tenth day.

September 4, patient was discharged feeling perfectly well and the wound entirely healed. The vaginal discharge still showed the presence of gonococci four weeks after leaving the hospital.

Bacteriological report by Dr. I. Strauss, pathologist of the hospital: Patient, R. J., operated upon August 2, 1906. Spreads of vaginal discharge showed numerous pus cells, many intracellular Gram-negative diplococci or gonococci. Fibrin and exudate from peritoneum; numerous gonococci in masses of fibrin. No

pus cells; other bacteria absent. Cultures from peritoneum gave gonococci in pure culture on serum agar and serum sugar agar. Cultures from vaginal discharge contain gonococci. Appendix normal.

The case was therefore definitely an instance where the diffuse peritonitis was due to gonococcal infection alone, and a review of the literature of the subject (including 74 cases reported) present several points of interest for consideration.

Etiology.—Gonorrhœal peritonitis can exist in the male, but judging from the very few cases reported must be uncommon, and is caused by the infection extending along the lymphatics of the cord to the peritoneum. One such case with positive bacteriological findings at autopsy was reported by Challan in 1893.

In the female it may be a complication of an *acute* gonorrhœal vulvo-vaginitis, and, as pointed out and demonstrated by Veith, Cumston and others, gonorrhœa may be the sole cause of peritonitis arising during the second or third week of the puerperium. The infection is conveyed to the peritoneum either through the lymphatic system, or, as more commonly demonstrated by cases operated, the peritonitis is due to the emptying of the gonorrhœal pus direct into the general cavity through the patent ostia abdominalis.

Gonorrhœal peritonitis may also be produced by direct infection during removal of an acute pyosalpinx, an instance of which is the case of Frank's, already narrated in this paper. That diffuse gonococcal peritonitis is not more common may be accounted for by the gummy or adhesive character of the exudate, which causes adhesions and confines the infection to the pelvic peritoneum or to the tube itself by sealing the fimbriated extremity.

With a view of ascertaining the dangers which might follow the rupture of a pyosalpinx, several investigators undertook to examine bacteriologically a number of tubes removed surgically.

Menge in 1891 reported results of his examination in 26

cases of purulent salpingitis and found bacteria in 8 of these, 3 of which contained gonococci. All three gonorrhœal tubes had ruptured during the operation, and their contents caused a soiling of the peritoneum. One of these patients died, and post-mortem one and one-half hours later showed streptococci in the peritoneal cavity.

Andrews, in 1904 (cited by Dudgeon and Sargent), published the results of bacteriological examination of the interior of the tube in 684 collected cases of pyosalpinx. The diagnosis in most instances was based upon microscopy only; some upon both films and cultures; and a few upon animal experiments. The result showed 55 per cent. to be sterile; 22.5 per cent. to contain the gonococcus, 6 per cent. saphrophytes only, and the rest a variety of pyogenic organisms. These figures, being based largely upon very incomplete bacteriological examinations, must be received with a good deal of reserve, but they go to show what a small proportion of cases of pyosalpinx constitute any grave danger to the peritoneum.

Symptomatology.—Several observers, notably Saenger, Charrier, Rousseau, Comby, Northrup and others, attempted to describe characteristic diagnostic features of diffuse gonorrhœal peritonitis, and the abrupt or explosive onset with very serious aspect is mentioned by Comby and Northrup as characteristic of this malady.

A careful perusal of the histories of the cases so far reported show that the symptoms do not differ materially from those elicited in peritonitis from other causes.

Ruptured appendicitis has in several instances been mistakenly diagnosed. Nor is it always possible to differentiate clinically an acute pelvic from an acute diffuse peritonitis of gonorrhœal origin.

Prognosis and treatment have occasioned much discussion, owing to the view taken by some of the observers, particularly the French writers, who are inclined to take a very favorable view as to the outcome.

That gonorrhœal peritonitis is capable of producing a fatal septicæmia is proven by cases reported by Frank, Mejia

V. Leyden, Muscatello, Frank and Koehler, Lilienthal (quoted by Welt-Kakels), Koplik, and others.

Most writers agree that acute diffuse gonorrhœal peritonitis is particularly fatal in children.

In 1896 Broese reported 2 cases of vulvo-vaginitis complicated with symptoms of diffuse peritonitis, in which operation was deferred and both recovered. These and similar cases reported by Comby, Northrup, Sebilleau, Galvagno, Marfan, render the indications for operations questionable.

Most of these cases lack, however, the bacteriological proof of their gonorrhœal origin, and some lack the sufficient evidence that they were diffuse, but rather only pelvic peritonitis with severe symptoms.

Of the 75 cases collected, including the writer's case, only 30 had the diagnosis fortified by autopsy or bacteriological examination.

A detailed review of all the cases is precluded by the brevity of time allotted to me to the reading of the paper—a brief summary only will therefore be presented for your consideration.

Of these 30 cases, 14 resulted in death of the patient. There were 20 operated upon with a mortality of 4. Two of the deaths of the operated cases cannot be ascribed to the operation, nor alone to the gonorrhœal peritonitis.

One case by Hunner and Harris developed bronchopneumonia after operation, and at the autopsy, while the gonococcus was recovered in the peritoneal cavity, streptococci were found in the blood of the heart, in the lungs, bladder and other organs.

Second case is one of Dr. Koplik's, cited by Dr. Welt-Kakels, a child which had undergone two serious operations for empyema, developed a general peritonitis for which she was operated by Dr. Elsberg in the service of Dr. Lilienthal at Mt. Sinai Hospital. Cultures from the peritoneum proved the peritonitis to be of gonococcal origin.

The child was certainly not in a favorable condition, and therefore it is hardly fair to ascribe to the operation a contributory cause of her demise.

If we exclude these two cases, we have 18, with a mortality of 2—certainly a small one.

Conclusion.—Diffuse gonorrhœal peritonitis is a serious and sometimes fatal malady, which, when not operated, is likely to leave a legacy of pus tubes in the female already doomed to sterility and possibly lasting invalidism.

Diffuse gonorrhœal peritonitis may recover with palliative or symptomatic treatment alone, but we must continue to operate some of the cases with reasonable assurances of recovery.

The number of cases of gonorrhœal peritonitis operated upon will be diminished when we will have the means of making a positive diagnosis as to the bacteriological character of the infection, or when a satisfactory antigonococcic serum will be at our disposal.

It is hoped, however, that the discussion occasioned by this report will enable us to bring to light some more clinical data which will help us to outline definitely the course to pursue in cases of suspected acute diffuse gonorrhœal peritonitis.

Conclusions: The gonococcus is capable of producing a local or a diffuse peritonitis without the presence of other pyogenic bacteria.

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SOME PRACTICAL DEDUCTIONS FROM PERSONAL
EXPERIENCE IN THE TREATMENT OF
APPENDICITIS.*

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NOTWITHSTANDING the large and rapidly increasing experience in operating for appendicitis, there seems still to be a wider divergence in the opinions held and the methods practised than can fairly be attributed solely to temperamental differences among those who hold and practise them. And upon at least two points—the wisdom and character of interference in the gravest form of cases and drainage—this divergence is so great that the views held on one side are directly opposed to and condemnatory of those held on the other. As a contribution toward the possible establishment of more uniformity in opinion and practice I have collated my personal hospital statistics for the past four years and beg now to place them before you. The period of four years was chosen because, while brief enough to insure practical uniformity of practice, it is yet, I think, long enough to protect against the usual errors of chance.

The services are those of the New York and the Hudson Street Hospitals. The former covers a total of about sixteen months—four services of about four months each between October, 1903, and February, 1907, and a few intermediate cases. The latter covers my personal work during 1903–1906, about thirty months. To avoid misapprehension I may add that, while the list is wholly operative, yet it excludes no admitted case that died; cases which recovered without operation are not included. The New York Hospital list was made by the Librarian from the card index, and its completeness and accuracy are supported by contemporaneous reports made to

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the Board at the end of each term of service. The Hudson Street Hospital list was made by the house surgeon from the bound volumes of case reports for the four years.

The New York Hospital service presumably differs but little, if at all, from that of any other large city hospital, and from private practice mainly in that a somewhat larger proportion of the cases are probably first seen in the later stages of the disease. In the Hudson Street Hospital service this difference is rather more marked, for the community which it serves is poorer and less well provided with private medical advice. Of course, in a hospital the provision for operating and safeguarding the patient is in some respects better than in private.

A classification of the cases for the purpose of this paper is not easily to be made, for the symptoms, the gross pathological changes found at operation, and the apparent gravity of the cases do not closely correspond. It has long been the practice in the laboratory of the New York Hospital to subject all appendices removed at operation to a systematic examination, and the results of many of these examinations form part of the histories. They show quite uniformly a series of changes of an inflammatory and ultimately ulcerative character, starting in the mucosa. Of these, the lowest, apparently representing recovery from a moderate inflammatory attack, is an atrophy of the mucosa with local or general narrowing of the lumen. Next is a round-cell infiltration of the mucosa, extending more or less through the other coats and reddening or even roughening the surface and sometimes associated with partial necrosis of the mucosa. Then comes "a fibrino-purulent exudate" in all the coats, with partial or complete necrosis of the mucosa, and in the later stages ulceration and perforation of the entire wall, the latter apparently taking place with special frequency at points corresponding to enteroliths of various sizes. The perforation may occur promptly, on the first day, and in one case was absent on the eighth day, although pain, tenderness and rigidity had been marked throughout.

The grade of peritoneal reaction does not correspond closely with the condition of the appendix or with the length of

time since the onset of the attack. A general peritonitis, shown by abundant turbid serum throughout the cavity, may be present by the second day and with only a partial necrosis of the mucosa of the appendix and a round-cell infiltration of its wall. In 2 of the 4 cases, of this kind, of the list the appendix was not perforated. And many cases of abscess, walled in or free, and of localized collections of turbid serum coexist with an appendix that shows to the naked eye only hyperæmia of the surface and stiffness and enlargement of more or less of its length, and under the microscope any of the changes from thickening of the mucosa to its necrosis, and from round-cell to fibrino-purulent infiltration of the coats.

I have, therefore, roughly grouped the cases according to the character and extent of the peritoneal reaction. Some of the dividing lines are necessarily arbitrary and somewhat vague, and some of the groups might perhaps as fairly be combined with each other as separated.

Group I is of the cases of general peritonitis. In all there was abundant turbid serum or even thin pus throughout the peritoneal cavity.

Group II includes the cases in which similar exudates were found beyond the immediate neighborhood of the appendix and pelvis, but not everywhere.

In Group III this reaction was limited to that neighborhood and to the hollow of the pelvis.

In Group IV there was an abscess completely walled off, with or without adjacent peritoneal reaction.

Group V is composed of those numerous cases with which all are so familiar—the “acute suppurative,” the “acute gangrenous,” and some of the “acute catarrhal” forms; the appendix is swollen, rigid, congested or perhaps grayish in color,—sometimes free or with few adhesions, sometimes buried amid them or behind the cæcum or colon and then pliable and softened by inflammatory changes.

Group VI includes the milder cases, the subsiding attacks, some of the recurrences, those in which the pain seems to have been due to an obstruction of the lumen of the appen-

dix rather than to an acute inflammation, those, in short, in which the inflammation is but slight.

Group VII includes the "interval" operations.

The cases are as follows:

Group.	New York Hospital.	Hudson Street Hospital.
I. General peritonitis.....	3.....	1
II. Extensive peritonitis....	5.....	4
III. Local and pelvic.....	9.....	6
IV. Closed abscess.....	16.....	6
V. Acute appendicitis.....	24.....	11
VI. Subacute appendicitis... 7.....		3
VII. Interval operations....	3.....	0
	—	—
Total	67.....	31
	(No deaths.)	(1 death.)

All of the New York Hospital cases recovered, and all of the Hudson Street Hospital cases except one. The fatal case was in Group II—extensive peritonitis with a perforated appendix; he survived until the eighth day. It is but fair to add that the clean record of the New York Hospital list would have been broken had it not been for my enforced absence on one occasion. The case was an urgent one of extensive peritonitis on the fourth day; another surgeon operated; the patient left the table in good condition but died fifteen minutes later with symptoms of pulmonary embolism.

The main principle of the operative treatment has been to do the least that would probably be sufficient to accomplish the object, whether that were the arrest of an appendicitis or of a peritonitis. The work is done rapidly, the incisions are as small as the conditions permit, the intestines handled as little as possible and usually protected with flat sponges (not gauze pads) as soon as the peritoneal cavity has been opened.

In 9 of the 98 cases, in which the position of a palpable mass made approach from the median line advisable, the curved transverse incision with longitudinal separation of the recti (the incision which I habitually use instead of median laparotomy) was employed. In all the others McBurney's intermuscular "gridiron" incision was used. My preference for

the latter has long been unshaken and is, I think, unshakable, and I deem it one of the most valuable of the many valuable things we owe its distinguished author. It not only leaves the wall unweakened after recovery, but it also wholly avoids injury to the nerve supply of the rectus. With care and patience it gives ample room in most cases for the necessary intra-abdominal work, and if more space is needed it can be easily had by extending the cut in the fascia across a portion of the sheath of the rectus and drawing that muscle inward, or, if room must be made upward, by cutting upward alongside the rectus for an inch or so. The work ended, this supplementary incision is closed with interrupted sutures of chromic catgut, and I have seen no ill consequences follow. In the 98 cases it was used 5 times. The extension into the sheath of the rectus is noted in only 6 of the histories, but I am confident that it was made to a slight extent in several others.

As soon as the cavity has been opened, and if it is dry, the finger is cautiously introduced to determine the situation of the appendix and the general conditions. Of the simple cases it is not worth while to speak, for the technique of the removal of the appendix presents no serious question. If the finger finds a mass, one or two flat sponges are pressed in and tucked down on the lower side to crowd back the intestines from the iliac fossa and protect them and the hollow of the pelvis from possible contact with pus; then the finger seeks lines of least resistance in the mass and is cautiously pressed onward, usually between the mass and the posterior parietes, while an assistant stands ready with stick-sponges. As soon as pus is felt or seen it is quickly sponged away as it flows out from the little abscess, and when the flow has ceased the sponges are passed into the cavity until it has been thoroughly dried. Then the finger again enters the abscess cavity and seeks to free the appendix. It seems to me advisable to do by touch as much as can be so done, rather than to make wide exposures in order to see. One can generally recognize by its greater resistance the portion of the meso-appendix which contains the artery, and can safely tear through the rest if he cannot readily

expose it for ligation. Such bleeding as ensues soon stops, or the point can be exposed and caught.

If the appendix can be thus found and freed I usually secure the stump by simply tying it with a catgut ligature after having cauterized its interior with the fine Paquelin point. When the base of the appendix and adjoining wall of the bowel are not inflamed and can be brought into easy reach I use the purse-string silk suture and invagination of the stump; but I never use it when the wall has been softened by inflammation. In two cases the appendix has separated at its junction with the cæcum, leaving a rather large opening. This I closed with sutures in the usual way.

When the appendix is found detached, or has been torn away by the manipulations used to free it, I make no great search for its stump if it is not readily accessible, but leave it for spontaneous closure. Three stumps in this list were thus left untied with no recognizable ill results. A fæcal odor may persist for some time in the discharge, but not longer than in other cases where the stump has been tied, or there may be a slight admixture of fæces in the discharge for a few days.

If the appendix is not accessible without a wide exposure and extensive separation of adhesions, if the patient is old and feeble or his condition grave, I content myself with simply wiping out the cavity and providing drainage. In 7 of the cases in this list the appendix was thus left untouched, and in only 2 of them did it give rise to further trouble; in each after an interval of two months. In one, which had fully healed, the patient returned with the usual symptoms of an attack; I opened him along the scar, found a small foul abscess and the appendix easily accessible, and removed it. In the other a sinus had persisted; I enlarged it and easily found and removed the appendix. Of the 98 cases of the list, in 37 the stump was invaginated with a purse-string suture, and in 49 it was simply tied.

Of course, it is well that an inflamed appendix should be removed; there is probably even no important loss to the patient in the removal of a healthy appendix, but I am sure

that the removal of the appendix is not necessary to the cure of an appendicitis and possibly not even to the patient's reasonable security against another attack. At least, in one case in which for various reasons I felt constrained to limit my interference very narrowly, I saw a simple half-inch opening in the abdominal wall, with immediate escape of pus and drainage for a few days, followed by complete freedom from attacks for a period that is now nine years. And yet the patient had previously suffered for two years from repeated attacks.

In the young, such caution may be superfluous; but in the old, whose tissues and organs have felt the strains of competition, luxury, or want, whose abdominal walls are fat and flaccid, the less draft we make upon them the better. And so, too, with those who are very ill: let the operation be limited to the life-saving indications, and let us not take a counsel of perfection which adds a strain that may be beyond the patient's powers of resistance.

If the pus is not encapsulated, if it lies free between the cæcum and the wall, perhaps with some free thin exudate showing at the incision, it is treated in the same way—carefully sponged out and the area dried. So, too, if there is also a collection within the pelvis; a few introductions of sponges on handles will remove it. Occasionally, when the collection has been larger than usual, I have removed it by washing with salt solution, using a double tube which afforded an easy escape for the wash and aiding the escape by keeping the sides of the incision wide apart. In the cases of extensive and general peritonitis, likewise, I have used the same tube, but always under low pressure and with free escape, and using only small quantities of water, just enough to effect the removal of so much of the exudate as would easily come. The main reliance has been upon gentle sponging. This seems to me safer than large incisions and abundant washing, and I am not sure that even less would not be sufficient in those graver cases, as it has proved to be in the less extensive peritonitides of the III and IV Groups. And it leaves the patient, in the case of survival, free from the weaknesses and discomforts of large

abdominal scars. Space is lacking to give the histories of these graver cases in detail. I must leave you to estimate their gravity upon the length and continuity of the list and the extent of the peritoneal reaction. In addition, in the few of the 12 recoveries of the first two groups in which the leucocyte and differential counts have been preserved, the divergence from the normal line set by Dr. Gibson was on the dangerous side and the bacterial examination showed mixed streptococcus and *B. coli communis* infections.

Drainage was used in all of the first four groups and in 29 of the 48 cases of the last three groups. Three forms of drains were used: first, and most frequently, the cigarette drain; secondly, small strips of gauze, either alone or in conjunction with the cigarette; and in 6 cases, where the need seemed to be slight, only a strip of rubber tissue. In the cases of the first three groups the cigarette drain was passed down into the pelvis, and sometimes a second one, or a strip of gauze passed upward toward the liver or toward the opposite side. In one of the cases of general peritonitis a second opening was made on the left side for a drain. These cigarette drains have always been removed or much shortened within three or four days, and the gauze strips have been taken out on the second or third day. The retention of the short drains leading to the abscess cavity or the stump of the appendix has been determined by the amount and character of the discharge. They have been used also in a few clean cases in which there has been much oozing or tearing of adhesions. In one case of large faecal abscess lying close by the promontory of the sacrum and reached by the median route, the drain was passed through a counter-opening in the loin.

I am strongly convinced of the value of drainage, and would not willingly forego the feeling of security which it gives. I am quite ready to concede that many of the cases in which I use it would recover without it; but what weighs upon me is the uncertainty lest there may be some among them in which its absence will mean an added danger, another operation, or even death. Its disadvantages are not more, I

think, than trifling inconveniences—a brief delay in the final cicatrization of the wound and a momentary pain in the withdrawal. The rubber drain has not even those if it is removed on the first or second day. Why should we leave even a small post-operative exudate or bleeding to be cared for by the peritoneum when it is so easy to remove them?

Finally, it has been urged, with statistics to support, that in grave cases abstention will save more lives than operation. This list contains 13 cases of general or extensive peritonitis with only one death. Suppose that not all of the cases should be counted as grave. Cut the list in half and call it 6 cases with one death. Can abstention do better? Is not the question rather one of the extent and character of the operative interference? Let that be brief and limited to what can be done quickly, easily, and with the minimum of exposure and handling of the intestines, and even, if necessary, to drainage alone. Surely nothing is lost by providing an escape for the exudate and reducing the task of the body to taking care of the bacilli and the toxins which it contains. I do not even ask for the washing of the cavity. As I have said, I use it only in moderation as a gentle means of quickly removing a large amount of exudate, with no thought of making that removal complete. In short, let us remember that we are dealing with very ill patients whose strength is already taxed to the utmost by their disease and who have no reserve with which to meet the drafts we may make upon them, and let us reserve our ideally complete operations for the young, the strong, for those appendices whose potentiality for harm has as yet been only slightly manifested.

MOTOR-BOAT FRACTURES.

BY HENRY P. DE FOREST, M.D.,

OF NEW YORK.

Surgeon to the Police Department.

SINCE the days of prehistoric man certain occupations have been productive of certain peculiarities of physical development and have been attended by certain accidents as direct results. Were records available of the physical condition of the early hunters we would find "bow-fingers" as well as bow-legs. With the advance of civilization these physical characteristics became more numerous and more generally recognized. A monograph, for the use of expert criminologists in Paris, describes several hundred varieties of callosities and deformities caused by occupation. Hardly a trade can be mentioned that does not produce certain well marked physical characteristics if the same posture or motion be continued for any length of time.

Such stigmata are of chief value to men who are working with Bertillon methods for the purpose of identifying individuals, but at times they are of such severity as to require medical treatment. In the domain of surgery, "housemaid's knee," "miner's elbow," and "porter's shoulder" have been recognized for years, while "writer's cramp" is equally well known to physicians in general.

The occupations that produce such lesions are, in most instances, necessary ones and can hardly be given up or avoided; but of recent years, with the advent of many new kinds of "sport," it has been found that the favored few who have little to do but play, instead of work, are by no means free from similar conditions. "Base-ball finger" was the first of these to appear and then, in turn, came "lawn-tennis elbow," "football knee," "runner's leg," "catcher's shoulder," and "bicycle face."

The list of games that may demand a price of similar value

in return for their enjoyment might be extended to a considerable length. Foot-ball, tennis, base-ball, hand-ball, lacrosse, bicycling, hurdling, and foot-racing all contribute to the list. In the more violent forms of athletic exertion "putting the shot" not infrequently causes serious sprains.

CASE I.—Mr. W. J. D., a doorman in the police department, while engaged with some of his friends in "putting the shot" felt a sudden and severe pain in his right elbow. He paid no especial attention to the matter until the following morning when his arm was found to be greatly swollen and irregularly ecchymotic. The disability continued. He reported sick but did not admit the cause of the injury at first, stating that he was subject to rheumatism. Some months later a considerable contracture persisted and when he first came under my care the joint was almost useless. The exact nature of the trouble was only determined by the use of Roentgen rays. The radiograph showed no injury to the bones. He was accordingly sent to the hospital and anæsthetized with gas. As soon as volition disappeared the joint was fully extended and after free flexion and extension it was secured in full extension by a splint. The following day, because of some pain in the arm, he removed the splint and the arm at once returned to its original angle of contracture. He declined to have anything further done to the arm and now, about 3 years after the injury, the contracture still persists (Fig. 1).

Even the simple and ancient game of quoits is not free from danger to the participants, aside from the risk of being struck by the quoit itself. The sudden twist of the wrist given as the iron leaves the hand may in itself do damage.

CASE II.—Mr. T. K., a patrolman in the police department, while playing a game of quoits felt something snap in the right wrist and pain and swelling developed after a short interval. The radiograph showed that the ligament had torn loose from the styloid process of the ulna and that a considerable separation of the bones at that part of the wrist joint was the result. Immobilization for about a month was needed to secure good functional result (Fig. 2).



FIG. 1.—Radiograph showing contracture of right elbow joint. Sprain caused by "putting the shot."



FIG. 2.—Radiograph showing sprain of right wrist with rupture of styloid ligament, caused by "pitching quoits."

During the bicycle craze a number of cases were observed by the writer in which the constant vibration of the handle-bar during long rides over rough roads produced numbness and even temporary paralysis of the fore-arms, and in one or two cases, the hard and small wooden saddle caused similar conditions of the legs, combined with severe sciatica. The vibration of the machinery and steering wheel of the modern automobiles has already caused similar symptoms in chauffeurs. Even physicians who drive their own cars are not exempt, and the writer has, at the present time, under observation a surgeon whose skill as an operator is seriously impaired by the wide muscular tremor that his hands have acquired since he joined the ranks of those who use horseless carriages.

Still more recent are the injuries that have been received by those who are using motor-boats, and to these the present article especially directs attention. In most instances the machinery of the boat, usually with gasoline as a motive power, is started by hand. The more or less heavy balance wheel of the engine has a permanent handle projecting from the rim, or a heavy brass or iron rod sunken in a socket and held in place with a spiral spring when not in actual use. When the engine is started this handle is seized and the wheel turned quickly around. If the gasoline and air mixture is right and the electric spark really sparking, a single turn may be all that is necessary to start the series of explosions within the cylinder that drive the engine. It frequently happens that the conditions are not right for a great variety of reasons which can be learned by the hour from the owner of any motor-boat. In any event the wheel has to be turned a number of times before the engine will start; one hand is used, it becomes tired; the other is used, it, too, becomes tired; then both are used. Ultimately, if all goes well, the shaft becomes heated, or the water dries out of the gasoline tube, or the carburettor produces a good mixture, or something else happens and the machinery starts, sometimes with great rapidity. The handle escapes from his grasp, flies around, and before the man has time to get out of the way he is struck by it on the hand. In case the

handle is in a socket, the spring is supposed to bring it flush with the rim of the wheel as soon as it is released, but if the handle is rusty, or the spring is weak, or the handle binds in the socket, this does not always occur, and injuries with this type of handle are as frequent as when a stationary pin is used.

The injuries that result from this impact are usually trifling, but the following series of cases which occurred at a single wharf during the past summer will show that some of them may be very serious. Inquiry at other places would doubtless give other and perhaps larger lists.

CASE III.—Mr. A. D., aged 30, while starting his gasoline engine was struck on the calf of the left leg by three successive revolutions of the fly wheel. The bones of the leg were not fractured but the clothing was torn and a considerable portion of the gastrocnemius muscle was torn away in the badly contused and lacerated wound that resulted. The first impact was so violent that the leg was numb and he could not move for a moment or two. Considerable loss of power in the leg still remains after some months and a marked limping gait will probably be permanent.

CASE IV.—Mr. J. S., aged 35, injured in a similar manner. The handle struck his right hand before he could get it out of the road and badly lacerated the index and middle fingers, breaking the middle phalanx of the latter. Recovery uneventful.

CASE V.—Mr. C. S., aged 22, was struck by the stationary handle of his gasoline engine and the first phalanx of the index finger of the left hand was fractured. Recovery uninterrupted.

CASE VI.—W. S., a sergeant of police, aged 42, was injured in a similar manner: the sparking adjustment was wrong and the wheel flew backwards, the handle striking him on the back of his right hand. When this case was seen after twenty-four hours there was considerable swelling and ecchymosis of the hand. At the first of the examination a distinct crepitus was felt but only once, and continued manipulation could not again elicit this symptom. In the belief that there was some obscure form of fracture present, the patient was radiographed and it was discovered that the blow, occurring on the side of the metacarpal of the right index finger, had caused a linear fracture



FIG. 3.—Radiograph showing linear fracture of metacarpal bone of right index finger. Caused by recoil of handle of motor-boat engine,



FIG. 4.—Radiograph showing "tent-shaped" fracture of fourth right metacarpal bone. Caused by recoil of handle of motor-boat engine.

extending proximal into the joint. Only at the very tip of this fragment could crepitus be felt (Fig. 3). A moulded metal splint was used and an excellent result was obtained. At the end of five weeks he was again able to return to desk duty. Such a linear fracture is unusual.

CASE VII.—Mr. C. B., aged 34, was another victim. In his case also the explosion took place at the wrong phase of the engine cycle and he was struck on the under side of the right hand in the middle of the palm. The fourth metacarpal bone received the brunt of the impact and was fractured at its middle in an angular direction so that the ends of the fragments of bone formed a tent-like elevation upon the dorsum of the hand. The deformity produced was more pronounced than usual, for in most instances the adjacent bones act as splints and the broken bone is held in good position in this manner. The angular deformity is shown in Fig. 4. With the aid of the radiograph a pad was placed over each extremity of the bone on the palmar side and a single pad over the angular projection on the dorsum. Two small glass rods, with rounded ends, on each side of the bone, corrected the tendency to lateral displacement and with these occurred in a moulded metal splint the result was excellent.

CASE VIII.—Mr. B. C., aged 33, was injured by a similar blow upon the back of the right hand. His hand became much swollen and discolored but he thought it merely a bruise and did nothing for it until two weeks had passed when the continuance of the symptoms caused him to come for treatment. With the former cases in mind, although no crepitus could be detected, a radiograph was made and a transverse fracture of the fourth right metacarpal bone was found (Fig. 5). The bone was in perfect alignment and was held so by the action of the two adjacent metacarpal bones. This plate is also interesting as it shows another form of injury received in play, a "base-ball finger," due to a fracture of the first phalanx of the little finger, received some years ago. In this case a simple splint for immobility was all that was needed to secure an excellent result with no deformity.

CASE IX.—Mr. F. S., another member of the police force of the city, aged 48, received a more serious injury. He was struck by the flying handle upon the left wrist and the radius was fractured in two directions giving lines like the letter X (Fig. 6).

The force of the impact was received upon the dorsum of the wrist and the resulting deformity was that of an exaggerated Colle's fracture. Good recovery in five weeks.

CASE X.—Similar to Case VII but still more serious, was that of Mr. W. F. who was struck in a similar manner upon the wrist, but from beneath, by the flying backward of the released handle. A compound fracture of the right wrist resulted and considerable laceration and contusion of the soft parts about the broken radius and ulna. So severe was this injury that it seemed probable an amputation might be necessary. This was averted, however, by carefulness and cleanliness, and a fair result was obtained.

CASE XI.—Drowning does not seem at all likely to occur as a result of such an injury, but this was nearly the fate of Mr. A. S., a slender man of 23, who was engaged in starting the engine. The explosion again occurred at the wrong cycle, the handle flew backwards and struck his right wrist on the upward turn of the wheel. The force of the blow was so great that not only did he sustain a compound fracture of the right wrist but he was thrown bodily overboard into the waters of the bay. He was no swimmer and was so stunned by the injury that, had not help been promptly at hand from those who saw the accident, the victim would have drowned. It is probable that some portion of clothing became entangled in the handle of the wheel and so gave sufficient attachment to throw him overboard. A serious illness resulting from the immersion developed, in addition to the shock of the compound fracture, and operative procedures and it was some weeks before he finally recovered. It is not unlikely that one or two drowning accidents noted in the daily newspapers during the past season occurred in a similar manner, as motor boats have been found running without a driver and the body of the man was afterwards found injured and drowned.

Similar injuries occur during the "cranking" of an automobile, and once the attention of the surgeon is directed to the subject it is surprising how many cases can be secured. During the past month while the matter was uppermost in his mind the writer has had his attention called to a number of such accidents.



FIG. 5.—Radiograph showing transverse fracture of fourth right metacarpal bone. Caused by recoil of handle of motor-boat engine.



FIG. 6.—Radiograph showing X-shaped fracture of left wrist caused by recoil of handle of motor-boat engine.

CASE XII.—W. B. B., a physician, while engaged in starting the engine was struck on the right wrist by the rebound of the crank at the time of the primary explosion. The radius was broken close to the wrist joint and in two places, very similar to those shown in Fig. 6. This physician reports that he has had about six cases, similar in character, in his personal charge during the past year. He lives in the neighborhood of a garage and they have been sent to him for immediate treatment.

CASE XIII.—Dr. C. D., another medical man, met with a similar experience. In his case instead of pushing down on the handle with the arms rigid he was nearly at the highest point of the circle when the explosion occurred. The crank did not leave his hand but the backward impulse was so sudden and so violent that the radius was broken completely across; the ulna was not injured (Fig. 7). The deformity at the time of injury was extreme.

CASE XIV.—Mr. T. A. R., while cranking his machine, had the spark too far advanced and the explosion occurred at the wrong phase of the engine; the handle flew backward, striking him below the knee, breaking both bones of the leg.

Two cases have been called to the writer's attention in which the patella was broken. Minor injuries to the leg, and particularly to the knee are common. The daily press (*New York Sun*, November 1, 1906) has recently reported a case in which the nose was broken and the skull was also fractured.

Type of Fracture.—The fact that the initial velocity of the flying handle is much greater than that of the human body, in case of a fall, or of that of falling timbers, stones, and the ordinary causes of fracture in everyday life, has a marked effect upon the lines of fracture and causes them to resemble those produced by large calibre projectiles without the penetrating effects. The fracture, as a rule, occurs at the point of actual impact, and is rarely transmitted to the weaker parts of the bone. So localized, indeed, is the injury that fragments of bone may be broken off or such small bones as those of the carpus may be individually broken. The lines of fracture are, as a rule, quite straight and the direction taken may be most unusual.

Diagnosis is often quite difficult, and the use of the fluoroscope and radiograph is imperative in cases of doubt.

The hand and wrist receive the greater number of injuries, but the fingers are pushed aside easily and quickly so that fractures in the phalanges are not common. On the other hand, the metacarpal bones seem to be fractured most frequently, and injury to the carpus, sprains or even an actual fracture is not rare. When the force of the blow is expended directly upon the fore-arm or leg the injury may be more severe, and compound fractures are not uncommon in these localities.

Etiology.—When these cases are studied to determine the cause of the explosion taking place when the driver is unprepared or during the wrong phase of the engine cycle, it would appear that the majority are due either to carelessness or to ignorance. Too many persons buy a car or a boat, are taken out for a trial trip, are shown the essentials of starting and of stopping, buy the machine, and fancy that by reason of having paid the purchase money they are thereby granted the degree of mechanical engineer. The dangers are slowly becoming known and actual schools for instruction for the complete construction and management of motor-boats are now established. The first of all to be established is maintained by the Y. M. C. A. of this city, and the practical demonstrations of their craft on the Harlem on Friday and Saturday afternoons, with the numerous apparent accidents, have caused the uninitiated to call it the "Jonah Boat."

The best of instruction cannot prevent carelessness, and the attitude taken by the manager of a motor company, who sustained a badly injured wrist with fracture of one of the carpal bones and a resulting excision and did not care to have the case reported for several reasons, shows that familiarity does not protect against the possible danger.

All agree, that most of the accidents occur while the handle is being pushed downwards with the weight of the body upon the rigidly held and extended arms. If the handle is pulled up it is safer, and if the explosion does occur at that time



FIG. 7. Radiograph showing fracture of right radius caused by recoil of handle while "cranking" automobile.

the handle flies away from the grasp, and is much less apt to do damage to the driver. In automobile accidents the legs receive the larger number of injuries as the crank is higher from the ground. In the automobile, however, the force is transmitted from the crank to the engine through the medium of a ratchet, so that the crank does not continue to revolve. Then, too, if the effort be made always to stand clear of the crank and apply the force by pulling up instead of pushing down, the chance of accident is greatly lessened.

With motor-boats, especially those whose engines have been placed in sail-boats, cat-boats, dories, and the like, to give auxiliary power when needed, the mechanism is much more simple and the space in which to avoid the flying handle is much less. Accidents are common enough in both classes, and with a little effort the above record could be greatly amplified.

TRANSACTIONS
OF THE
NEW YORK SURGICAL SOCIETY.

Stated Meeting, March 13, 1907.

The President, DR. GEORGE WOOLSEY, in the Chair.

DORSAL MENINGOCELE.

DR. WILLIAM A. DOWNES presented an eight months' old infant, which at birth had a pure meningocele the size of a walnut in the dorsal region of the spine (Fig. 1). It gradually increased in size, but under very careful protective treatment it never became inflamed nor irritated, and gave rise to no ill-effects. There was no associated deformity or malformation. The patient was brought to the Babies' Hospital, and operated on last December. A circular incision was made through the skin, and the pedicle of the tumor was dissected out. It communicated with the spinal canal at about the level of the third dorsal vertebra. The child made an uneventful recovery, and there had been no leakage since the operation.

Dr. Downes called attention to the size and unusual location of the meningocele and the fact that it was covered by membranes almost entirely. A slight strabismus which existed at the time of the operation had disappeared. The child is now perfectly well and there is no evidence of hydrocephalus which often follows operation for the relief of this condition, especially when situated in the sacral or cervical regions.

DR. ROYAL WHITMAN said that in his experience club-foot was more often associated with spina bifida lower down, and in such cases it was often accompanied by partial or complete paralysis and loss of sensation,—rather unusual complications when the defect was of the upper portion of the spine.

DR. GEORGE WOOLSEY thought that a meningocele proper

was rarely seen so high up as in the case shown by Dr. Downes. The usual location of these tumors was in the lumbosacral region. Another peculiarity of the case was the incomplete skin covering, as most pure meningoceles had a complete covering.

TUBERCULAR PERITONITIS.

DR. CHARLES N. DOWD presented a girl, twelve years old, who was first seen by Dr. Geo. M. Ball on Saturday night, November 24, 1906. She had apparently enjoyed good health up to the preceding Thursday morning, although she had had two or three previous attacks of pain and vomiting. On Thursday she had had a severe attack of vomiting, and her bowels had moved slightly, twice. On Friday morning she vomited once, and two or three times on Saturday. The vomitus on that day had a fæcaloid look, and in the evening was very forcible in character. She stated that all day she had had difficulty in preventing vomiting. There was moderate rigidity in the right hypochondrium, but no abdominal distention. Her pulse was 90; temperature normal. She was taken to St. Mary's Hospital at once. The vomiting persisted during the night, and on the following morning the temperature was 99.5; the pulse 130; the rigidity had increased, and was especially marked on the right side of the abdomen. There was no distention.

Operation was done without delay. Upon opening the abdomen, there were well-marked evidences of tuberculosis of the appendix, the head of the colon and the lower end of the ileum. The appendix was removed. An abscess cavity containing about 2 ounces of tubercular pus was found in the mesentery, about 5 inches above the ileocæcal valve, which had by its pressure produced absolute occlusion of the intestine at that point. It was emptied by sponges, and the patency of the intestine was thus restored. There was considerable free serum in the lower part of the abdominal cavity. The abdomen was closed without drainage, and healing occurred by primary union without incident, thus again illustrating the desirability of omitting drainage in these cases. The patient made a good recovery, and had since remained in excellent health. She has gained in weight, has had no further intestinal symptoms and now appears to be very vigorous and strong.

DR. DOWD presented a second case of tubercular peritonitis

in the person of a girl, nine years old, who came under his observation on April 25, 1905. She had enjoyed good health until two weeks prior to that date, when she began to complain of pain in the right side of the abdomen, with irregular fever, and loss of appetite and strength. Upon admission to the hospital, there were evidences of fluid in the abdominal cavity.

Operation, May 1, 1905: The omentum was found much thickened; it was at least 2 inches thick and extended very little below the umbilicus. A section taken from it showed extensive tuberculosis. The intestines also were studded with tubercles wherever they were seen. After this operation, a sinus persisted in the abdominal wound, and the child was sent to the country for two months. Upon her return the sinus was cured, and the wound ultimately healed. She was discharged from the hospital January 30, 1906, and had since remained in good health, and is now the picture of ruddy strength, although in all probability many tubercles still remain within the abdomen.

TENDON TRANSPLANTATION.

DR. CHARLES N. DOWD presented a boy who was six and a half years old when he came to St. Mary's Hospital on May 18, 1905. Four years prior to that date he had fallen and injured his back, and for eighteen months subsequent to that injury he was unable to walk. At the time of his admission to the hospital there was marked atrophy of the extensor muscles of the left leg and thigh, and the left foot was inverted to such a degree that he hobbled about on its outer edge.

Operation: The tendon of the tibialis anticus was split, the division being carried well up among the muscle fibres. The posterior half of the tendon was left attached in its normal position, while the lower end of the other half was separated from its attachment, was carried outward and secured to one-half the tendon of the peroneus longus, which had also been split, but the displaced part was severed at its upper end.

The result of the transplantation was excellent, and the inversion of the foot had been practically corrected. Even without the aid of a short steel support, which the boy still wore, he was able to walk with entire comfort, and placed his foot squarely on the floor. Since nearly two years have elapsed since the operation, a fair trial has been given to the procedure.

DR. ROYAL WHITMAN said that when tendon grafting was first introduced, it had been regarded by many as an actual cure for various deformities of the limbs, especially as the immediate results were usually very striking. Further experience, however, had demonstrated that partial relapse was the rule. He considered it as of comparatively limited value unless combined with other procedures, such as arthrodesis at the centres of deformity, or unless, as in the present case, a protective brace was worn.

The speaker also called attention to the importance of splitting a muscle high up and separating it completely into two parts if it were to act effectively as independent muscles.

DR. DOWD said that in several cases where he had split the tibialis anticus he had found it a very satisfactory procedure, and that it was an excellent measure in helping to maintain the equipoise of the foot. He agreed with Dr. Whitman that a complete cure should not be looked for by tendon transplantation, and that some kind of a brace should be worn continually to help maintain the position. In this case it had certainly accomplished a great deal, since the boy placed his foot squarely on the floor and with the help of an inconspicuous "drop foot" brace he was able to walk with almost a normal gait.

CARCINOMA OF THE BREAST AT SIXTEEN.

DR. GEORGE E. BREWER presented a negress who had been admitted to the Roosevelt Hospital in January, 1907, suffering from a small, hard nodule in the upper and outer quadrant of the right breast. She stated that as long as she could remember there had been a "small round ball" under the skin near the areola. This was not painful, and had given her no trouble until six months ago, when it began to grow larger and apparently gave rise to painful sensations in the breast.

On examination, a hard, somewhat elastic oval nodule was felt, which was distinctly circumscribed and freely movable. It had no attachment to the skin nor to the pectoral muscles; the nipple was not retracted, and no axillary lymph nodes could be felt. The growth was regarded as a fibro-adenoma, which was possibly cystic.

The tumor, together with a small amount of breast tissue,

was removed through a straight incision radiating upward and outward from the nipple. On microscopic examination the growth was found to be an intracanalicular adenopapilloma which had undergone distinct carcinomatous degeneration. As soon as the pathological report was received, the patient was again etherized, and a complete Halsted operation was done. Her recovery was uneventful.

DR. WILLIAM B. COLEY said he had never seen a carcinoma of the breast under the age of twenty. Among the 2,713 cases of carcinoma of the breast recently collected by Heimann, there were only 4 under the age of sixteen—about 1 to 700. Under the age of twenty there were 7 cases, the proportion being about 1 to 400.

DR. PARKER SYMS said that Beatson of Glasgow had called his attention to one point in the differential diagnosis between benign and malignant tumors of the breast. In the former, the nipple line on the affected side would be lower than that on the opposite side before there had been retraction, while in a malignant case the nipple line on the affected side would be higher than that on the opposite side.

In connection with this general subject, Dr. Syms asked the opinion of the members as to the propriety of making an exploratory incision in a case of breast tumor of a doubtful nature, and how much risk accompanied such a procedure. He said that he resorts to this procedure occasionally.

DR. DOWD thought it was very desirable to make an exploratory incision into a breast tumor of doubtful character before determining the extent of the operation. He knew of cases where such a precautionary measure would have prevented the performance of radical operations for fibroma and inflammatory growths in this region. At best, the radical operation occasionally resulted in considerable discomfort, with occasional swelling of the arm and pain on the affected side; these were defects that did not apply to the old Volkmann operation. For that reason, a preliminary incision, with the examination of sections by the freezing microtome, was very important in certain cases. It is done under anæsthesia as a part of the regular operation.

DR. WOOLSEY said he had always regarded a preliminary incision and the immediate examination of frozen sections a safe and desirable measure in the differential diagnosis of breast

tumors. As an additional safeguard to prevent infection, he advised cauterization of the cut surfaces, and, if the growth proved to be malignant, the radical operation would of course be indicated at once. The complete removal of all the glands and surrounding tissues would prevent the spread of any cancer cells, set free by the incision, into the tissues beyond the field of operation.

DR. E. S. JUDD, of Rochester, Minn., suggested the advisability of removing every tumor of the breast as soon as it was discovered, irrespective of the age of the patient.

DR. COLEY agreed with Dr. Judd that it was very important to remove these so-called benign and cystic tumors as soon as they were discovered. He recalled one case at the General Memorial Hospital where a cystic tumor of the breast had been treated by another surgeon by hypodermic puncture three years before. Three years later the cystic tumor had degenerated into a typical carcinoma and the disease was too extensive to permit a radical cure.

DR. BREWER said he was not in sympathy with the rather widespread belief that it was dangerous to make an incision into a doubtful tumor of the breast. His own practice was that when even he had to deal with a tumor of the breast it should be freely extirpated, and then frozen sections should be immediately examined in order to establish its true character. In a recent textbook on surgery, it was stated that there was very little evidence to show that benign tumors of the breast ever became malignant. This, Dr. Brewer said, he considered bad teaching, as he could personally recall at least three cases seen in one year, where benign tumors had become malignant. The case he had shown at this meeting was another example of the same kind. The speaker emphasized the importance of the removal of all these tumors as soon as they were discovered.

THE SURGERY OF PERITONEAL TUBERCULOSIS.

DR. PARKER SYMS read a paper with the above title, for which see page 95.

DR. JUDD said that he thought Dr. Mayo's idea was that the primary lesion in the peritoneal tuberculosis was always some point in the mucous membrane and not in the peritoneum itself, and the great desideratum in operating was to discover the loca-

tion of the primary lesion. It was only by finding and removing the primary focus that a permanent cure could confidently be looked for. In the female, this primary focus was usually in the tubes—probably in three out of four cases. In the males operated on at Rochester the appendix, if possible, was removed in all cases, and it proved to be the primary focus of the disease in about 50 per cent. In several instances the primary lesion was found to be in the stomach, duodenum or gall-bladder, and in other cases there was a distinct tubercular lesion in the cæcum or ileum.

DR. DOWD said that a review of the literature had suggested the query as to how much proof we had that simple incision of the peritoneum had much effect on peritoneal tuberculosis. The statistics did not show a very great preponderance in favor of cases operated on, and when we bore in mind the vague character of the symptoms in this condition, it was perfectly justifiable to assume that many cases of tubercular peritonitis had recovered in which the diagnosis had never been made. The speaker said that in the two cases he had shown at this meeting the condition had gone unrecognized until it was far advanced and there was a sudden outburst, evidenced in one case by intestinal obstruction, and in the other by an effusion of fluid into the peritoneal cavity. He had also looked over the histories of the cases which had come under his own observation and had found very little evidence of the curative effect of simple incision but abundant evidence of the evasive, indefinite nature of the disease. These cases numbered 29, verified by operation or autopsy. In 3 of them unsuspected, yet extensive, peritoneal tuberculosis was found in operation for hernia. In 3 instances the vermiform appendices were the site of the maximum inflammation and were removed. In 2 instances, pieces of tubercular intestines were resected with good results. In 2, tubercular uterine appendages were resected also with good results.

In 14 instances extensive plastic exudate was present. This is the type which authorities generally agree upon as unaffected by simple incision. In one of them who died from intestinal obstruction, a cure was supposed to have been accomplished by medical treatment. Another case illustrates very plainly the difficulty in diagnosis; a year and a half after the first operation another operation was done for persistent sinus, and the intestines

were found everywhere studded with tubercles, although the abdomen was soft, undistended, and, excepting for the sinus, had seemed normal. The type with marked serous effusion is the one which is supposed to be most benefited by incision, but this is the early stage of the inflammation in most instances and the one which is most likely to do well under any treatment.

In peritoneal tuberculosis, Dr. Dowd said, we were certainly dealing with a very evasive disease, and it was difficult to interpret the effects of treatment, either medical or by simple peritoneal incision. While an operation in these cases seemed advisable, it should not be undertaken on the ground that in some remarkable or mysterious way it would cure the disease, but rather on the ground that by opening the abdomen we might discover the source of the infection and remove it.

DR. COLEY said he was entirely in accord with Dr. Dowd that this question of peritoneal tuberculosis was still very obscure, and that it had not been absolutely decided that an operation would cure many more cases than would medical treatment. Neither did he believe that removal of the appendix would always effect a cure in this condition. The speaker said he could recall several cases upon which he had operated for hernia, and had found the hernial sac studded with tubercles, although the patients had given no symptoms pointing to a tuberculous lesion. In one case he had operated for a ventral hernia following an operation for appendicitis in which another surgeon had removed a tuberculous appendix two years before. The sac of the ventral hernia was filled with small tubercles, as was also the neighboring parietal peritoneum. The patient continued to grow worse and died about a year later in spite of the two laparotomies.

DR. BREWER said that many of the cases that had been referred to illustrated a well-recognized principle in surgery, namely, that, given a case of tuberculosis, if we could remove the primary lesion the case would be able to take care of itself. This was noticeably so in tuberculosis of the kidney and other organs of the genito-urinary tract. After the removal of a tuberculous kidney, for example, the involved ureter would often be able to take care of itself.

DR. WOOLSEY said that he agreed with Drs. Dowd and Brewer in regard to the importance of removing the original focus in these cases, but he was not quite so optimistic in regard

to the value of the medical treatment. He could recall several cases with effusion where under medical treatment the patients had gone from bad to worse, and where an operation, even without discovering the primary focus, had produced at least a temporary cure.

In speaking of the primary focus in these cases, Dr. Woolsey said he had seen it in the several localities where it was most often found, including a number of times in the appendix. He recalled one of the first recorded cases of appendectomy, operated on by Dr. Hall in 1886, where the appendix had been removed for that distinct reason. The case was one of supposed hernia, and the tuberculous appendix had been found in the hernial sac. The speaker said he had recently operated on a Japanese where the primary tuberculous lesion was in Peyer's patches in the ileum. The retroperitoneal glands were also extensively involved, and there were tubercular lesions in other regions of the body, including the lungs. In one case of peritoneal tuberculosis where the patient refused a radical operation and injections of iodoform emulsion were advised, the method proved painful and unsatisfactory.

DR. SYMS, in closing, said the statistics of peritoneal tuberculosis showed that as far as we could compare series of cases, these patients did better under surgical than under medical treatment. While the serous type did fairly well under any treatment, the surgical treatment was superior to the medical. Mayo and others had shown that a large proportion of these cases were curable by rational surgical treatment, even where medical treatment and perfect climatic conditions had failed.

Stated Meeting, March 27, 1907.

The President, DR. GEORGE WOOLSEY, in the Chair.

ACUTE DIVERTICULITIS OF THE SIGMOID, WITH INTRA-ABDOMINAL ABSCESES.

DR. GEORGE EMERSON BREWER presented a man, forty-five years old, who had hitherto enjoyed good health. He had never

suffered from digestive disturbances suggestive of appendicitis, gall-stone colic or peritonitis.

In August, 1902, while at dinner, he was suddenly seized with an attack of abdominal pain, with nausea and faintness, which necessitated his leaving the table. The severity of the attack soon passed off, and he was able to join his friends later in the evening. The following night proved a restless one, as he had more or less constant pain in the lower portion of the abdomen, which prevented sleep, and at times was accompanied by nausea and general bodily weakness. The following day he continued to feel badly, but he kept up and about for the reason that he was a guest at a country house and did not wish to inconvenience his host. Later in the day he went for a drive, and suffered acutely from the jolting of the vehicle. In the evening he was obliged to call a physician, who, after an examination, pronounced the case one of colitis. He returned to the city the following day, and, as the symptoms continued, he remained in bed. During five days he continued to suffer with pain in the lower left quadrant of the abdomen, together with fever and general malaise.

When Dr. Brewer first saw the patient, his temperature was 103; pulse, 110; leucocytes, 17,000. There was marked rigidity of the left rectus muscle, and a tender mass in the iliac fossa. He was immediately removed to the Roosevelt Hospital, and under ether anæsthesia an incision was made over the most prominent portion of the tumor. After dividing the tissues of the abdominal wall, a large abscess cavity was entered which contained about 4 ounces of foul pus, and an oblong fæcal concretion. On washing out the abscess cavity, a small ulceration was seen in the wall of the sigmoid, through which there was a slight fæcal discharge. The cavity was packed with sterile gauze, the wound partly united, and a dressing applied.

After operation, the temperature and pulse rapidly declined to normal, the pain ceased, and the appetite returned. The discharge from the abscess cavity gradually diminished until a cathartic was administered on the fourth or fifth day. This gave rise to a very abundant fæcal discharge which continued for several days. It then began to diminish, and the sinus finally closed in about six weeks from the time of operation. He had since been in perfect health.

DR. WOOLSEY said he had seen these diverticulæ of the gut at autopsy, but never as a cause of infection. The case shown by Dr. Brewer was interesting as bearing on the etiology of left-sided intra-abdominal infection.

CARCINOMA OF THE SPLENIC FLEXURE OF THE COLON.

DR. GEORGE E. BREWER presented a man, forty-seven years old, who was admitted to the Roosevelt Hospital in January, 1907, suffering from acute intestinal obstruction, vomiting, and marked prostration. He gave a history of having had numerous attacks of abdominal pain during the previous nine or ten months, which had always yielded to cathartics and a careful regulation of the diet. Two days before admission he had had such an attack, but the cathartic administered by his attending physician had failed to produce any movement of the bowels, and there had occurred vomiting, increased pain, and a progressive distention of the abdomen. When seen by Dr. Brewer in consultation, the abdomen was uniformly distended and moderately tender. As numerous enemata had failed to bring about any evacuation, and as no gas had been passed for twenty-four hours, an immediate operation was advised.

Under ether anæsthesia the abdomen was opened in the median line. The small intestine and the ascending and transverse portions of the colon were greatly distended. The sigmoid was collapsed, and palpation revealed a hard mass in the splenic flexure. As the distended cæcum lay directly beneath the abdominal wound, it was opened with a trocar, and about 1 quart of fluid fæces evacuated. The small opening was closed, the bowel stitched to the abdominal wound, and reopened with the Paquelin cautery the following morning.

There was a moderate amount of shock following the operation, but after the fistula was established and the bowels freely moved, the patient's condition improved, and two weeks later a second operation was undertaken for the removal of the growth. The colostomy wound was sealed with gauze and rubber tissue, and a long incision made over the descending colon extending from the twelfth rib to the iliac fossa. A dense carcinoma was found, involving about 3 inches of the colon, just below the splenic flexure. The transverse colon was brought into the wound, clamped, and divided about 2 inches above the growth. The

descending colon was freed from its attachments, clamped, and divided just above its junction with the sigmoid, and the intervening portion of the gut and a generous piece of the mesocolon were removed. Both open ends of the intestine were closed and turned in by purse-string sutures, and a lateral anastomosis was made between the transverse and sigmoid portions by the suture method. The surrounding tissues were then thoroughly disinfected, and the wound closed by layer suture, a small cigarette drain being left in the upper angle.

The patient rallied well from the shock, and aside from a moderate infection of the subcutaneous tissue of the wound he made a prompt recovery. On the fifth day following the operation a fair-sized movement occurred by the natural passage, and after that the colostomy wound gradually closed. When he was discharged from the hospital, six weeks after the operation had been performed, he had an excellent appetite and was gaining rapidly in both weight and strength. The microscopical examination of the specimen showed it to be adeno-carcinoma.

DR. WOOLSEY called attention to the fact that in the case shown by Dr. Brewer the intestinal symptoms had been present nine or ten months. The speaker said he had seen two cases of carcinoma of the splenic flexure, and in both of them there were no premonitory symptoms until the time of the obstruction, which in the first case was absolute. The latter patient was brought to the hospital four days after the onset of the obstruction, and an artificial anus was established. In the other case a resection was done.

BLASTOMYCOSIS OF THE SPINE.

DR. GEORGE E. BREWER presented a man, twenty-three years old, a native of Russia, who was admitted to the Roosevelt Hospital in January, 1907. For the past six months he had suffered from pain between the shoulders, stiffness of the back, and a progressive loss of weight and strength. On examination, a large, fluctuating swelling was found between the scapulæ over the spinous processes of the third and fourth dorsal vertebræ. On aspiration, a dark, chocolate-colored fluid was withdrawn. There was moderate rigidity of the dorsal spine, pain on motion and marked tenderness over the swelling.

Under ether anæsthesia, an incision, 15 cm. in length, was made over the tumor, and the tissues divided until the abscess was reached beneath the erector-spinae muscles. About 4 ounces of pus were evacuated. On further examination, it was found that the spinous process of one of the vertebrae, together with a portion of its lamina and the arch of an adjacent vertebra, were exposed and more or less necrotic. These were removed, and the entire abscess cavity dissected out. The surrounding parts were then douched with a 1-100 solution of formalin, and the extensive wound united by deep and superficial sutures. Practically no reaction followed the operation, and the wound healed without suppuration. The patient left the hospital in about two weeks.

Three or four weeks later he returned, complaining of pain in the lumbar region, and upon examination a similar fluctuating tumor was found lying to the right of the upper three lumbar spines. The wound of the primary operation had remained healed, and free from tenderness. The second operation was similar in every respect to the first, with the exception that only the tip of the transverse process seemed involved. The recovery from the second operation was somewhat delayed by suppuration in the wound, but the patient was able to leave the hospital, completely healed, in three weeks.

Microscopical examination of the pus and tissues removed from both foci showed abundant blastomycetes. No cutaneous nor other primary lesion could be found, and there was no evidence of lung involvement or lesion of any other organ or tissue.

Dr. Brewer said this was the first case recorded of an apparently primary blastomycotic lesion of bone, and the only case of involvement of the spine in which improvement or cure had been noted.

DR. WILLIAM B. COLEY said that he at present had under observation at the General Memorial Hospital a case of acute blastomycosis with very rapid generalization, which, apparently, was not primary in the skin. The patient, a man in vigorous health up to last December, began to have severe pains in the dorsal region of the left foot. The foot became very much swollen and in a few days showed fluctuation. Shortly after this two small nodules developed in the skin of the lower portion of the outer aspect of the right thigh. These were slightly elevated

above the surrounding surface, presenting indurated edges and ulceration in the centre, with a tendency to form dry scabs. Very soon four or five similar lesions appeared in the face. At about the same time the patient developed a dry hacking cough which has persisted ever since and has been almost constant. In addition to the skin lesions described, a number of subcutaneous lesions appeared in various parts of the body, the majority in the thighs, some on the arms and some on the neck and forehead. These varied from the size of a hazlenut to that of a hen's egg. If left to themselves, in a week or ten days they became very much softened, showing fluctuation and, finally, ulceration in the centre, discharging a brownish-colored material of about the consistence of cream. In the fluid taken from such tumors before ulceration occurred, pure cultures of blasomycetes were found, which have been successfully inoculated into dogs, producing similar tumors. The lesions in the face have almost entirely disappeared under applications of pure carbolic acid left on for a minute and followed by alcohol. The patient is steadily growing worse, although he has been put on iodide of potassium, getting as much as 250 grains a day. Hæmoglobin has fallen to 35 per cent. The case will be published in detail later.

PERSISTENT FÆCAL FISTULA FOLLOWING GENERAL PERITONITIS.

DR. GEORGE E. BREWER presented a colored boy, nineteen years old, who was admitted to the Roosevelt Hospital in the summer of 1906, suffering from acute general peritonitis. He was operated on by Dr. Charles H. Peck, who found a diffuse suppurative infection, which apparently involved every portion of the membrane, which could be seen through an incision extending from the ensiform to the pubis. As the condition of the patient was extremely critical, and as the intestines were so matted together by inflammatory exudate as to preclude the possibility of an extensive search for the point of infection, the large abdominal wound was rapidly closed in part, leaving drains in the upper and lower angles. Considerable shock followed the operation.

He was critically ill for several weeks, and during his convalescence developed two fæcal fistulæ, one at the upper, and one

at the lower extremity of the abdominal wound. Through these two openings there poured out practically all intestinal contents for many weeks. At times the condition of the fæcal discharge would be semi-solid, indicating a communication with the colon, and at other times the discharge would suggest a high jejunal fistula.

The boy emaciated rapidly, and became extremely weak and anæmic. He rallied, however, and the amount of fæcal discharge diminished; but as soon as he gained a little strength and was able to take more food the fistulæ would again enlarge, and great quantities of matter from the small intestine would then be discharged.

In October he came under the observation and care of the reporter. At that time he was exceedingly pale and thin, and presented the evidences of a poor surgical risk. He pleaded so hard for operation, however, that it was finally decided to make the attempt. On opening the abdomen, the upper fistula was found to lead to a sinus which passed along the portal fissure of the liver, and then downward along the right side of the ascending colon to about its middle, where it communicated with the colon by an opening as large as a silver quarter. The lower fistula communicated with two loops of the small intestine, one of which was apparently the jejunum. It also communicated with a sinus which passed to the right iliac fossa around the cæcum to the outer side of the ascending colon and joined the sinus from the upper opening. The two openings in the small intestine were closed by Lembert sutures. The entire sinus was next dissected out, and the opening into the colon closed by two rows of Lembert sutures, and reinforced by an omental graft. The abdominal cavity was then closed, drains being left at four points in the course of the extensive incision.

The operation was an exceedingly difficult one, and required nearly an hour and three-quarters for its completion. One of the difficulties encountered was due to the fact that the intestines were absolutely matted together by a chronic tuberculous peritonitis, the progress of which had evidently been arrested either by the mixed septic infection or by the original operation for its relief.

There was considerable shock following the operation, which was combatted by active stimulation. The boy rallied slowly, and

eventually made a satisfactory convalescence. Although two of the drain openings suppurred, at no time was there any faecal discharge from the wounds. As soon as he was able to be up and move about the ward, he gained rapidly both in weight and strength.

DR. L. W. HOTCHKISS said that during the past winter he saw a case somewhat similar to the one shown by Dr. Brewer. This patient was also a negro and had had an acute onset of abdominal pain, and while an exact diagnosis was impossible, there was apparently an acute peritonitis, due probably to a perforation. Upon opening the abdomen, the intestines at pyloric end of stomach were found somewhat reddened, and the peritoneal cavity was filled with a non-purulent fluid. The appendix, stomach, and gall-bladder were apparently normal. The case was regarded as one of the acuter forms of tubercular peritonitis, although the cultures were negative. The abdominal wound subsequently broke wide open, making a secondary operation necessary, which resulted in a good union being obtained and the patient was discharged from the hospital apparently well.

SECTION OF THE COSTAL ARCH FOR BULLET WOUND OF THE LIVER.

DR. IRVING S. HAYNES presented a man, twenty-three years old, who was brought to the Harlem Hospital on October 18, 1906, with a gunshot wound of the abdomen. The wound of entrance was just below the tip of the ensiform. There was no wound of exit.

As soon as possible, a median incision was made under ether anaesthesia, and the course of the bullet through the liver noted. In order to reach the exit wound in the liver the skin and right rectus muscle were divided transversely opposite the base of the ensiform and the seventh and sixth costal cartilages severed at about their middle. The falciform ligament was also cut through from the umbilicus to the top of the liver, close to the abdominal wall and diaphragm. With strong traction upon the severed costal arch the posterior wound in the liver could be reached and felt but not seen. It readily admitted the index and middle fingers. By the fingers an iodoform wick was packed into this wound and a smaller wick introduced into the anterior wound in the left

lobe of the liver. Both wicks were brought out through the abdominal incisions. No wound was felt in the diaphragm.

The packing in the liver wounds checked the hæmorrhage, but not entirely, until the liver was forced upward against the diaphragm. To hold it there a large Mikulicz packing of plain gauze was introduced beneath it. The rectus was sutured. The peritoneum with the falciform ligament included, and the different layers of the abdomen sutured above and below the iodoform wicks. Nothing was done to the severed cartilages.

On October 29, the Mikulicz packing was removed and the gap in the abdominal wall closed by silk-worm sutures previously placed for such purposes. A few days later the iodoform wicks were removed and rubber tubing substituted. The discharge was very free, consisting of bile and pus.

On November 10, an operation to establish drainage posteriorly was performed as the space behind the liver was not draining properly.

Before this the bullet had been located in the mid-axillary line on the right side and about over the ninth rib. The incision was made in this place and the bullet with the sac in which it was perfectly encysted removed entire. One and one-half inches of the ninth rib was resected, the chest opened. The costal and diaphragmatic pleuræ were united by very delicate and fine adhesions; so these two layers were firmly sutured to the external opening. The pus cavity was located by an aspirator and the diaphragm opened alongside the needle.

By means of a long curved probe passed from the anterior wound over the liver, a good-sized rubber tube was drawn from the posterior wound to emerge from the anterior one. Further drainage was provided by a short tube into the abscess cavity. The long drainage tube was removed after a few days and all discharge drained from the second incision.

The case progressed slowly but satisfactorily. He was out of bed on November 18, and left the hospital on December 4. He came back for a week's stay about three weeks later as the drainage was not satisfactory. This was remedied by inserting a good-sized tube and firmly strapping the abdomen about his waist so as to crowd the liver upward and obliterate the abscess cavity. These measures succeeded, though the discharge did not entirely cease until the early part of this month (March).

The interesting features about this case are: The large hole through the liver—controlled by gauze packing within—and compression from below upward against the diaphragm. The great amount of working space afforded by section of the rectus muscle and the sixth and seventh costal cartilages. The prompt union of these cartilages without any special precautions. The effective drainage of the subphrenic abscess from the mid-axillary line over the ninth rib. The presence of bile for a long time in the purulent discharge. The escape of the patient from embolism, for many of the large hepatic veins must have been thrombosed.

COMBINED OPERATION FOR HERNIA AND FOR REMOVAL OF APPENDIX.

DR. WILLIAM B. COLEY presented a man, illustrating Torek's incision, combining removal of the appendix with operation for inguinal hernia. The patient was sent to the General Memorial Hospital about four weeks ago, on the diagnosis of strangulated hernia. It was found that only omentum was contained in the sac and that his acute symptoms were due to inflammation of the appendix. Temperature and pulse were normal. The operation was postponed for two or three days, and then the usual Bassini incision for inguinal hernia was made, the aponeurosis being incised $\frac{1}{2}$ to $\frac{3}{4}$ inch higher than usual. By retracting the aponeurosis well, it was very easy to separate the fibres of the internal oblique, as in the ordinary McBurney incision. The appendix was found acutely inflamed, and removed, the internal oblique sutured, and then the hernia operation was completed in the usual way.

A week ago, Dr. Coley did a similar operation in a boy of twelve. Dr. Coley reverses the order of the operation as practiced by Dr. Torek, who does the hernia operation up to the point of tying off the sac, then beginning the appendix portion of the operation, while Dr. Coley believes it better to attend to the appendix first.

SOME PRACTICAL DEDUCTIONS FROM PERSONAL EXPERIENCE IN THE TREATMENT OF APPENDICITIS.

DR. LEWIS A. STIMSON read a paper with the above title, for which see page 122.

DR. GEORGE E. BREWER said that while the generally accepted views in regard to the proper treatment of appendicitis were apt to undergo modification from time to time, yet in studying the statistics presented by Dr. Stimson—comprising a list of 98 cases operated on at a general hospital, with but 1 death—one could not but be impressed with the fact that the method of the operator was an important factor in the result. In this series of practically unselected cases, many of them acute, the mortality was about 1 per cent. The minimum amount of operative interference was probably responsible for the excellence of these statistics. The dictum was now generally accepted that the less we handled the inflamed intestines the better the result; the less we interfered with the appendix, the less would be the danger to the patient.

In regard to the question of drainage in these cases, Dr. Brewer said he had passed through all the various stages, and his views on the subject were practically as follows: He believed that all acute cases in which there was no extensive peritonitis, should be closed without drainage; also, that all acute cases in which there was no necrotic matter, should be closed without drainage. When necrotic matter was present, he invariably used drainage. In the absence of necrotic material, he saw no advantage in drainage, as the drain simply benefitted the immediate neighborhood in which it was placed, and could exert no beneficial effect upon a spreading generalized peritonitis; such cases he thought were much more satisfactorily treated without drainage.

DR. L. W. HOTCHKISS said he agreed entirely with the position as defined by Dr. Brewer, and was very glad to know that the views of Dr. Stimson coincided so closely with his own which he had taken occasion to express in a paper read before the Society in 1906. The only point of difference, practically, was as to the necessity of drainage in generalizing or diffuse suppurative peritonitis, meaning by this, a condition in which the pus was very generally distributed throughout the peritoneal cavity without visible encapsulation, and where the focal infection necrosis in and about the appendix was cleanly removable. In this class of cases, he had come to use minimal drainage in the form of a small cigarette to the appendical site or no peritoneal drainage at all, contenting himself with draining the external

wound only and allowing the peritoneum to take care of itself. Dr. Hotchkiss said he had tried all the various forms of treatment from the wide incision, evisceration, and gauze drainage, down to his present method of the small McBurney incision, development of the appendix by touch rather than by sight, irrigation with saline solution of the peritoneal cavity, when the pus was generally distributed, and avoiding all unnecessary traumatism to the intestines from handling and exposure. Under this plan he had reported one series of 72 cases in a period extending over the same time as Dr. Stimson's cases, a smaller series to be sure, but still including 15 cases of diffuse suppurative peritonitis, and without any mortality. In the paper read before the society in 1906, he had reported 28 cases of diffuse suppurative peritonitis treated by this method, of which 5 died.

DR. JOSEPH A. BLAKE, after referring to the extremely favorable results in the series of cases reported by Dr. Stimson, said that in his opinion the McBurney incision was the best for most cases, and much better for the purpose of drainage than an incision along the outer border of the rectus. In regard to drainage *versus* non-drainage in peritonitis, he did not think it wise to wholly uphold either one stand or the other. While many cases could be safely left without drainage, there were some in which we could not well get along without it. One of the chief advances that had been made in the treatment of these cases was not in leaving out drainage altogether, but in relieving the surgeon of the necessity of making multiple incisions and in inserting large pieces of gauze or drainage tubes. Drainage was certainly indicated in dealing with a condition of local necrosis, but even then rarely more than one drain was necessary, inserted either to the iliac fossa or to the bottom of the pelvis. The speaker thought it took considerable experience and judgment to decide whether drainage could be safely omitted or not, and in doubtful cases he thought it better to err on the side of safety and introduce a drain. Personally, he always used a drain through the abdominal wall, but he had largely done away with deep drainage.

DR. CHARLES L. GIBSON said he thought the age of the patient in these cases should be considered in connection with the mortality rate. He had come to expect young children with general peritonitis to recover, even with an apparently extensive infection, which would be apt to end fatally in an older individual.

In regard to drainage, the speaker said he felt that Dr. Stimson had re-established the subject on a sound, common-sense basis. One method of drainage which he had found very efficient and which contributed much to the comfort of the patient, was the use of a modified Mikulicz tampon made of perforated rubber dam, properly folded and placed, and filled with gauze. He regarded this superior to the ordinary cigarette drain.

DR. HOTCHKISS said that most of his cases were young, *i.e.*, under thirty; 2, however, were over forty, and 1 was a man of fifty-eight.

DR. STIMSON, in closing, said it had been a pleasure to hear so much testimony in favor of drainage, which was much more generally employed than he had supposed. As to the ages of his patients, to which Dr. Gibson had referred, he could only state approximately that among the 13 cases of general or extensive peritonitis included in his list, 3 were under the age of twelve years, or that 2 others were under twenty.

In speaking of drainage in general peritonitis, Dr. Stimson said he was quite ready to concede that good results could be obtained with less drainage than he had deemed advisable, but he wished to take exception to the statement that a drain in this region did not drain, and that it would always be prevented from doing so by adhesions forming in the course of a few hours, which would render it useless. On the contrary, he had seen these drainage tubes discharge freely for three or four days, in amounts far too large, he thought, to be supplied solely by the area immediately surrounding the drain.

Dr. Stimson said that one of the chief objects of his paper was to emphasize his objection to the use of free and multiple incisions in these cases, laying open the abdomen widely with the idea of getting rid of every trace of exudate. He had a horror of that method, especially on account of its late results, such as the occurrence of ventral hernia, the relaxation of the abdominal wall and the general disability of the patient. While these patients perhaps escaped with their lives, yet many of them were practically cripples.

In dealing with limited suppurations, the speaker said he saw no reason for immediate closure of the wound. By doing that, a certain number of these patients would have their lives imperilled, and that risk could be avoided by the temporary use of a

drain running down to the site of the appendix, a measure which did not delay convalescence and introduced no additional risk of its own. The average stay in hospital after operation of the patients of the last three or four groups in his list was the same, whether the wounds were drained or not drained.

CYSTIC SARCOMA OF THE KIDNEY IN AN INFANT.

DR. GEORGE WOOLSEY showed a specimen which he had removed in February, 1907, from an infant four months old. At the time of its removal, it was larger than the child's head. It had first been noticed about a month after birth, and steadily increased in size until it filled about one-half of the abdomen, especially on the left side. It gave rise to no urinary symptoms, and it was not until shortly before the time of operation that symptoms from pressure on the thoracic organs became marked.

Its removal was accomplished without much difficulty except for its adhesion to the peritoneum below the transverse mesocolon, which was torn. It was found to consist of the left kidney, or its posterior half, from the front of which extended the tumor which was entirely cystic. Many of the superficial cysts had been ruptured during the removal. A pathological examination of the tumor, made by Dr. James Ewing, showed that it contained both sarcomatous and epithelial elements. He found none of the striped muscle tissue that was sometimes present in these mixed tumors (embryomata). The patient died of shock on the day of the operation.

DISLOCATION OF THE SEMILUNAR AND FRACTURE OF THE CARPAL SCAPHOID.

DR. LEWIS A. STIMSON showed a specimen obtained from a man of thirty years who fell a distance of about 25 feet, sustaining a fracture of the pelvis and an injury to the left wrist, the latter consisting of a forward dislocation of the semilunar bone and a fracture of the scaphoid. The wrist joint was very movable, and there was abundant crepitus, with sensitiveness on pressure. The diagnosis was corroborated by the X-ray, and the semilunar and proximal fragment of the scaphoid were extirpated. Motion in the wrist is now limited but increasing.

DR. HAYNES spoke of some experiments in the dissecting room, where he had produced a fracture of the scaphoid by flex-

ing the wrist and then striking the dorsum of the hand a sharp blow with a heavy mallet. Shortly afterwards Dr. Downes reported to him a case where the injury had been produced by hyperextension.

DR. WILLIAM A. DOWNES said he had treated 4 cases of fracture of the carpal scaphoid this winter. In 1 of these the injury was produced with the hand in the hyperflexed position, and was probably produced by direct violence; and in the other 3 the hand was in a position of hyperextension.

REVIEWS OF BOOKS.

THE TECHNIC OF OPERATIONS UPON THE INTESTINES AND STOMACH. By ALFRED H. GOULD, M.D., of Boston, Mass. Large octavo, pp. 302. Philadelphia: W. B. Saunders Company, 1906.

This book is the result of experimental work, the aim of the author having been to study a mechanical subject in the only available way, *i.e.*, upon animals. Of the multitude of intestinal and stomach operations which have been suggested during recent years, only a limited number have proved of permanent value. In the slow and cautious methods demanded in operating upon human beings, his responsibility to the patient prevents the surgeon from trying to determine and to eliminate unnecessary technical steps.

The operations chosen for the experimental tests were those most used to-day, and with that as a basis, a discriminating and critical experimental study was carried out upon animals and the cadaver. In the course of the work a great many new details came up which proved to be of importance heretofore not appreciated.

The book deals essentially with the elementary details. It is a book about technic, and an understanding of the minutiae which, combined, make up the operation. This means accurate technic.

The first chapter deals with repair. This is inserted to give the reader confidence that, if the work is done according to the rules laid down later, the healing of the intestines is bound to follow in fairly set grooves.

A great deal of attention is given to tying knots, suture material, stitches, needles, clamps, in order to show just how these are employed. This chapter leads naturally to a brief consideration of the anatomical questions which are involved in intestinal operations.

The completed gastric and intestinal operations are easily understood by one who has made himself familiar with the elementary matters.

Surgical teaching is undergoing a change. The success of the book depends upon the recognition of the source from which the data comes. It is not hearsay, it is a discriminating criticism of the work of others in which are introduced a good many new ideas; in one case the entire operation is original.

The illustrations are numerous and accurate; all possible details are cut out in order to focus the attention of the reader upon as small an area as possible. This has demanded an increased number of drawings, but in the end it has distinctly made for clearness. The number of drawings makes the text appear short, but the technical pictures in the text stand out as sharply as they do in the drawings.

LEWIS S. PILCHER.

A TEXT-BOOK OF DISEASES OF WOMEN. By J. CLARENCE WEBSTER, M.D.(Edin.), F.R.C.P.E., F.R.S.E., Professor of Obstetrics and Gynecology in Rush Medical College. Large octavo of 712 pages. Philadelphia and London: W. B. Saunders Company, 1907.

In the preface to this volume the author states that he has endeavored to keep constantly before him the following aims:

1. To give prominence to the scientific basis of each subject under consideration. For this purpose the most thorough attention has been given to modern researches in sectional and dissectional anatomy, histology, embryology, comparative anatomy, pathology and bacteriology, in so far as they bear on diseases of women, and the author has included the chief facts collected by himself in original investigations carried on during the past sixteen years.

2. To study clinical phenomena in their widest relationships.

3. To insist upon exercising caution in the adoption of therapeutic measures not yet thoroughly tested, especially of

certain ones which have, in recent years, been recklessly advocated.

4. To give emphasis to methods which have proved satisfactory in the author's experience.

The author has carried out his plans and has presented the entire subject as fully as the scope and size of the volume permits. The chapter on anatomy is particularly good, as it includes the results of the writer's own studies of this important part of the subject. The general plan of the work is excellent, beginning with the anatomy (including embryology), then puberty and menstruation, genital tract in relation to microorganisms, neuromes in relation to pelvic diseases, case-taking and physical examination, minor therapeutic measures and surgical technique. After this the various gynecological conditions are considered, including a chapter on "Appendicitis in Relation to Pelvic Disease." The press-work is a very creditable specimen of book-making, and while the heavy glazed paper increases the weight of the book it adds to its general appearance and the clearness of the illustrations.

Two features which especially commend the book are the thorough presentation of the anatomy of the pelvis and the description of the methods of diagnosis and treatment (including operations) which have proven most serviceable in the hands of the writer.

JOHN A. SAMPSON.

ATLAS AND TEXT-BOOK OF HUMAN ANATOMY. Volume II. By Professor J. SOBOTTA, of Wurzburg. Edited, with additions, by J. PLAYFAIR McMURRICH, A.M., Ph.D., Professor of Anatomy at the University of Michigan, Ann Arbor. Quarto volume of 194 pages, containing 214 illustrations, mostly all in colors. Philadelphia and London: W. B. Saunders Company, 1906.

Volume II of this "Atlas and Text-book of Human Anatomy" is equal in every way to Volume I, which has been recently reviewed in the ANNALS OF SURGERY. Volume I treats of the anatomy of the bones, ligaments, joints and muscles, while

Volume II is devoted entirely to the viscera, including the heart. Under this heading are included all the organs situated within the cavities of the body, so that the brain, spinal cord, heart, and even some of the organs of special sense, as the eye, are described under this designation. In treating the subject, the organs contained within the visceral tube of the body are grouped in three chief sub-divisions: (1) the digestive apparatus; (2) the respiratory apparatus; (3) the urogenital apparatus. Following out this sub-division, two particular constituents are recognized in each, viz., a tubular canal; and a series of non-tubular parenchymatous organs whose chief component constitutes the secreting epithelial substance of the glandular structures belonging to the individual apparatus. These are classified as sub-divisions. The volume is divided into a Treatise on General and Special Splanchnology, and a Treatise on General and Special Angiology. The volume is magnificently illustrated, the lithographs being true to life and not merely schematic, as is often the case in text-books and atlases of anatomy. The Anatomy and Text-book is a translation of the German edition by Dr. Johannes Sobotta, of the University of Wurtzburg, and is edited, with additions, by J. Playfair McMurrich, A.M., Ph.D., of the University of Michigan.

PAUL PILCHER.

A TEXT-BOOK OF HUMAN PHYSIOLOGY. By DR. ROBERT TIGERSTEDT, Professor of Physiology in the University of Helsingfors, Finland. Translated from the Third German Edition, and Edited by John R. Murlin, A.M., Ph.D., Assistant Professor of Physiology in the University and Bellevue Hospital Medical College, New York City. With an introduction to the English Edition by Professor Graham Lusk, Ph.D., F.R.S.(Edin.). Royal octavo, pp. xxxi, 751. New York and London: D. Appleton and Company, 1906.

The general excellence of Tigerstedt's "Lehrbuch der Physiologie des Menschen" and the high rank maintained by it as a medical text-book in Germany justify its translation, and for the labor involved in the undertaking Prof. Murlin de-

serves the gratitude of teaching physiologists in this country. This English edition is a somewhat abridged, but otherwise faithful rendering of the third German edition; the omitted portions being such as are not ordinarily included in the regular courses in physiology given in American medical colleges. Some additions have been made to the text by the American editor, and a number of illustrations of simpler or improved forms of apparatus inserted. The exclusion of the section dealing with body-movements, though in accord with the common omission of that portion of the subject from our medical-school courses in physiology, is scarcely commendable. Its inclusion would have increased the size of the book by no more than fifteen pages and rendered it quite equivalent to the original work. Inasmuch as the mechanics of joints and of animal movements is of considerable practical value—especially to the surgeon and neurologist—its neglect by teachers of physiology in this country is rather surprising. Aside, however, from this defect—and, perhaps, but few will consider it a defect—the book is admirably suited for general use as a text-book by medical students. The reviewer is aware of but one other text-book in English that is likely to compete with it, and of the two is inclined to give first place to Murlin's Tigerstedt.

J. C. CARDWELL.

A TEXT-BOOK ON THE PRACTICE OF GYNÆCOLOGY. For Practitioners and Students. By W. EASTERLY ASHTON, M.D., LL.D., Professor of Gynæcology in the Medico-Chirurgical College of Philadelphia. Third edition, thoroughly revised. Philadelphia and London: W. B. Saunders Company, 1906.

The earlier editions of Prof. Ashton's work have already received reviews in this journal. Naturally, the changes which have taken place during the year since its first appearance have not been extensive, but supplementary material has been added and some revisions have been made. The metric system has been introduced. Microscopic examination and diagnosis of curettings from the uterus; the blood, in relation to surgery; colonic lavage as a treatment of constipation; and the treatment

of vaginismus, are subjects which have been revised and rewritten. It is worthy of note that the superficial denudations for the cure of cystocele have been discarded and Dudley's method of operating has been substituted. The numerous methods for the correction of chronic retro-displacements of the uterus show the unsatisfactory results of our present operative treatment. The subject of gonorrhœa in the female has not received the consideration which it deserves and leaves the reader at a loss as to the best method for its treatment. The three editions within one year speak well for the popularity of the work.

PAUL PILCHER.

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ORIGINAL MEMOIRS.

AVULSION OF THE SPINE OF THE TIBIA.

BY J. HOGARTH PRINGLE, M.B.(ED.), F.R.C.S.,

OF GLASGOW.

Surgeon to the Royal Infirmary.

I AM not aware whether any report has yet been published of a case in which the tibial spine has been sutured to the tibia after its avulsion; in fact, as far as I have been able to discover, there are only three instances of the injury on record: those of Dittel, of Poncet and of a patient admitted to University College Hospital, London, in 1873. In each of these cases the avulsion of the tibial spine was only discovered either after amputation or after the death of the patient.

I am therefore induced to publish, on account of the rarity of the condition, the following notes of a patient whose tibial spine was sutured to the tibia.

CASE I.—A. L., aged thirty-six years, was admitted to the Glasgow Royal Infirmary June 14, 1903, three days after having received a severe blow on the outer aspect of the left knee joint from the shaft of a cart. He was knocked down, and thinks that the knee was knocked inwards. He is a big, powerful man. The left knee greatly swelled from effusion into the joint cavity and there is a good deal of bruising of the superficial tissues. The only abnormal movement is in the way of abduction of the leg at the knee. This was so extreme that my house surgeon, Dr. A. B. Ross, reported the case to me as one of probable rupture of the

internal lateral ligament of the knee, and, after frequent examinations of the limb with a constant failure to elicit any antero-posterior movement or any abnormal rotation of the leg upon the thigh, I rather inclined to this idea of rupture of the internal lateral ligament. The question of rupture of both crucial ligaments was gone into, although I was not at that time aware that any operative treatment had ever been carried out for that injury; but there seemed to be no evidence in favor of this particular condition.

On June 26 I exposed the internal lateral ligament, but found it apparently quite intact. Before incising the tissues, and when the patient was under anæsthesia, renewed attempts at movement of the tibia on the femur failed to produce any abnormal antero-posterior movement.

The joint was then opened into, the blood and fluid in it washed out, and it was at once seen that the anterior crucial ligament still attached to its bone insertion had been torn off the tibia and taken the spine with it; with a little trouble this was sutured, and the wound closed. He made a good recovery and has been seen several times since. He was brought before the Glasgow Medical Chirurgical Society, November, 1903, and was last seen September 3, 1905, when he said he had perfect confidence in the strength of the knee; it troubles him only a little at times when coming down stairs. There was the very slightest degree of abduction permitted when the joint was fully extended. At the right knee joint no lateral movement whatever was permitted while fully extended.

CASE II.—At the time the forementioned patient came under my care, I had seen once or twice a gentleman who first consulted me in October, 1902, on account of a looseness and feeling of insecurity of his right knee joint. He had been injured at football the previous March and thought he had received the violence on the outer aspect of the limb. The knee had been greatly swelled directly after the injury and was in splints for three weeks. Since then he had never had any feeling of security in the limb. When I saw him there was no fluid in the joint, but there was a remarkable looseness, so that it seemed to be possible to abduct the tibia, while extended on the femur, through 25 degrees; it was not possible to displace the tibia forwards or backwards on the femur nor to produce any abnormal rotation at the

knee. The thigh muscles were much atrophied, the circumference of the right thigh being 35 and of the left thigh 38 cm.

In consequence of the absence of abnormal rotation, and, in fact, any abnormal displacement of the tibia upon the femur other than the abduction, I concluded the internal lateral ligament had been ruptured and that there was no evidence of injury to either of the crucial ligaments.

The patient would not then consent to operation; but in the following summer, as he found no improvement taking place, decided to have it, and, accordingly, on August 6, 1903, this was done. When he was fully anæsthetized, on manipulating the joint it was found that the head of the tibia could be brought forwards on the femur for about 2 cm. (it had never been possible to do this previously), but no abnormal rotation could be brought about. In consequence of this abnormal displacement forwards it seemed very probable that the anterior crucial ligament was ruptured, but with so much abduction possible the original diagnosis of rupture of the internal lateral ligament as well, seemed to be justified in spite of the experience of the last case. The lateral ligament was therefore first exposed and found to be intact, at any rate as far as its superficial fibres were concerned. The joint was then opened and the anterior crucial ligament found torn from its femoral attachment. This was sutured to the tissues on the external condyle and the joint closed.

He made a good and uneventful recovery. I saw him on July 29, 1904, when he told me he had perfect confidence in the knee joint, that he hunted, ran to harriers and danced without any support to the joint. There was the very slightest abduction possible. The circumference of the thighs was, right 40, left 40.5 cm.

In August, 1905, he wrote saying he had given the joint a severe wrench while jumping and that it became much swelled, but I did not see him again until January, 1906, when he told me he was able to golf, run and dance again. The circumference of the thighs was now the same, 39.5 cm., and the amount of abduction possible at the extended knee was only of the very slightest degree, but there was a little.

Although avulsion of the tibial spine is a rare injury there have been a few cases of rupture of the crucial ligaments published during recent years, and some papers on the subject of

the mechanism of the injury have appeared. It may be worth while, therefore, to discuss the subject a little fully first of all from the point of view of the mechanism by which the injury occurs, and secondly from the diagnostic point of view.

The first patient to be operated upon was that of Battle. In this case both crucial ligaments were torn from the femur, and Robson recorded a case in which both ligaments were sutured after being torn "from their upper attachments."

Pagenstecher has recorded three cases operated on, in each of which one ligament only was ruptured: twice the anterior and once the posterior.

In consequence of their extraordinary strength, rupture of both crucial ligaments together can only occur as the result of very extreme violence and probably is associated always with gross injury to some of the other ligaments of the joint, and, more or less, complete dislocation, as was present in both Battle's and Robson's cases. I have had an opportunity of examining three knee joints which had been the seat of a recent dislocation of the tibia from the femur; both crucial ligaments had been torn in two of them, and in the third, the anterior crucial ligament was torn; but in all three there was extensive injury to some of the other (lateral or posterior) ligaments as well.

Regarding the rupture of one crucial ligament by itself, the matter is not quite clear, although many experiments have been carried out by Dittel, Pagenstecher and Honigschmied with the object of elucidating some points.

In Dittel's patient, with avulsion of the tibial spine, the injury took place apparently as the result of forcible separation of the tibia from the femur while the knee was in the flexed position; the patient died after the limb (the left) had been amputated (the nature of the injury was only discovered after dissection of the amputated limb), and on the cadaver, after prolonged attempts, Dittel succeeded in producing on the right knee the same injury by violence applied in the same manner.

Pagenstecher carried out a series of experiments and found that by flexing the leg forcibly over a large wooden bolster he

could rupture the anterior crucial ligament, and that he could also do so by blows applied from behind to the upper end of the tibia while the knee joint was flexed (both processes similar to the supposed method of the accident in Dittel's patient, *i.e.*, separation of the tibia from the femur). With blows applied to the upper end of the tibia from the front with the knee flexed he was able to produce rupture of the posterior-crucial ligament and often with tearing out of the "intercondyloid eminence." Pagenstecher could only rupture the anterior ligament from its femoral attachment, never from the tibial. Honigschmied made a very large number of experiments on the cadaver regarding the effect of various extreme movements at the knee on the several ligaments of the articulation. While he was able to rupture one or other crucial ligament, and sometimes both, in a varying proportion of cases by movement in any direction, if carried out to excess, he seems to have ruptured the anterior crucial ligament most constantly by hyperflexion, tearing it from the femur, and the posterior crucial ligament most constantly by hyperextension and tearing it from the tibia. (In both Battle's and Robson's case the two crucials were torn from their femoral attachments.)

The question of rupture of these crucial ligaments has interested me a good deal, and I have made some observations on the dead subject regarding the anterior ligament, and the effect of its rupture upon the stability of the joint. I find that, provided the pelvis be fixed, it is not very difficult to rupture the anterior crucial ligament by a combined movement of flexion, abduction and internal rotation of the leg at the knee. I think it is mainly the internal rotation which is effective, and which is certainly more easily permitted when the joint is flexed than when it is extended; but once laceration of the fibres is started the abduction, no doubt, plays an important role, for, with a knee joint flexed and rotated inwards, if the anterior capsule be removed, and slight abduction be made, it can be seen that the anterior crucial ligament is tending to draw across the sharp internal margin of the external condyle; at any rate, in all my experiments the anterior crucial has only ruptured from its

femoral attachment, in this respect agreeing with Pagenstecher's results, and, I believe, that the draw across the internal border of the condyle by the abduction has some effect in leading to this result.

It appears to me to be quite possible that this combination of movements may have been the real mechanism of the injury in my two patients, certainly neither of them had the knee flexed over any object (in the manner of Dittel's and Pagenstecher's experiments), but both of them were of the opinion that they had been struck upon the outer aspect of the joint and that the knee had been knocked inwards, thus producing an abduction of the tibia on the femur; and it is conceivable that with such an injury the thigh and body of a patient might be swung round upon the fixed foot in such a manner as to cause an eversion of the thigh upon the tibia—equivalent to an inversion of the tibia on the femur. In further support of this idea, I may add that Pagenstecher states regarding his Case III that the knee "was knocked inwards" at the time of the accident; while his two other patients "fell upon the knee;" and of the first of these he writes that when the patient was first seen the limb was in a position of "slight valgus" (abduction). He also says of his patients Cases I and II that there was easy mobility to each side permitted at the knee, but regarding his patient Case III he states definitely that there was no lateral movement possible.

In the examination of both my own patients the most remarkable feature to me was the extraordinary degree of abduction that seemed to be permitted at the knee (there was no adduction) while the leg was apparently fully extended; it was so marked that the first diagnosis in each case was that of rupture of the internal lateral ligament.

It is not just easy to see why there should have been so free abduction as was present in these two patients, but it is probable that it is due to a combination of causes. Dr. Bruce Young has shown it is round the anterior crucial ligament, tightened up as it is by the extension of the joint, that the inversion of the femur takes place, as round a pivot, in the last move-

ment of locking the extended knee; and it may be that with this important ligament ruptured, and therefore unable to functionate, the inversion, and therefore the locking, is incomplete and, in consequence, a degree of abduction may be permitted which is not possible in an intact joint; for with an intact joint, as long as the tibia is extended upon the femur no abduction is possible at all, whereas if the knee be flexed to a very slight angle, and the locking thereby be undone, a certain degree of abduction becomes possible. Still, I do not believe that this explanation will account for all the abduction that was possible in my patients, for I have divided this ligament a great many times upon the cadaver, but have never been able to obtain the same degree of abnormal movement in this direction, as was present in the patients; but I observe if attempts to abduct the leg on the thigh are made when the anterior crucial ligament is divided that there is permitted a degree of internal rotation of the leg by which the swell of the calf of the leg comes to be more prominent at the outer aspect of the limb, so that at first the impression is produced that a greater degree of abduction has taken place than actually was the case; when completely extended there is only this rotation, although a slight degree of abduction does take place, if the knee be flexed.

There is, however, another factor to be considered; when I succeeded in rupturing the anterior crucial ligament on the cadaver I found on examining the ligaments of the joint that there was always a degree of tearing of the internal lateral ligament at its deep or articular aspect; it never was complete; it never involved, that is to say, the superficial fibres, and none of the other ligaments of the joint ever showed any degree of injury. With these short fibres of the internal lateral ligament ruptured it is not only possible but probable that a greater degree of abduction would be permitted than if they were intact.

Now in this connection it is worth recalling the statements of Pagenstecher regarding his patient Case I; it was of this patient that he wrote that the knee, after the injury, was in a "slight valgus position" and with "easy mobility to each side," and at the operation the posterior crucial ligament was

found torn, the anterior was intact: this is of interest, and, it seems to me, of considerable importance, for in a knee joint that is extended, the posterior crucial ligament ought not theoretically to have any effect whatever on the movements of the joint, for it is then in a state of relaxation. According to all anatomists the posterior crucial ligament is only tightened in the flexed position of the joint, and, unless the deep fibres of the internal lateral ligament were also torn, it is extremely difficult to understand how the leg could be either in a position of valgus or permit easy mobility to each side as long as the knee was extended.

Still with the injury as I have artificially produced it on the cadaver, *i.e.*, complete rupture of the anterior crucial along with rupture of the deep fibres of the internal lateral ligament and with the soft parts round the joint intact, I have never been able to get a degree of abduction at all comparable to that which was present in my patients.

Experiments regarding the rupture of the knee joint ligaments have also been carried out by von Hints, who states with reference to the crucial ligaments, that "after division of one lateral ligament he divided a crucial ligament and found he could obtain lateral movement of the knee in the hyperextended as well as the extended joint, and after division of both crucials along with one lateral ligament he could bend the knee almost to a right angle," but I have never been able to obtain a lateral bending to this extent of any of the knees examined. With the anterior crucial ligament alone divided through an incision exposing the interior of the joint, as for Kocher's method of resection and the soft parts otherwise intact, I find that if the knee joint be maintained extended there is no abduction permissible, whereas if flexed through about 25° – 30° one can abduct the leg through about 8° at most. But if in addition the internal lateral ligament be divided and the knee flexed through 25° or 30° one can then abduct the leg through 15° ; but the abduction may appear to be rather more if one does not discount the internal rotation which, as already mentioned, tends to occur.

Through the kindness of Dr. T. H. Bryce I had an opportunity of examining, at Queen Margaret College, the ligaments of the knee joints of some dissecting-room subjects, with all the soft parts removed, and here, with both crucials along with one of the lateral ligaments divided, the greatest degree of lateral movement I could obtain was 70° , very much greater than I could get in any joint which had the surrounding soft parts intact, though considerably less than that obtained by von Hints.

The diagnosis of these injuries is not always easy. In the case of rupture of both crucial ligaments it is probable that antero-posterior movements of the tibia on the femur will always be abnormally free, and this should suggest the possibility of this injury, but in my two patients I never could produce this abnormal movement except in the second case, and then only when the patient was anæsthetized, although it had been examined for on several occasions, as the question of rupture of one or other of the crucial ligaments had been discussed several times. One would, on theoretical grounds, expect that with rupture of the anterior crucial ligament alone the head of the tibia would be permitted to come forward in manipulation, and that with rupture of the posterior crucial the tibia could go backwards on the femur in the flexed position of the joint, in which position alone the posterior crucial is tense. Von Hints, however, states the direct opposite and quotes Dittel in support of his statement, but it is obviously altogether erroneous.

I am inclined to think that with an injury to a knee joint resulting in distention of the cavity with blood, provided no other lesion were obviously present, it might suggest injury to one or other of these crucial ligaments or to the tibial spine. If internal rotation of the extended leg were permitted at the knee, or if the head of the tibia could be brought forward on the femur, it would point to the anterior crucial or tibial spine as the seat of the injury, and perhaps an abnormal adduction would also. The one sign of rupture of the posterior crucial ligament alone should, so far as I can see, be the possibility of displacing the head of the tibia backwards while the knee joint

is in the flexed position. Abnormal abduction of the leg on the femur, I am inclined to attribute to rupture of, at any rate, the deep fibres of the internal lateral ligament.

Probably, however, in many instances the real nature of the injury will only be accurately determined by an exploratory operation, which is certainly called for in every case of instability of a knee resulting from accident, for an unstable, loose knee joint is useless for the support of a patient's weight, and in the few cases that have hitherto been treated the results of suturing the tibial spine or crucial ligaments have been very satisfactory.

Pagenstecher has suggested for this injury the term "internal distortion" of the knee, which appears to be altogether unnecessary, and is certainly not exact, whereas the terms "Avulsion of the tibial spine" and "Rupture of the crucial ligaments" label the nature of the injuries as precisely as can be desired; and they require to be kept distinct from one another, for one is a fracture of bone and the other is not.

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OSTEOGENESIS IMPERFECTA AND IDIOPATHIC FRAGILITAS OSSIIUM.

BY CHANNING C. SIMMONS, M.D.,

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ABNORMAL idiopathic fragility of the bones as a definite disease has been recognized for many years, and the condition has been described more or less perfectly by many observers. The disease may be divided into two main groups (1) symptomatic fragilitas ossium, in which the abnormal fragility of the bones is due to some local or well recognized general condition, and (2) the idiopathic form, often termed osteopsathyrosis.

Symptomatic fragilitas ossium due to local conditions is seen following bone tumors, such as sarcoma, metastatic cancer, bone cysts, and, most markedly, in multiple myeloma, or sometimes as the result of inflammatory processes, as osteomyelitis or gumma. It is seen also in certain general systemic bone diseases, as rachitis, and osteomalacia. It is said to occur in congenital syphilis, but there is some doubt whether syphilis, except in the form of a gumma, ever affects the bones sufficiently to cause fracture. In certain nervous and mental diseases, abnormal fragility of the bones is known to occur, fractures being caused by the slightest violence. This is marked in insanity and tabes, and in these cases, as pointed out by Charcot, it is probably due to a trophic disturbance. Pathological fractures have been reported occurring in cases of scurvy, and they are not uncommon in the aged, where they are due to the osteoporosis of old age. The above mentioned causes of abnormal fragility are well recognized, and the condition itself is of relatively minor importance.

Comparatively little, on the other hand, is known of idiopathic fragilitas ossium, and the etiology of many of the cases is still obscure. It was first differentiated from

osteomalacia and the symptomatic forms by Lobstein ² in 1883, who suggested the term osteopsathyrosis for the condition, and it has generally been known by this name since, or as periosteal dysplasia (Schuchardt ³). It may be defined as a condition of macroscopic and microscopic osteoporosis of unknown cause, producing a fragility of the osseous system, resulting in multiple fractures. Gurlt ⁴ in 1862 wrote a classical article on the subject, and since then many articles have appeared, among which may be mentioned those of Schultz,⁵ Linke,⁶ Griffiths,⁷ Schuchardt, Biggs,⁸ Trendelenberg,⁹ Nathan,¹⁰ and Broca and Herbinet.¹¹ Griffiths collected from the literature 57 cases, several of which, however, are probably not true idiopathic fragilitas ossium.

The following two cases were treated in the wards of the Massachusetts General Hospital, and are reported through the courtesy of the physicians in whose services they occurred.

CASE I.—Service of Dr. A. T. Cabot. Female, 13, single. Massachusetts General Hospital. No. 145,787. December 30, 1905.

Family History.—Mother and father well. None of her relations have been subject to fractures. One brother, 11 years old, perfectly well. No evidence of syphilis in the family.

Previous History.—Chicken pox and whooping cough, but otherwise always well. She has had fractures as follows:

(1) At birth, right humerus; (2) at five years, right femur just above condyles; (3, 4) between five and eight years, broke left lower leg at about centre twice during these three years, but does not remember exact dates; (5) at eight years, broke left tibia again at about same place; (6) at twelve years, hit elbow and "sprained it;" no pain in particular, and no treatment; X-ray shows a fracture of the olecranon; (7) three months ago, broke left tibia at about same place for fourth time; (8) December, 1905, broke right femur above condyles; (9) February, 1906, broke left femur above condyles.

Of the earlier fractures she does not remember a great deal. Fracture No. 5, the third fracture of the left lower leg, was caused by a fall, but the mother says it appeared as if the fall were in

consequence of the leg breaking, instead of the fracture being caused by the trauma. Fracture No. 7 occurred three months before her admission to the hospital, and happened in the same manner. When not recovering from fractures the child has attended school, played with other children, and has been in every way normal. She has been in bed since September, 1905, recovering from fracture No. 7, and previously to that she had worn a leather brace on her left leg. The fractures as well as she can remember, have been accompanied with the classical symptoms to a greater or less extent, but pain and swelling have never been marked. The lack of pain is well illustrated in fracture No. 6, the olecranon, which caused so little inconvenience she did not seek treatment.

At birth she was a healthy baby, and nothing abnormal was noticed, the fracture of the humerus, occurring at delivery, being looked upon as an obstetrical accident. Her appetite has been normal, and her diet that of well to do country people, and the same as the rest of the family.

Present Illness.—Last night was awakened by a sharp pain in her right thigh, which on examination proved to be due to a fracture of the femur.

Physical Examination.—Head large and square. Posterior fontanelle depressed, two inches in diameter and soft, but no pulsation felt. Anterior fontanelle closed. Poorly developed and pale. Pupils equal, and react to light. Throat and mouth normal. Heart and lungs and abdomen not remarkable. No rachitic rosary. Right arm shows slight bowing at lower third of the humerus. The elbow shows an old fracture of the olecranon with considerable separation of the fragments, but no limitation of motion or other functional disability. Left arm normal. Right lower leg shows anterior bowing at the junction of the lower and middle third, with some motion (fracture No. 7). Right femur shows a fracture at the junction of the middle and lower third with crepitus, abnormal mobility, etc. The radiograph shows an irregular fracture, not transverse, with little displacement. Epiphyses throughout the body normal.

Fracture put up under ether in Buck's extension, with Desault, and coaptation splints. On February 14, 1906, the Buck's extension was removed and, union being firm, the leg was put up in a plaster spica.

On February 15, at 5 A.M., the patient woke up with a sharp pain in her left leg, and on examination a fracture was found just above the condyles of the left femur. The fracture was treated as the other had been. On March 16 the spica was removed from the right leg, and union found solid.

On April 1 there was fair union in the left femur, and the leg was put up in a plaster spica.

Urine.—December 31, 1905. Pale, cloudy, acid. Specific gravity 1033. No sugar or albumin.

April 3, 1906. Amount in 24 hours 1350 cc. Color pale. Reaction acid. Specific gravity 1007. Urea, 1.13 per cent., 15.25 grams; uric acid, .033 per cent., .45 grams; chlorine, .267 per cent., 3.60 grams; phosphoric acid, .081 per cent., 1.29 grams; sulphates, .012 per cent.; sugar, 0; albumin, very slight trace; sediment, not remarkable.

This specimen shows a dilute urine, although the patient had been on extra diet and tonic treatment for nearly two months. The sulphates particularly are considerably diminished, the normal being about 2 per cent. The proportion of uric acid to urea is high.

April 18. Amount in 24 hours 720 cc. Color normal. Reaction acid. Specific gravity 1020. Urea, 3.15 per cent., 22.6 grams; uric acid, .07 per cent., .5 grams; chlorine, .503 per cent., 3.6 grams; phosphoric acid, .15 per cent.; sulphates, .125 per cent.; sugar, 0; albumin, very slight trace; sediment, not remarkable. This specimen is practically normal.

A description of the radiographs taken during the month of March is as follows:

Head.—A lateral view only was taken, which shows its peculiar shape, but nothing abnormal about the bones could be detected.

Upper Extremities.—An X-ray of the right shoulder showed the ribs, clavicle, and scapula normal. The humerus also appeared normal, except near the head, where there was some thinning of the cortex, and evident diminution in the lime salts in the central portion of the bone. The shaft cast a dense shadow, and the relation of the cortex to the medulla was normal. The radius and ulna (Fig. 1) were also normal, except that the upper extremity of the latter bone had somewhat the same appearance as the head of the humerus, although in a less degree, and there was

FIG. 1.



Case I.—Right arm. The shafts of the bones are normal, but the head of the ulna casts a somewhat fainter shadow than is usual. Ununited fracture of the olecranon.

FIG. 2.



Case. I.—Hand.

FIG. 3.



Case I.—Left femur. Marked thinning of the bone below the fracture.

FIG. 4.



Case I.—Right ankle.

an ununited fracture of the olecranon. The bones of the hand cast a somewhat fainter shadow than would naturally be expected, and the first phalanges were extremely long (Fig. 2).

Lower Extremities.—X-rays of the thighs showed the upper parts of the bones normal. On the right there was an oblique fracture 4 inches, and on the left a transverse fracture 3 inches (Fig. 3) above the epiphysis. The epiphyses about the knee were normal. From above the points of fracture to the ends, the bones cast a comparatively faint shadow, the appearances not being due to a high tube, but apparently to a lack of bone substance. The cortex was thin in the lower third of the bones, and the medulla proportionately larger. The widening of the medullary cavity was more marked, and abrupt on the right than on the left (Fig. 4). The fibulæ were small.

The tibiæ had at their upper and lower extremities a similar appearance to the upper end of the humerus, and lower end of the femori, and the appearance might be said to be somewhat similar to the changes seen after long immobilization of a limb in cases of prolonged tubercular bone disease. Some deformity from the old fractures could be seen in the shafts. Nothing comparable to a localized bone disease could be seen in any of the bones.

The patient received while in the hospital general tonic treatment. She was put on "extra diet," and was given cod liver oil and eisenzucker. During January she received small doses of thyroid extract three times a day, but this was later discontinued, and a syrup of manganese substituted.

CASE II.—Service of Dr. H. A. Towle. Female, ten months. Entered the skin ward of the Massachusetts General Hospital May 31, 1905.

Family History.—Father and mother well. One sister, four years old, and a brother two and a half years old, perfectly well.

Previous History.—At birth nothing abnormal was noticed, and for the first nine months the child was healthy and took nourishment well. One month before admission began to lose weight, and developed a skin eruption. The parents, Syrians, never noticed anything unusual about the bones.

On admission to the hospital the diagnosis of dermatitis was made, and the child treated accordingly with good effect; but about July 1 she developed a chronic bronchitis from which she died July 15.

Abstract of Autopsy.—July 16, 1905. Dr. Oscar Richardson. Anatomical diagnosis: Purulent bronchitis, anæmia, œdema of piæ, multiple fractures, osteoporosis. The body was that of a female child, much emaciated, 62.5 cm. long.

Head.—Anterior fontanelle open, posterior nearly closed. Pia moderately infiltrated with thin clear fluid. Vessels normal. Nothing remarkable about the brain or cord.

Trunk and Extremities.—The epiphyses of the long bones were slightly enlarged. The shafts of the long bones of the extremities showed deformity and multiple fractures. On section the bones cut easily with the knife, and the distribution of the cortical bone was uneven, it being in many places entirely absent. In no bone was it of normal thickness. The medullary cavities were large and filled with soft red marrow. There was little subcutaneous fat, and the muscles were pale.

Digestive tract and abdominal organs normal. Pleura smooth. Heart normal. The mucous membrane of the trachea and bronchi was red, thickened and bathed in considerable yellow purulent material. No areas of consolidation were found in the lungs.

Microscopic examination of sections from several of the bones showed practically the same condition. The cortical bone was thin, and the medullary cavity proportionately large, while the periosteum was thick and fibrous. The Haversian canals were large. There seemed, however, to be a normal number of osteoblasts, and but few osteoclasts were seen in an examination of several sections. The marrow was not remarkable, and contained fat, myelocytes and giant cells in normal proportions. In other words, nothing abnormal was noted except a lack of bone. A section through an epiphysis showed the cartilage forming bone in the usual manner.

Radiographs were taken post mortem, and showed from one to four fractures of each of the long bones of the extremities (Fig. 5) with some displacement. These fractures were nearly all transverse. The clavicles were normal, as were also the ribs.

The bones all showed the same condition. The cortex was extremely thin, and in places seemed to be absent, and the bones cast a faint shadow, which was evidently due to a lack of lime salts. The general appearance of the bones was similar to that in Case I.

FIG. 5.



Case II.—Radiograph, lower extremity. The multiple fractures and extreme thinning of the bone are clearly seen.

Lobstein, who first separated the idiopathic variety from other forms of *fragilitas ossium*, described it as a concentric atrophy of the bones with enlargement of the marrow cavity and thinning of the cortex. Gurlt, on the other hand, considered the bones normal but delicately formed. Charcot, Bruns, and Broca and Herbinet consider it a trophic disease, the lesion being situated in the anterior roots of the spinal cord, and this theory has had considerable weight on account of the similar condition known to occur in certain nervous and mental diseases—in fact, it is the generally accepted explanation. Other observers have considered it caused by disturbed innervation of the arteries of the bone. Schuchardt, and more recently Nathan, have advanced the theory that the disease in young subjects is identical with *osteogenesis imperfecta*. Many authors consider the disease *osteogenesis imperfecta* incompatible with extra-uterine life, but although it is a fact that most of the cases are born either prematurely or dead, certain others which are not of an extreme type undoubtedly live (Case II). Nathan reports two cases, in which abnormal fragility was present at birth, both cases living. Zeigler¹² believed the disease of pure congenital origin, due to some malformation of the primary bone cartilage.

These two cases undoubtedly represent cases of *osteogenesis imperfecta* which have lived and have no relation to trophic disturbances. The general appearance of Case I at birth was not remarkable, but although the delivery was easy the right humerus was fractured. The fact that no other fracture occurred until the age of five does not entirely eliminate *osteogenesis imperfecta*, as it is conceivable that the condition may have been present in a mild degree; in fact the number of fractures is not nearly as great as in many of the reported cases. The chief points at present in this case which suggest a congenital origin for the disease are the shape and size of the head, which is similar to that of rickets, and the fact that the posterior fontanelle is open, and it does not seem possible that trophic disturbances having their seat in the anterior horns of the spinal cord could affect the bones of the skull, or prevent

the fontanelle from closing. It is unfortunate, as Nathan has pointed out, that the condition of the fontanelles in the reported cases is rarely mentioned. There was not the slightest evidence of syphilis or rachitis in this case.

Case II is similar to Case I in many respects, but the disease is, of course, much more marked. If the two diseases are phases of the same condition, the cause is the same—that is, the theory of disturbance of the primary bone cartilage combined with inability of the epiphyseal cartilage, or periosteum, to form normal bone, as has been shown microscopically, is probably the correct one. The histological appearances of the bone in the two types should, however, be compared carefully, but unfortunately this is almost impossible as adults rarely die of the disease, and will account for most of the cases of idiopathic osteopsathyrosis.

Biggs and many other observers recognize two forms of the disease, one occurring in early life, of which the above cases are the type, and the second occurring in adults. This adult form may on further research prove to be identical with that seen in young people, but it is probably an entirely different disease, possibly of trophic origin. Cases where deformity or bending occurs before fractures are not true cases of idiopathic fragilitas ossium. An hereditary tendency in many of the reported cases has been marked, the disease being transmitted through either parent, and in this respect it is similar to multiple cartilaginous exostoses—a disease of the epiphyseal cartilage, or in some cases of the primary bone cartilage (Lippert¹³). Greenish's¹⁴ case is a marked example of the hereditary tendency.

Father.	{	Son, 2 fractures..	{	Son, 2 fractures.
		3 normal children		3 normal children.
	{	Normal son	{	Son, 8 fractures.
				Son, 3 fractures.
Son, 4 fractures.				
{	Normal son	{	Son, 4 fractures.	
			Son, 4 fractures.	
			Daughter, 3 fractures.	
{	Normal son	{	4 normal children.	

FIG. 6.



Osteogenesis Imperfecta. Radiograph of a skeleton of a still-born infant, showing an incredibly large number of fractures. (Warren Museum).

All the bones of the body, including the cranium, may be involved to a greater or less extent, but the femur, probably on account of its position, is most commonly fractured, next in order coming the bones of the leg and arm.

Symptoms.—The symptoms consist of repeated fractures occurring as the result of insignificant violence or muscular exertion, but are, not rarely, spontaneous. They may occur with great frequency, Blanchard¹⁵ having reported a case with 106 (Fig. 6). The bones may break while the patient is simply standing erect, and it is not uncommon for the patient to awake in the night with pain in the leg to find a fracture, as in Case I. Other than the tendency of the bones to fracture, the subjects are usually in perfect health if they survive the first few years of life.

The symptoms are the same as those of fractures occurring in normal individuals, but differ somewhat in degree. Pain is usually less, and may be insignificant, as illustrated in Case I, by the patient considering the fracture of the olecranon as a slight sprain. Crepitus is said by many to be "soft," but in this case at least did not differ from that of any fracture. Union is usually rapid with but little callous formation, but may be delayed. The deformity is not due to bending of the bones as in osteomalacia or rickets, but, in all true cases, to a faulty reduction of the fracture, and is most marked in the severe cases, the patient becoming resigned to the fact that his bones fracture easily and not seeking treatment, but using the limb before the bony union is solid.

Pathology.—Few of the cases if they survive the first few years of life die of the condition itself; so complete autopsy reports are uncommon. Nothing distinctive has ever been found in the bones, however, the condition being a simple osteoporosis resembling that seen in other diseases and that of osteogenesis imperfecta. The marrow cavity is larger than usual, and the cortex correspondingly thin. Microscopically the trabeculæ are thin, and there may be an increased number of osteoclasts, while the osteoblasts are diminished. The marrow may be normal or may contain an increased amount of

fat. The canals are also said to be dilated. Thus there is a true osteoporosis with a reduction in the amount of bone by dilatation of the marrow spaces and canals similar to the form seen in old age or occurring after disease. Chemical examination of the bone shows it to contain a normal proportion of lime and other salts in contradistinction to the bone in osteomalacia, in which there is a diminution of the salts, the bone being replaced by fibrous and osteoid tissue.

Diagnosis.—The diagnosis is made on the symptoms of repeated fractures occurring either spontaneously or after slight violence, other causes of multiple fractures, such as tabes or multiple bone tumors, having been eliminated by the examination and the X-ray.

Prognosis.—The prognosis is on the whole rather unfavorable. The mortality in the first few months of life is extremely high, but in the milder cases there has been a distinct tendency as the child reaches puberty for the bones to become more normal, and the liability to fracture ceases, although in other cases the fractures have occurred with increasing frequency. In those cases where the condition has occurred in adults, there may be a spontaneous cure, or the disease may progress from bad to worse. Ultimate deformity is almost sure to occur.

Treatment.—The treatment directed towards the cure of the disease is unsatisfactory, no drug having any effect. Calcium and phosphorus salts have been largely given in the hope that they would be deposited in the bones, thus strengthening them; but although cases treated in this way have recovered, there is no proof that the cure had any relation to the drugs given. Thyroid extract has been recommended, and largely used, but apparently with little benefit. The patient should be given general tonic treatment in the way of good food, cod liver oil, iron, etc., and kept in the best hygienic surroundings.

What is more important than the general treatment in the present state of our knowledge, is the prophylactic treatment. The patient should be warned of the liability to fracture and protected in every way from violence. Leather or steel braces

may be worn, adapted to the individual case, to protect the legs and thighs. When fractures do occur they should be treated as usual, and the greatest care observed as to the position to obviate any unnecessary deformity.

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TRAUMATIC EPITHELIAL CYSTS.

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Historical.—This name was given by Garrè to the small epithelial cysts which usually occur on the volar surface of the hand and fingers, and which in his opinion regularly owe their origin to some trauma. Gros and Reverdin were the first to suggest this mode of origin, but it was not until Garrè's paper appeared that careful studies with a view to clearing up this point were made.

According to the usual descriptions, these cysts are small, round or oval tumors, varying in size from a lentil to a walnut or even larger, and are covered by non-adherent skin, which may be normal or present a tiny scar. They are composed of a cyst wall which is easily separated from the surrounding structures, and contain white atheromatous or pultaceous, semi-solid material. The cyst wall is made up—from without inward—of a layer of connective tissue, then of cuboidal and polygonal epithelial cells, which become gradually flattened in the succeeding layers until finally the innermost strata shows only cornified epithelium. Desquamated horny epithelial cells, granular detritus and at times cholesterin crystals fill the interior of the tumor. In short, we have the usual elements of the epidermis, surrounded with connective tissue, but arranged in inverse order so that the stratum corneum is innermost and furnishes the material for the cyst content.

It is because they present features so similar to those of the ordinary sebaceous cyst that the older German authors called them atheromatous cysts. However, their situation in parts wholly devoid of sebaceous glands and the nature of their content made it soon evident that some other reason for their occurrence must be sought. Later, they were regarded as dermoids because of their general characteristics and their

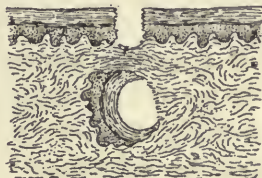
epithelial nature. Against this view the following important points were adduced: they were not observed in children, rarely in adolescents, and the usual elements—hairs, teeth, glands, sebaceous material—found in dermoids never occurred. And thus from considerations such as these and from clinical and microscopical study, it became generally accepted that they

FIG. 1.



Epidermis is displaced; first stage.
(After Garre.)

FIG. 2.

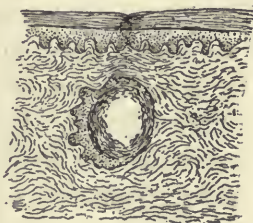


Epidermis has grown, and now curls up;
second stage. (After Garre.)

were purely epidermal structures whose origin could be explained in but two ways, either by the traumatic theory or the theory of foetal inclusion.

The advocates of the traumatic theory think that in the course of an injury such as a puncture, the introduction of a foreign body, or a lacerated wound, a portion of the surface

FIG. 3.



Epithelial Cyst complete. (After Garre.)

epithelium, with or without its nourishing vessels, becomes detached, and is deposited in the subcutaneous tissues, where it continues to grow and finally forms a cystic tumor. Garrè has depicted the process diagrammatically in his paper, and his figures have been reproduced here (*viz.*, Figs. 1, 2, and 3). It will be seen that the displaced epithelium continues to grow

in breadth and in thickness. Encountering considerable resistance on all sides, it is forced to curl up, and as it continues to do so, forms a globular structure which is finally converted into a complete sphere. The cyst continues to grow by virtue of the activity of the epithelium, which is constantly pouring cornified epithelium into its interior.

Sufficient clinical and experimental evidence has been presented in the last few years to give great weight to the traumatic theory. Woerz in his reviews of 55 cases finds that 24 gave a distinct history of trauma. Most of the injuries were in the nature of punctured wounds; in one instance a blow with a hammer was held responsible, and in three instances the formation of the cyst followed a panaritium. More recently, Pietzner has collected 73 cases from the literature. In 43 of these trauma is given as the cause, the following various forms having been noted: dog bite, blow with a hammer, incised wound, penetration of a piece of wood, punctured and contused wounds.

Although these data are suggestive, they alone would not be convincing were they not strengthened by experimental observations. Kaufmann in an interesting piece of work showed conclusively that detached, buried epithelium could give rise to so-called atheromatous cysts. His method, which he calls "Enkatarrhaphie," was to separate off an elliptical island of the skin of the cock's comb by clean cut incisions, and then to bury it by suturing the margins of the wound. After a few days the little island of epithelium increased in size, its edges began to turn up, and finally veritable cysts filled with atheromatous masses composed of cornified epithelial detritus were produced. Manasse and Schweningen showed that the detached epithelium need not necessarily be connected with its blood-vessels. The former, experimenting with dogs, found that pieces of epidermis could proliferate when introduced under the skin, or fascia, or even into tendon tissue.

Of interest in this connection is the observation made by von Kummer, who saw an epithelial cyst form about the point of a needle which had been buried in the tissues. Neugebauer

cites a case of neurolysis for cicatricial compression of the musculo-spiral nerve. After two unsuccessful operations, the nerve was freed and surrounded by an epidermal graft with a view to the prevention of vicious adhesions. A sinus soon developed and out of it a pultaceous white detritus was evacuated. It was doubtless a case of a partially formed epithelial cyst.

Finally it has been observed that the great majority of the cases occur in men who because of their work are much more exposed to traumatism than are women. But 7 of the 55 cases collected by Woerz were found in the female.

In support of the other view, that these cysts are congenital in origin, we have the publications of Franke, who, although one of the first to recognize their true histological nature, is now generally believed to be wrong in his contention as to their causation. Claiming that they were due to foetal inclusion, he nevertheless conceded that a traumatism might be instrumental in stimulating their sudden development.

Epithelial cysts also occur in the iris, and Masse was able to produce these experimentally by implanting squamous epithelium. Sutton has aptly termed them implantation cysts and they are frequently called by that name.

Woerz and more recently Pietzner have summed up the main clinical features. The former collected 55 cases, the latter 73 cases from the literature. From Pietzner's review the following conclusions may be drawn: The period of time which elapses between the trauma and the development of the cyst may vary from one month to twenty-four years. In 68 of the cases, the cysts occurred on the hands. But 10 cases were females, 63 males. Most of the tumors were found on the flexor surface of a finger. Forty-three patients gave a history of traumatism. The size of the cysts varied from a hemp-seed to that of a pigeon's egg or even larger. He also questions the validity of Franke's theory as to their embryonal origin from a consideration of his own cases and of the majority of the cases reported.

Own Observations.—I wish to contribute three further

examples of this condition to the literature, because of certain points of interest that were observed and because traumatism was undoubtedly responsible for the production of two of the cases.

CASE 1.—J. M., male, January, 1907; seen in Dr. Walter Brickner's¹ department, Mt. Sinai Hospital Dispensary. About two months ago he pricked the index finger of his left hand with a sharp nail. He paid no further attention to this slight injury. For the past four weeks he has noticed a little growth at the site of former injury. This has become progressively larger and causes him inconvenience rather than pain.

Examination, January 14, 1907.—Upon the palmar surface of the last phalanx of the left index finger, about at its middle, a small pearly white hemispherical tumor rises abruptly from the surrounding parts. It measures 4 mm. in diameter, has a glistening surface not unlike that of some white vegetable fabric. (Fig. 4. Owing to this peculiar appearance, its true character was not at once recognized; indeed it closely resembled the small parasitic cysts that are so frequently seen in animals. It was easily removed by grasping its protruding portion with a forceps and pulling it out of its bed in the tissues. During this manoeuvre its fragile envelope was torn and a white granular cheesy substance, the cyst content, escaped.

Pathological examination.—The cyst is ovoid and measures 4 by 7 mm. Its outer surface is perfectly white, smooth, and glistening. Its wall is homogeneous in character throughout and about the thickness of the ordinary epidermis. It is completely filled with a white pultaceous material not unlike the contents of a sebaceous cyst.

Microscopical examination showed a cyst wall composed of two layers the outer made up of squamous epithelial cells, the inner being a cornified lamellated stratum. Fig. 5² shows a cross section of the cyst with its contents in situ. The structure is similar to that of ordinary epidermis with its layers inverted, except that its elements show evidences of the effect of pressure and atrophy. The cells of the rete mucosum (stratum Malpighi)

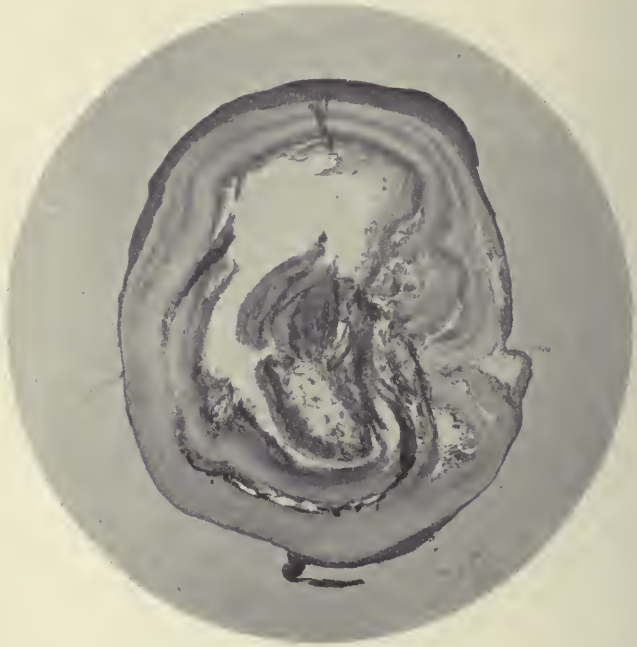
¹ I wish to thank Dr. Brickner for his kindness in allowing me to study this case.

² I wish to thank Dr. F. S. Mandlebaum, Director of the laboratory, for the preparation of the photomicrograph.

FIG. 4.



FIG. 5.



are small and atrophic, very much flattened, and the stratum granulosum presents long fusiform cells evidently under considerable pressure. There is no definite stratum lucidum but a thick layer, the stratum corneum, blends with the contents of the cyst. This is composed of desquamated horny cells and detritus.

The unusual feature observed in this case is the fact that the cyst was nowhere covered by normal epidermis and was lying partly without and partly within the tissues. It is difficult to imagine the exact mechanism of its production. Perhaps the displaced epithelium in this case was not carried in very deeply and was covered, when healing took place, by but a thin layer of epidermis. Then, as the cyst increased in size and as its contents began to distend its walls, this thin covering of normal epidermis, by virtue of the pressure from within, gave way and allowed the cyst to protrude beyond the surface of the skin.

CASE 2 is interesting because the mode of development could be observed.

J. K., male, 13 years, came to the Good Samaritan Dispensary (January 20, 1907) in order to have the point of a needle removed from the pulp of the left index finger. A small incision was made and the needle point, about one-eighth of an inch long was removed. The wound healed by primary union. On April 8 the patient returned complaining of the presence of a little hard spot on the same finger, which he said refused to heal.

Near the tip of the palmar surface of the left index finger, at the site of the old incision there is a tumefied area about the size of a split pea. The skin over it is thickened and at its most prominent part presents a tiny opening too small for the entrance of a small surgical probe. On pressing upon the neighboring skin a white granular substance escapes from the opening.

Under cocain anæsthesia the little tumor was circumscribed by an oval incision and excised. A section was made through the mass and the opening found to lead into a small cyst about 4 mm. in diameter and filled with a white granular, cheesy material.

Microscopic examination showed that the cyst wall was com-

posed of normal epidermis whose cornified layer was greatly increased in thickness. The opening on the surface measured less than 1 mm. Here the epidermis could be traced directly into the lining of the cyst. The contents were desquamated and degenerated cornified epithelial cells.

Here again we have an atypical case. Whether the channel which allowed the escape of the cyst contents was secondarily established by traumatism, or whether the displaced epidermis had not been completely detached by the trauma, is an open question. Either one or the other theory could explain the condition.

CASE 3 differs from the other two in that no history of traumatism could be obtained, and is remarkable because of the situation of the cyst.

F. K., female, 39 years, was treated by me at the Good Samaritan Dispensary for chronic mastitis. Under the skin of the breast, near the axillary fold, a pea-sized indurated area began to make its appearance whilst she was under treatment. After a period of 2 weeks had elapsed, the mass became adherent to the skin, the latter became reddened and painful. Owing to the peculiar situation of this indurated area and the fact that similar inflammatory nodules had been previously removed from the breast (with a view at that time of establishing a diagnosis of tuberculous inflammation³), I excised the little tumor with a sufficient amount of healthy skin. The wound was sutured and healed by primary union.

Pathological Examination.—Upon section there is a small abscess cavity about 1 cm. in diameter, filled with thick mucoid pus. It lies 0.5 cm. below the skin. The wall of the abscess is composed of squamous epithelial cells arranged in a manner closely resembling that of the epidermis. Externally there is connective tissue, with evidences of acute and chronic inflammation. Then there are a number of layers of squamous epithelial cells which become cornified as we approach the inner strata and finally there is an inflammatory exudate composed of fibrin and

³ I have since concluded, from the pathological examinations, that we were dealing with a case of multiple gummata of the breast.

polynuclear leucocytes. In the inflammatory zone surrounding the wall of the cavity there are many giant cells of the "foreign body" variety. The epithelial layers are infiltrated with round cells and polynuclear leucocytes.

We were evidently dealing with a small epithelial cyst which had become infected.⁴ Lying in the loose subcutaneous tissue near the axilla, its presence was not discovered until, by virtue of the inflammatory exudate externally and into its interior, it became adherent to the skin and palpable. It was far removed from the breast tissue and the sections showed no evidence of breast glands in the vicinity, although a careful search was made for them. We are inclined to believe therefore that it is a true epithelial cyst rather than a product of metaplasia of some preformed glandular structure. No history of trauma could be elicited in this case, and the question as to the origin of the cyst is therefore an open one.

In conclusion I wish to call attention to the points that have been brought out in the study of my three cases. Two of the cases prove conclusively the correctness of the theory that traumatism is responsible for a certain type of epithelial cysts. One of the cases (No. 1) was noteworthy because of the peculiar appearance of the cyst, being, as it were, implanted in the skin and subcutaneous tissues, and lying partly within and partly without the integument of the finger. Apparently we have in Case 3 a cyst similar to those occurring in the hand, but unusual in its situation.

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SYPHILIS OF THE BONES AND SOME RADIO-GRAPHIC FINDINGS.*

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THE earliest writings on De Morbo Gallico by Fallopi¹ in the sixteenth century bear witness to the recognition of syphilitic bone affections.

Viewed in the light of an infection, it lay in the nature of the syphilitic malady to look for metastatic deposits in bones, as in other infections. Clinically we have been wont to distinguish between the osseous lesions of hereditary and those of acquired syphilis. Our understanding of the lesions peculiar to either of these will be made clear if we adopt the conception that the bone, as a connective tissue harboring blood-vessels and cells (in the marrow spaces) known as osteoblasts, will react towards any organism as do other connective tissues. Hence it is by way of the blood-vessels that the infectious organism will be propagated. The same holds good for the investing periosteum. Its deeper layer is vascular and its blood-vessels are continuous with those of the Haversian system and the marrow. Therefore, the whole pathological process is always to be regarded as an osteomyelitis either in the marrow or beneath the periosteum, or about the epiphyseal line of ossification. The extent of the process may be diffuse or circumscribed. The specific pathological process may be gummatous, sclerotic, or purulent, or a combination of these; its end results may be the pathologic-physiological conditions of necrosis, osteoporosis, sclerosis, sequestra formation, epiphyseal separation, joint complication with functional disturbance, interference with bone growth, and spontaneous fracture. Physically, the bone is affected and we may speak of osteitis.

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In hereditary syphilis the lesion is located about the epiphyseal ends of the shaft (the ossifying zone of the cartilage). This lesion of osteochondritis, so fully described by Wegner,² Parrot,³ and Taylor⁴ in the seventies of the last century, has in no way up to the present time been enlarged upon, but verified innumerable times. Its essential features are a proliferation and dystrophy of the cartilage cells with increased deposit of lime salts, and an irregular extension in the ossifying zones of the marrow spaces. The blood-vessels, few in number, become still further encroached upon by the cells, in consequence of which degenerative changes take place (Waldeyer⁵), resulting in granulation tissue of a low order, causing necrosis, hence epiphyseal separation. Beneath the periosteum there is proliferation and erosion of the underlying bone. In still-born macerated infants of syphilitic parentage, when all the other salient features of the disease are absent, this bone lesion is demonstrable and almost stands out as a pathognomonic of the lethal disease. Furthermore, of recent date is the observation of Betarelli,⁶ who found the *Spirochæta pallida* in three still-born infants in the marrow, beneath the periosteum and in the ossifying zone of the cartilage.

Clinically, even when there is no palpable enlargement of the epiphyseal ends of the bones, the existence of an involvement is revealed by the presence of a palsy of the upper extremity which is titled as the pseudoparalysis of Parrot. It is encountered within the first months of infancy, generally affects the upper extremities, and when unilateral often simulates birth palsy. This latter condition is not painful and may be excluded by the absence of reaction of degeneration. The condition of subluxation of the radius (Streubel, Hutchinson), also spoken of as painful paralysis of young infants (Chais-saignac), following an inadvertent traction of the forearm, may simulate this pseudoparalysis, but the clicking sensation or noise coincident with the replacement of the subluxated radial head restores motion to the lifeless arm even if the pain does not disappear immediately.

At times there is deformity about the epiphysis of the

lower end of the humerus, due to subperiosteal deposits, or that of the radius, and more rarely with epiphyseal separation, increased mobility of the epiphysis may be made out, with or without crepitation. Acute inflammatory signs and suppuration, if they exist, are due to a complicating pyæmic infection emanating perhaps from the umbilicus, perhaps from an infected circumcision, or of gonorrhœal origin.

In the lower extremities, in the presence of the osteochondritis, in contradistinction to the palsy of the upper extremity, the limbs are held in a contracted position.

Nor is this osteochondritis limited to the long bones. It occurs rarely in the metacarpal bones and the phalanges and is familiar to us from the writings of Bulkley⁷ and Taylor as dactylitis syphilitica. One, more, or all the long bones of each hand may be affected. These spindle-shaped swellings are very tender, and, owing to the process of rarefaction of bone in the interior, the cortex may be easily indented (*spina ventosa*), giving rise to the crackling sensation of parchment or eggshells, or the bone is very much thickened. Where one bone, as an isolated lesion of hereditary syphilis, is affected, there is great difficulty of its differentiation from tuberculous dactylitis. Where many phalanges are affected there is a possibility of confounding the condition with rachitis. Quite common is the syphilitic onychia, and in later hereditary syphilis, the saddle-nose and perforation of the hard palate.

Where doubt is entertained as to the nature of the lesion it has been shown by Kienböck and Hocksinger,⁸ of Vienna, that the X-rays give a definite picture. The epiphyseal ends of the diaphysis (not the epiphysis) are enlarged and translucent and the periosteum is very much thickened. In tuberculosis, on the contrary, there is never any periosteal reaction; there is always a great deal of involvement of the soft parts, and the cortical layer of the bone is never of that density peculiar to syphilis. The bone is not translucent, but rather porous. In rachitis, where the pathological changes are also most active at the epiphyseal line, the X-ray generally shows a cup-shaped defect of the diaphyseal parts.

In the later forms of hereditary syphilis other parts of the skeleton may become affected; and there we have to deal with an osteomyelitis of the shaft in the form of a central gummata, sclerosis of the bones with deformities resulting in "sabre en lances" and osteitis deformans. Often the long bones are the seat of spontaneous fractures.

In passing I wish to say that the healing of these fractured bones may not at all be retarded even without treatment, and the same holds good for the bones of syphilitic infants fractured inter-partum, whether dependent on diseased bone or not, as I have seen on two occasions.

In acquired syphilis, contrary to prevailing belief, bone involvement is present even at the time of early secondary manifestations, and nodes of smaller size on the head, ribs, and sternum are often encountered. These syphilitic deposits as expressed by Mauriac⁹ are the analogue of the adenopathy; they are transient and have nothing in common with the later gummatous deposits.

In the tertiary period true gummatous deposits are encountered in the marrow and beneath the periosteum of the long bones and in the bones of the skull, and it is the opinion of Lewin and Eschle that the pathological changes are most marked about the blood-vessels. Gummatous deposits in the marrow may be very small and overlooked *intra vitam* as responsible for the osteitic pains in syphilitics. Thus Chiari¹⁰ found in 27 syphilitic cadavers, 9 cases of gummata in the long bones. The larger gummatous deposits of the flat bones, sternum, clavicle, skull, and shafts of the long bones are more readily recognized, and yet there is the possibility of confounding them, where corroborative evidence of syphilis is wanting, with tuberculosis, blastomycetes, sarcoma, and actinomycosis.

Tuberculosis of the shaft is secondary to an extension from the epiphysis; the finding of the tubercle bacillus will dissipate all doubt. The use of tuberculin is unavailing, for Billroth has pointed out that in syphilis and actinomycosis a typical reaction can also be obtained. In the very rare instances where the blastomyces forms subperiosteal swellings,

microscopic examination will show the presence of blastomycetes. Sarcomata and likewise the ray fungus may be found—nevertheless the last resort to the microscope may even be unavailing. However, the X-rays have become the final arbiters for all of these, and the independent observations of Albers-Schönberg (Hamburg), Hahn,¹¹ Kohler (Wiesbaden),¹² and Ritter¹³ have resulted in giving us an analysis of the Röntgengrams of syphilitic bone affections which coincides in most respects and harmonizes with the pathological findings. They regard as typical the dense shadows formed by the periosteum and the corticalis, amounting at times to the obliteration of the medullary cavities. In other parts there are areas of translucency due to absorption of the bone. It is this participation of the periosteum which guards against its confusion with neoplasm, for the latter causes absorption of the bone and causes very abrupt termination of bone limits and no shadow formations due to proliferation.

The following radiograms tend to confirm the findings of these aforementioned authorities.

Figs. 1 and 2 represent the anteroposterior and lateral views of radiograms of a syphilitic arthritis of the elbow. The patient has for many years been under the care of Dr. B. Lapowski. This bone affection has resulted notwithstanding persistent antiluetic treatment with injections of soluble and insoluble mercury salts. The lower end of the humerus, increased in size, presents a thickening of the corticalis to the extent that the medulla is obliterated. There are three areas of absorption which are surrounded by thickened bone.

In Fig. 3, from the same patient, the middle third of the ulna shows an obliteration of the medulla which is replaced by thickened corticalis. A few areas of absorption surrounded by thickened bone can be made out also. In the middle third of the radius, whereas the corticalis and medulla are normal, there is clearly to be seen a subperiosteal deposit and a bowing of the shaft due to an increase of its length (Fournier).

Fig. 4, from the same patient, is a radiograph taken at the site of a very tender area of the lower third of the tibia, corre-

sponding to which there is to be seen a thickening of the corticalis at this level.

Fig. 5 was a radiograph obtained from a female, *æ*t. 28, who, besides her dactylitis, had a subperiosteal gummata of the os frontis. Though married four years she has borne no children, but has aborted several times. The radiograph of the dactylitis shows an increase in the corticalis in the entire extent, amounting to an obliteration of the medulla in the centre. The epiphyseal end of the shaft—not the epiphysis—shows an area of absorption. The soft parts are not involved.

In tuberculosis there is translucency due to absorption and atrophy of the bones; at times small sequestra, but never any increase in the shadow due to bone proliferation, nor thickening of the periosteum.

Fig. 6 is the radiogram of a girl 8 years of age, concerning whom no specific history was to be elicited. Contrary to the X-ray findings, she was subjected to an operation for the marked swelling of the soft parts. Examination of a section removed revealed the existence of gummatous deposit.

This radiogram shows the periosteum of the ulna thickened and lifted up by a gummatous deposit. The corticalis is increased in thickness and encroaches upon the marrow. The ulna is curved because of the greater increase in growth of the bone length in the continuity of the shaft than at either end (Fournier), and the medulla in the centre of the radius is encroached upon by the thickening of the corticalis.

These radiographic findings harmonize with the pathology, for in the subperiosteal gummata we can define a central area of softening surrounded in the periphery by a zone of thickening due to proliferation beneath the periosteum. These gummata may perforate spontaneously and discharge by a minute sinus, which latter again serves (Koenig) to distinguish it from the larger, fistulous openings of tuberculosis. Before the advent of any accessory infection the fluid discharged may be mucilaginous and cheesy; later it is purulent, and when healing is complete we have the cicatrices adherent to the underlying bone which are also peculiar to syphilis.

FIG. 1.



Syphilitic Arthritis of the elbow. Arteriosclerosis obliteration of Medulla-Gumma in shaft. Erosion on surface.

FIG. 2.



Lower end of humerus shows areas of absorption surrounded by areas of ossification.

FIG. 3.



Ulna—spindle-shaped. Gummatus lighter area surrounded by denser darker areas of bone. Medulla obliterated. Radius—shows a subperiosteal deposit and bowing of bone. (Fournier.)

FIG. 4.



Thickening of the corticalis of the lower $\frac{1}{3}$ of the tibia (A).

FIG. 5.



Syphilitic Dactylitis. Thickening of corticalis. Absorption of the head of the metacarpus.

FIG. 6.



Ulna is bowed (Fournier). The corticalis thickened encroaches on medulla. The periosteum thickened is lifted up from the underlying bone by a gummatous deposit. The corticalis of radius is thickened at its center.

Syphilis involving the joints is secondary to extension from the epiphyses; and the greater participation of certain joints, particularly the elbow joint, in the process, has been attributed to the fact that the juxta-epiphyseal line of cartilage is intra-articular, whereas in other bones much of the epiphysis and diaphysis is extra-articular. There is, however, a pure synovial type of syphilis, which can only be diagnosed by exclusion, and gummatous deposits may be situated in the capsule and the bursa about these joints.

As far as the X-ray examination is concerned we note an identity in the bone findings of congenital and acquired syphilis which is not encountered in other bone lesions.

Caries sicca and craniotabes of rare occurrence have been omitted, for the authorities differ as to their common cause. Virchow claims caries sicca to be syphilitic; Koenig assigns tuberculosis as the cause. Parrot and Taylor regard craniotabes as syphilitic. Future X-ray examinations will no doubt offer a solution of this problem.

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THE CORRECTION OF CERTAIN FORMS OF
" SADDLE-NOSE."*

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EACH race of people accepts a particular type of features as the normal, and marked variations from this are sure to attract undesirable attention, especially when they concern the nose. Among Caucasians one of the most objectionable deformities is the so-called " saddle-nose," which may be due to disease, to injury, or to lack of development.

Many methods have been devised for the correction of saddle-nose, some of them consisting in the sliding of bone-flaps from the forehead, others in the subcutaneous insertion of metal or celluloid plates, and still others in the injection of paraffin.

The use of bone-flaps should be reserved for bad cases, arising from injury or disease, in which there is great deformity and much cicatricial contraction; but the results are usually unsatisfactory owing to operative limitations and to the formation of unsightly scars. In comparatively mild cases, and in those where the skin is loose and can be stretched, it is better to insert plates or to inject paraffin.

So much attention has been directed to the use of paraffin, since its introduction by Gersuny in 1900, that the employment of metal supports has been relatively neglected; but, after trying both methods, I am convinced of the superiority of the latter in certain cases, providing they are properly inserted.

Cold paraffin may be injected in a semi-solid form, like firm vaseline, and this often answers the purpose admirably, when the skin is loose and the deformity not great. Another method is to employ more solid paraffin, with a high melting point, which is injected in the fluid state, while hot, and which

* Read before the Denver City and County Medical Society.

undergoes subsequent solidification. In either procedure, however, it is difficult to control the distribution of the material in the subcutaneous tissues, especially if tension exist. In spite of the utmost care, the paraffin will find its way down the sides of the nose or up onto the forehead, where its presence is not desired. There is also the risk of embolism, which although small, is always present, particularly when fluid paraffin is used, a number of cases of blindness from this source having been reported. In addition, sloughing of the skin has occurred from the employment of hot material under pressure. Fluid paraffin is also difficult to manage, owing to its tendency to solidify in the injecting-needle.

By the proper use of metal or celluloid plates these dangers and difficulties may be avoided. They are indicated in cases in which the deformity is so great that in order to correct it paraffin would have to be injected under considerable pressure, and yet not so great as to prevent sufficient stretching of the skin to permit the insertion of a plate. Very bad cases, in which the skin is bound down by scar tissue, must be treated by plastic operations, if it is thought best to do anything with them at all.

The plate may be made of celluloid, silver, or gold, celluloid being perhaps preferable. Its length should be carefully determined, so that its upper end will rest upon the bone above, while its lower end is supported by the firm tissues of the extremity of the nose. The corners and edges should be well rounded and not too sharp, and it should be perforated with as many small holes as possible without weakening it too much, in order to permit of easy and thorough incorporation within the tissues. It must be curved slightly from side to side and wide enough to properly round out the bridge of the nose. It must not be unnecessarily thick, but it must be heavy enough to keep its shape under all ordinary conditions.

Plates for the correction of saddle-nose were formerly inserted in one of two ways, either through a horizontal incision along the bridge of the nose, or through an incision in the septum below the tip, the skin being undermined with scissors

as far as necessary (Monks). There are objections, however, to both of these methods, although many good results have been obtained. The incision along the bridge is the least desirable, and should be discarded, because it leaves a conspicuous scar and does not provide for stretching of the skin when necessary, which may cause gaping of the wound and sloughing out of the plate, as happened in a case coming under my observation.

The incision at the tip of the nose, although better than that along the bridge, does not fulfill the conditions as it should. It is rather difficult, for instance, to tunnel through the tough tissues at this point, there is considerable likelihood of perforating the nasal cavity, and the danger of infection from the nostrils is not to be wholly disregarded. There is likewise difficulty in stretching the skin.

Recently I have devised a method of operating which seems to overcome these objections. A short incision is made across the root of the nose, between the eyes (Fig. 1). Through this the skin is undermined along the bridge to the tip, and also well down the sides if the skin require much stretching. This is easily accomplished, almost bloodlessly, by inserting a pair of blunt scissors, curved on the flat, and opening and closing the blades as they are pushed forwards.

If the "saddle" is pronounced, the skin can be stretched by inserting under it the point of an ordinary blunt, curved sound, with the convexity resting upon the forehead in order to obtain leverage (Fig. 2). After the pocket beneath the skin has been prepared it will be found that the concavity of the nose will necessitate the insertion of the plate at such an angle that its end will catch in the tissues, thus preventing it from sliding into position. In order to obviate this, the tip of the nose should be perforated with the point of a large darning-needle. The needle should then be reversed and its blunt end pushed upwards subcutaneously until it passes out through the incision (Fig. 3). On top of this needle, as a guide, the plate may easily be slid into place (Fig. 4).

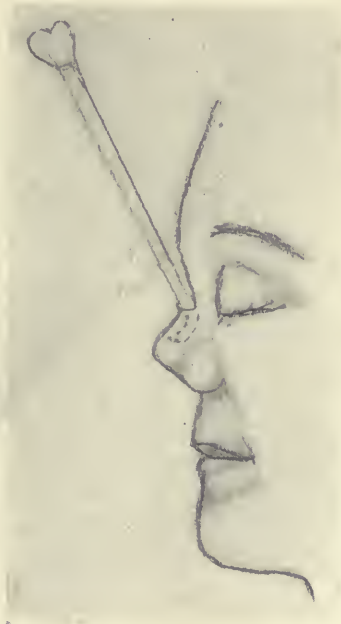
The wound is then closed with a subcuticular suture, or a

FIG. 1.



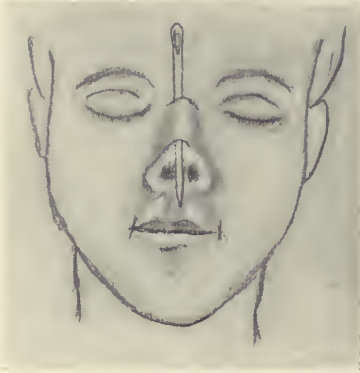
Showing site of incision at root of nose.

FIG. 2.



Stretching and elevating skin over the depression.

FIG. 3.



Needle inserted for guide.

FIG. 4.



Plate being slid into place.

little cotton and collodion. There is no tendency to gaping. The insignificant scar resembles a natural crease in the skin, and is scarcely if at all noticeable.

I have operated once in this way, and can testify to the comparative ease of the procedure and to its superiority over the method by horizontal incision, which I have also used. The case was one of marked saddle-nose resulting from specific disease, in which the deformity was too great to be overcome by the injection of paraffin. The operation was done as outlined above, the skin being stretched by means of a sound. Primary union occurred, and the result remained satisfactory for about eight months; but the corners and edges of the plate being rough and sharp, it finally perforated the nasal cavity and had to be removed. This was the fault, however, of the plate and not the method, and could readily be avoided in the future.

INTUSSUSCEPTION.*

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THIS paper deals with the consideration of cases of intussusception during the first twenty-four hours after the onset of the disease. In order to collect a sufficiently large number of cases from which to draw fairly definite conclusions, Dr. Daniel Lewis, editor of the *Medical Review of Reviews*, has at my request had a search made through the files of that journal of cases reported during the last five years. The list of 203 cases furnished me by Dr. F. Robbins, to whom my thanks are due, with 96 cases by Clubbe in a brochure kindly loaned me by my friend Dr. Charles T. Poore, and two of my own cases not hitherto reported, make a total of 301 cases. Of these, 194 were males and 92 females. In the other cases the sex is not given. Males are therefore about twice as liable as females to this disease; and these figures confirm what has many times been stated with reference to the relative frequency of intussusception in the sexes.

Evidence furnished by the material at my disposal has a somewhat important bearing on the etiology and diagnosis of intussusception, but especially on its prognosis and treatment.

The conditions that favor the development of intussusception are evident enough; but the exciting cause still remains obscure. The age, the relatively long mesentery, the presence of the ileocaecal valve at the termination of the small intestine and the larger lumen of the caecum and the colon beyond, the circular disposition of the muscular fibres, are all favorable anatomical conditions for an intussusception; and the physiological action of the intestinal tract with its sometimes irregular muscular contractions add to the risk of the development of the disease; for in the normal action of the intestinal muscles

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the subject is all the time on the border of an intussusception. These conditions, however, never of themselves produce trouble. The immediate cause must be sought elsewhere. I think the study of statistics and experience in the treatment of intussusception will impress one with the important part that the contents of the intestines play in the immediate causation of the disease. Once started the condition is easily explained; but the generally accepted etiology seems to lack a starting point. Treves says, "There is practically unanswerable evidence to show that intussusception is brought about by irregular action in the muscular wall of the intestine." This is undoubtedly true, but it leaves us ignorant of the cause of the irregular action of the muscle. Nothnagel says, "If I understand this matter correctly, true sequence of events is the following: While the bowel is performing normal peristaltic movements an annular and strictly local constriction of the bowel happens to occur. This constriction may be greater than normal and so pronounced that the limit of physiologic invagination is exceeded and the first degree of pathologic intussusception develops, exactly in the same manner as it has been seen to do in our experiments. It is quite unnecessary to invoke any primary causative factor; what is needed is a simple increase in the intensity of the normal movement of the bowel, which of itself is sufficient to produce this dangerous condition. On this basis, too, the great predominance of invagination of the bowel in early childhood can be satisfactorily explained, for it is usually admitted that at this age the bowel is more irritable and more mobile than in later life. The proof of this assumption is that the so-called agonic form of invagination is most frequently found in the bodies of children."

This explanation would seem to be inadequate to account for the very beginning of an invagination. The irregular muscular contraction does not "happen to occur," but must be due to some temporary cause differing from the constantly present conditions that favor the development but never by themselves cause invagination. It seems reasonable, as noted above, that the starting point may be found in the presence

of material inside of the gut, which by its bulk or by chemical irritation excites the spasm or irregular muscular contraction which is essential in any form of intussusception. The spasm by itself is not sufficient to cause the invagination. In the diarrhœal diseases of children there is pain, irregular muscular contraction, spasm, increased peristalsis, increased irritability and irritation, but invagination occurs so seldom that it may very well be doubted whether the invagination has been due to these causes alone. If there is added to these conditions a mechanical obstruction furnished by the contents of the intestine, the invagination is not difficult to explain. And, recognizing the existence of reversed peristalsis, which may be present in any form of acute obstruction of the intestine, it is not more difficult to account for the rare cases of retrograde invagination than for the direct form. If we examine the varieties of intussusception the evidence in support of the idea that mechanical obstruction is the primary cause of invagination is strengthened; for in by far the largest number of cases the lesion is found at or near the ileocæcal valve; a few occur in the large intestine, still fewer in the small intestine and 8 out of 14 cases reported in the small intestine had a diverticulum at the lower end of the intussusception. These diverticula located in the lower part of the ileum, where the bowel contents are acquiring a less fluid character, furnish a ready starting point for an invagination. The list below gives the location of invagination in my cases where it is definitely stated:

Ileocæcal	140	Cæcum-ascending and transverse	
Ileocolic	31	colic	1
Enteric-ileocæcal	13	Meckel's diverticulum	1
Ileocolic-ileocæcal	4	Diverticulo-enteric	1
Diverticulo-ileac	4	Retrograde-enteric	1
Colic	6	Diverticulo-ileo-ileocolic	1
Cæcal	2	Ileocolic and iliac	1
Cocolic	3	Double	19
Ileo-appendix	1	Double iliac	1
Transverse colic	1	Iliac	2
Diverticulum	1	Enteric	3

In all 237 cases. Fourteen in the small intestine, 17 in large intestine, and the rest, 206, combined. A consideration of the

above figures and the conditions that are anatomically and physiologically present in intussusception makes it at least reasonable to think that a mechanical cause, as above suggested, was the starting point in invagination. The so-called agonic forms of this disease which are found in the lower intestine, small in size, not infrequently multiple, and sometimes retrograde, producing no symptoms, are more probably due to centric causes, and seem entirely different from the cases considered in this paper.

In this connection I desire to present two patients who have recovered from intussusception, together with a brief history of each case.

CASE I.—Male, nine years of age, sent into hospital by Dr. C. J. Noonan, May 23, 1906, with the history of having been seized with sudden violent pain on the street twenty-two hours before he entered the hospital. There had been some nausea, but no vomiting; frequent desire to stool, but no passage of blood or mucus, temperature normal, from the beginning; pulse normal first twelve hours, about 110 in hospital; no shock at any time, slight distention; a tumor, first recognized after twelve hours, between gall-bladder and umbilicus, about six inches in length, tender on slightest pressure. The boy had had three injections without effect, except a slight streak of blood after one of them.

Immediate laparotomy under ether and delivery of tumor. It was interesting to observe after partial reduction and letting up on traction the intussusciens sliding up over the intussusceptum instead of the intussusceptum gliding downwards into the intussusciens. The upper end of the sheath was slit-like from traction by mesentery and not round. There was no spasm, indeed, by very slight pressure the finger could be easily inserted for a distance of two inches between the sheath and the intussusceptum. Traction had little effect in reduction. The mass, with the exception of the last inch or two, was easily reduced by combining traction with pressure and by utilizing the intestinal gas below the mass and employing the process that the farmer uses in milking, but in reverse direction, flexing the little finger strongly, and then the ring, middle and first finger successively; in this way sufficient pressure was made on the gas locked up between the

fingers and the intussusceptum to distend the sheath and also press out some gas and blood from the intussusceptum and to render the reduction easy. The lower end shot out by a little added pressure and revealed a much swollen diverticulum. Fourteen inches of gut were gangrenous—the lower end of demarcation very distinct, the upper line rather ill-defined. The mesentery was twisted on itself and was untwisted in the reduction. The whole mass was excised; end-to-end anastomosis with continuous glover's suture through all the coats, using No. 2 plain catgut, secondary continuous Lembert suture in peritoneal coat with No. 1 plain catgut, suture of mesentery, layer sutures for abdominal wall; rectal feeding three days; normal bowel action third day without drugs, moderate febrile reaction for four days. Satisfactory recovery and the boy remains well after seven months.

CASE II.—Female, seven months old, seized with pain suddenly at twelve midnight, vomiting immediate, blood and mucous stool within an hour. Seen by Dr. F. C. Paffard about three P.M.; temperature $99\frac{1}{2}$; pulse 140; tumor in left iliac fossa; no shock, no tympanites; only on deep pressure over tremor was there tenderness; child looked well; laparotomy under ether seventeen hours after onset of symptoms; ileocaecal variety; felt in rectum, reduction easy except last three inches; slight dimple left in caput coli; layer sutures; vomited for twenty-four hours, but nursed also, bowels moved by enæma third day; temperature was about 100, subsequent recovery smooth.

Both of these cases furnish the ordinary symptomatology of intussusception, and illustrate both what we may and may not be expected to find as a basis for our diagnosis.

Osler says, "Intussusception is an affection of childhood and is of all forms of internal obstruction the one most readily diagnosed. The presence of tumor, bloody stools and tenesmus are the important factors. The tumor is usually sausage-shaped and felt in the region of the transverse colon. It existed in 66 of 93 cases. It was present on the first day in more than one-third of the cases, on the second day in more than one-fourth, and on the third day in more than one-fifth. Blood in the stools occurs in at least three-fifths of the cases, either

spontaneously or following the use of an enæma. The blood may be mixed with mucus. Tenesmus is present in one-third of the cases. Fæcal vomiting is not very common and was present in only 12 of the 93 instances. Abdominal tympany is a symptom of slight importance, occurring in only one-third of the cases."

An examination of the details of cases so far as they are given by the different reporters will justify the following statements: The disease occurs among previously healthy children in a large majority of cases, and any previous illness in the small minority has little or nothing to do with the causation of the invagination. The attack is sudden, characterized by severe paroxysms of pain and pallor. It is noticeable how seldom shock is mentioned as a symptom in the reported cases. The statement is emphasized that most of the patients after the pain ceases look well. Clubbe says, "the child may not look ill, its pulse rate may be hardly varied and its temperature may be normal." It is to be noted that he is speaking of cases seen in the first few hours. So-called shock symptoms develop later and are symptoms rather of collapse or sepsis than shock. Tympany is not a prominent symptom except late, when inflammatory symptoms occur. I should think the tumor, if the examination is properly made, would be found in more than 66 of 93 cases. Clubbe states that in his cases (124) "as a mass is invariably present in cases of intussusception, it should be possible to make it out if we examine carefully. I can only remember two cases in which I opened the abdomen without first feeling the mass. In these cases there was much distention, but the history and the symptoms were characteristic." In doubtful cases a general anæsthetic ought always to be used and bimanual palpation employed, remembering how the mass may slip away and reappear, or be hidden about the hepatic or sigmoid flexure of the colon, and that it may not always be sausage-shaped. We must not expect rectal examination to throw much light on these early examinations, nor in the less frequent cases where the small intestine is the seat of the disease. The bloody stools

with mucus and tenesmus are present in 97 per cent. of Clubbe's cases within from two to ten hours. The tumor can be recognized as early as three hours after onset of symptoms. Judging from the agonic forms of invagination that occur just before death it is certain we should not be able to feel the tumor in a living subject immediately after the first paroxysm of pain; but in one case it was felt at the end of two hours. Intestinal or fæcal vomiting has been noted in comparatively few cases and in those as a later symptom. In almost all cases we shall rely for diagnosis on the sudden attack of severe abdominal pain, blood and mucous stools, tenesmus and tumor. Where rectal symptoms are absent and the others present, I should feel that the disease was in the small intestine as the discharges come directly from the mucous membrane of the colon, and in the enteric form must be present as a later symptom.

The prognosis of intussusception and the effect of prompt and late resort to operative measures is well shown in the following table by Weiss:

321 CASES FROM 134 PUBLICATIONS.

	New born infants.	Children up to puberty.	Adults.
Conservative treatment	16%	22%	26%
Immediate laparotomy	61%	90%	85%
Late laparotomy	54%	50%	50%

In regard to the treatment of intussusception, all the reports with no exception emphasize the necessity of early treatment. One reports success in a large percentage of cases by taxis; some are in favor of injections, inflation or manipulation, separately or combined, as a first resort, and laparotomy in those cases in which these measures fail. The rest are in favor of immediate laparotomy. The favorable results from taxis are shown by the following report of the experience of Hirschsprung: "The author reports 107 personal observations on intussusception in children, varying in age from seven weeks to seven years (77 boys and 30 girls). Of these 107 patients, 65, 60, 75 per cent. recovered. Laparotomy was

rarely required, since taxis, under general anæsthesia usually led to a cure. It was rendered very evident that the prospects of recovery improve with the prompt institution of the treatment after the onset of symptoms. The duration of the disease before hospital treatment could be ascertained in 84 of these cases, and may be divided into three groups:

1. Admission twelve hours after onset of disease. 15 children. Died, 1 child. Percentage of deaths, 6.07.

2. Admission between twelve and twenty-four hours after onset. 28 children. Died, 10 children. Percentage of deaths, 35.7.

3. Cases over twenty-four hours old. 41 children. Died, 22 children. Percentage of deaths, 53.66.

Of the forty-four children under one year of age (25 boys, 19 girls), 70 per cent. recovered if the disease had lasted less than twenty-four hours; if longer, only 30 per cent. recovered. The duration of the disease increases in importance with the youth of the child."

In regard to the use of taxis, injection, inflation or inversion there may be two very important objections urged:

First, That the condition of the intestine can never be known. It is true the probability of gangrene in cases treated early is less than when treated late, but this is by no means always true, for in the cases tabulated below the gut was found gangrenous in eight fatal cases when the operations had been performed within twelve hours from the onset of symptoms, one as early as three and one-half hours, two in six hours, one in ten hours, one in eleven hours, and three in twelve hours, and one in a "few hours;" and besides, as in my own reported case there may be no systemic symptoms to indicate the presence of gangrene.

Second, There is a doubt after using any of these measures as to its success. We can never be sure, except by waiting, and so possibly losing valuable time, whether the invagination has been entirely reduced; for vomiting may continue after reduction and the bowels fail to act for a day or two, fever be present and some tenderness. On the other hand, it is

recognized that there is some danger in exposure of the intestine to the atmosphere and even more in the direct handling of it, in reduction; but it may be that these dangers have been over stated, and that they may be attributed, in some cases at least, to our over zealous efforts by drugs and enemata high and low and too long abstinence from food before operation, to too prolonged efforts to disinfect the intestine which may after all be only germ infested and not germ infected. The advantages, however, of direct manipulation of the gut through an abdominal wound, and being able to see what is being done, so far outweigh the dangers that it would probably be better in all cases to omit the employment of all other means and do an immediate operation. In doubtful cases a general anæsthetic will aid in a diagnosis, and we should give the patient the benefit of the doubt by operating at once rather than wait for future symptoms to develop.

In those cases where means other than operation were employed, water injection has failed in about 12 cases, in one of which the seat of the invagination was in the small intestine; water injection was successful in 5 cases, in one of which laparotomy demonstrated the success of the enæma.

In one case water had been used with apparent success, but was found to have failed by the laparotomy. Massage and inflation used in one case failed. Inflation failed in one case. In one case the invagination was shown by the laparotomy to have reduced itself.

The influence of age and the time of operation after onset of symptoms is well shown in the following table.

Figures, as far as they can be depended on, would therefore prove that age exerts a very material influence in the prognosis of intussusception, that the mortality on account of age alone is practically twice as great during the first six months of life as after eighteen months. When the element of time is made the basis of prognosis the greatest encouragement is offered.

Wiggin, quoted by Warren, says, "Counting only the operations that have been performed since the perfected technic

of abdominal surgery has become generally known—since 1889—and throwing out those cases in which the operation was not

Age	Number of cases.	Recovered.	Deaths	Interval in hours in fatal cases from onset of symptoms to operation.
2½ months	1	1	0	
2¾ months	1	1	0	
3 months	11	7	4	18, 24, 24, 24.
4 months	27	18	9	24, 24, 24, 24, 24, 30, 22, 16, 19.
16 weeks	11	1	0	
5 months	41	29	12	25, 19, 17, 18, 21, 12, 24, 6, 24, 12, 24, 24.
6 months	43	32	11	6, 28, 18, 11, 20, 24, 12, 24, 16, 16, 8.
7 months	32	27	5	20, 24, 25½, 12, 22.
8 months	21	17	4	26½, 24, 24, 6.
9 months	25	16	9	72, 17, 3½, 15, 24, 24, 12, 24, 18.
10 months	14	12	2	24, 10.
11 months	6	5	1	24.
12 months	6	4	2	18, 24.
13 months	3	3	0	
14 months	1	0	1	48.
15 months	3	3	0	
16 months	1	1	0	
18 months	3	2	1	12.
20 months	1	0	1	39.
21 months	1	1	0	
22 months	3	3	0	
24 months	1	1	0	
26 months	1	1	0	
27 months	4	3	1	24.
30 months	1	1	0	
32 months	1	1	0	
3 years	3	2	1	15.
3½ years	2	2	0	
4 years	2	2	0	
4¼ years	2	2	0	
4½ years	2	2	0	
5 years	1	1	0	
8 years	1	1	0	
9 years	2	1	1	12.
10 years	1	0	1	24.
12 years	1	1	0	
32 years	1	1	0	
Total,	271	215	66	24.35

	Recovered.	Died.	Death rate.	
Number during first six months	125	89	56	28.8
Number during second six months,	104	81	23	22.11
Number during third six months	11	9	2	18.18
Number after third six months	31	26	5	14.82

completed, we have a total of 18 cases of which 14 were successful and 4 unsuccessful, giving a mortality of only 32.2 per

cent. This, Wiggin believes, to be a fair estimate of the risk to-day of laparotomy performed on a young infant for the relief of this disorder, if done within the first forty-eight hours of the onset. This gives a chance of success represented by 78 per cent., which, according to this author, would speedily rise to 90 per cent., as the cases come more frequently to operation during the first twenty-four hours.

To what extent this prediction has been fulfilled is shown in the following table made up of the number of cases, recoveries and deaths, by time of operation after onset of symptoms.

It will be noticed from the figures given what a comparatively low mortality will follow operation during the first twelve hours.

The causes of death, when mentioned, were: shock 7, peritonitis 7, collapse 4, cyanotic pneumonia 1, second invagination at post mortem 1, tubercular mesentric glands 1, gangrene 3, marasmus 1, fæcal fistula and pneumonia 1, asthenia 1, hyperpyrexia 1. Twenty cases were subjected to reduction with apparently only two recoveries. Lateral anastomosis was done in one fatal case; death followed in one case of failure of reduction; no definite relation appears to exist between the special variety of intussusception and recovery or death.

The history of cases where gangrene has occurred has up to the present time furnished little encouragement to surgeons; and the experience of writers above recorded corresponds to the general experience of surgeons. The cases almost always have a fatal termination. Only 2 out of 20 cases reported recovered. It is to be noticed that in those 2 cases that the sutures used were a primary continuous through and through suture and a Lembert's continuous suture in peritoneal coat.

The mortality in these cases corresponds closely to the mortality given in Eliot's paper on Acute Intussusception in Young Children. My own successful cases reported above would lead me to think that a primary Glover's suture and a secondary Lembert's peritoneal suture is preferable to any other, and that the section of the gut must be made well beyond

the gangrenous mass, in healthy tissue, and that the mesentery should be interfered with as little as possible, not cutting into it deeply toward its root, thus leaving the sutured intestine as well nourished as possible.

It is interesting to notice how much advancement has been made in the treatment of intussusception in common with

Time.	Number of cases.	Recoveries.	Deaths.
One and one-half hours.....	1	1	0
Two ".....	1	1	0
Three and one-half ".....	1	0	1
Four ".....	3	3	0
Five ".....	2	2	0
Six ".....	13	10	3
Seven ".....	11	11	0
Eight ".....	12	11	1
Nine ".....	6	6	0
Ten ".....	11	10	1
Eleven ".....	3	2	1
Twelve ".....	25	19	6
Thirteen ".....	1	1	0
Fourteen ".....	2	2	0
Fifteen ".....	2	0	2
Sixteen ".....	6	3	3
Seventeen ".....	4	2	2
Eighteen ".....	15	10	5
Nineteen ".....	2	0	2
Twenty ".....	11	9	2
Twenty-one ".....	2	1	1
Twenty-two ".....	6	4	2
Twenty-three ".....	3	3	0
Twenty-four ".....	54	29	25
Twenty-five ".....	3	1	2
Twenty-six ".....	3	2	1
Twenty-eight ".....	1	0	1
Thirty ".....	1	0	1
After thirty ".....	4	0	4
Short time.....	4	4	0
Few hours.....	2	2	0
Some hours.....	2	2	0
Hirschsprung, twelve hours or under.....	15	14	1
Hirschsprung, twelve to twenty-four hours.....	28	18	10
Hirschsprung, over twenty-four hours.....	41	19	22
Total,	301	202	99

Recovered. Died. Death rate.

Cases reported in first twelve hours..	112	98	14	12.50
Cases reported in second twelve hours,	136	82	54	39.70
Cases reported after twenty-four hours,	53	22	31	68.90

Total, 301...202...99...32.22

most other abdominal diseases. Bouchut says in 1855, "the diagnosis of intussusception is uncertain and treatment powerless." Tanner, sixteen years later (1871), after speaking of the treatment of taxis says, "supposing these means fail, without absolutely recommending such a procedure, an exploratory incision into the abdomen would appear to be perfectly justifiable in an apparently hopeless case." Even as late as 1881, Ashhurst's statistics gave little encouragement to operate, for he says, "past experience gives no encouragement to operative interference in cases of intussusception in infants less than one year old."

The advance made in the treatment of acute intussusception has been made mostly within the past fifteen years. In 1892, "Keith Monsarrat, by grouping together cases from tables provided by Gibson, Wiggin, Barker, Pitts, Eves, and D'Arcy Power, obtained a total of 374 cases that had been operated upon; 181 were cured and 193 died, showing a mortality of 51.7 per cent." (Clubbe). Since that time the mortality has been practically reduced to the present very encouraging figures.

From the foregoing facts one may gather some bedside suggestions that bear directly on the treatment of acute intussusception. Intussusception is another name for internal strangulated hernia. The symptoms, except the tumor, are in almost all cases evident and striking even to the layman; and the diagnosis is therefore comparatively easy to the medical observer. Where the tumor is not easily felt, we fail in our whole duty to the patient if we do not employ a general anæsthetic for diagnosis instead of waiting to recognize the tumor later without it. Treatment ought to be surgical and practised not only within the first twenty-four hours but within the first twelve hours, like the treatment of any other form of strangulated hernia, remembering that in those cases where gangrene occurs the process may be more rapid than other forms of hernia. Laparotomy and manual reduction offer the patient the best chance of recovery. Mechanical agents in reduction short of direct manipulation—such as air, gas, water,

oil, etc., while they are free from the danger of atmospheric exposure and handling of the gut, are objectionable for the reason that we do not know, without laparotomy, the condition of the intestine to be reduced, nor whether, except by waiting, it has been reduced. While young infants operated on for the relief of invagination show a relatively high mortality with very early operative interference we may expect a low mortality—at present 12.5 per cent.

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OPERATION IN TWO STAGES FOR RELIEF OF ILEUS OF JEJUNUM.

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THIS case is reported, first, because it illustrates the difficulty of determining, even at operation, the exact cause of obstruction; and second, because it demonstrates the wisdom of immediate drainage of the bowel with secondary resection in critical cases of acute ileus in which the integrity of the intestine is questionable.

History.—November 11, 1906, R. E., 28 years old, mechanic, was suddenly seized with severe pain in the bowels after eating heartily. A cathartic relieved him, but the following night, pain returned and was very severe. It subsided toward morning, however, but a "dull, constant pain" remained, general at first throughout the whole abdomen, but later localized to a point just to the left and above the umbilicus. The bowels could not be again moved by cathartics or enemas. Great rigidity existed, but no tympany. No tumor mass could be felt. The abdomen in fact was rather scaphoid.

This condition existed for 24 hours, when he began to vomit contents of stomach and bowel, and later the vomitus contained bright red blood and many clots. This soon changed to "coffee ground" vomit with much mucus and occasional clots. Hiccough developed. Temperature 97°, pulse 112, and slightly irregular. The rigidity and local tenderness increased, the point of greatest tenderness being three inches above and just to the left of the umbilicus. Enemas contained mucus and blood clots, but almost no fecal matter. By the time he reached the hospital, his temperature was 96° and pulse 128. The vomiting and hiccough was continuous, and by the following morning, his temperature was 102°, pulse 140, face anxious, and abdomen slightly tympanic.

First Operation (Fæcal Fistula).—Ether, Dr. Child and Dr.

Chambers assisting. The abdomen was opened in median line. The intestines were much congested and somewhat distended with gas. They were systematically examined, the gut being replaced as rapidly as it was gone over. The large bowel was normal. In pulling up the jejunum near the duodenum, the intestine was brought into the wound with difficulty, and a retractor was moved, thinking that it might have caught or compressed the bowel. An inspection showed this was not the case, but as the gut was brought into the wound, an area about 10 to 12 inches long was encountered about 3 feet from the duodenum, that was almost black, greatly congested and covered in places with flakes of lymph. There were a number of petechial hæmorrhages throughout this area. The streaks of lymph were arranged in parallels at right angles to the bowel, (as if an intussusception had been unfolded), and the mesenteric vessels were in places thrombosed. The color of the gut partially improved upon exposure, but so bad did it remain, that it was brought down into the left iliac fossa and anchored there to form a fæcal fistula as soon as adhesions should form to protect the peritoneal cavity.

The patient reacted fairly well from the operation. Twenty-four hours later, however, he became very restless. His temperature rose to 102°; pulse 136; abdomen tympanitic; and all the signs of an extending peritonitis. The bowel was consequently immediately opened. Great quantities of blood and grumous material were discharged with the liquid fæcal matter. His symptoms almost at once subsided and his improvement was rapid. However, by the seventh day, it was noticed that the patient was rapidly losing in weight. The abdomen was greatly irritated by the acrid discharges from the wound, and his discomfort was great. So high up had the bowel been opened, that food taken by the mouth, was often found only partially digested in the wound a short time after eating.

Second Operation (Closure of Fistula with Resection of Bowel).—Ether was again given; the fistula temporarily closed by a running stitch, and the abdomen cleansed as thoroughly as its excoriating condition would warrant. Dense adhesions were encountered on opening the abdomen. In fact, the whole mass of intestines were matted together so firmly, that great difficulty was encountered in freeing the bowel at all, and in doing so, the

jejunum was so torn, that 5 inches of the gut were resected; the ends being brought together end to end with Lembert-Czerny sutures. A small gauze drain was inserted in the wound and the abdomen partially closed.

Recovery was uneventful, except for a slight leakage at the line of suture. This opening soon closed, and the patient went on to an uninterrupted recovery.

Owing to the extremely critical condition of this patient, the exact cause of the obstruction could not be absolutely demonstrated at operation. The weight of evidence, however, tends to support the opinion, that an intussusception existed, that was unfolded in the process of bringing the small gut into the wound and immediately replacing it. The parallel layers of lymph, the petechial hæmorrhages, and the thrombosed mesenteric vessels also support this contention. The congested area of gut, it is true, lay deep in the abdominal cavity, suggesting a retroperitoneal hernia, but this condition also exists frequently in intussusception, owing to the infolding of the lumen of the bowel on itself, and the consequent shortening of the mesentery. The history of the case, and demonstration of so much blood in the vomitus and in the washings from the bowel, also seem more consistent with intussusception than hernia or strangulation. Volvulus did not exist. There were no peritoneal bands nor rents in the omentum or mesentery. A hernia into the foramen of Winslow is extremely rare, and is said to exist only in those cases with an abnormal mesentery or an unusually large foramen; neither of these conditions existed in this case.

There was no co-existing heart-disease, nor evidence of acute embolism. Some of the mesenteric vessels immediately along the bowel were thrombosed, but this process seemed to be the result of some mechanical obstruction from without, rather than to disease or an occluding process within the lumen of the vessels. It is interesting to note, however, that the symptoms of mesenteric embolism, as given by McArthur in his careful study of this condition (*ANNALS OF SURGERY*, vol. 33, no. 4), almost exactly corresponded to those manifest in this case:

1. Blood in washings from the bowels, in the bowel movements, or in vomitus, unaccompanied by tumor of intussusception; 2. Colicky pains associated with pain in back and lumbar region; 3. Early collapse if the embolism has been sudden or extensive; 4. Cardiac disturbance, arhythmia, and great frequency of the pulse, albuminuria.

A diagnosis from intussusception or retroperitoneal hernia on these symptoms alone would, however, be impossible in many cases in which the presence of a tumor mass was absent. In my own case a small hernia into a retroperitoneal fossa could not be absolutely excluded. Moynihan gives the five most common varieties as: 1. Superior duodenal, 2. Inferior duodenal (Treitz), 3. Para-duodenal, 4. Mesenterica parietal (Waldeyer), 5. Meso-colic fossa.

A brief description of these fossæ is essential, owing to the confusion of terms.

1. *Superior Duodenal Fossa*.—Present 40 to 50 per cent. of the cases, alone or with infra-duodenal; lies to left of ascending portion of duodenum; looks downward. Apex extends up toward body of pancreas. Inferior mesenteric vein lies generally in superior duodenal fold. (Jonnesco.)

2. *Inferior Duodenal Fossa*.—Most frequent; 70 to 75 per cent.; more or less well defined; left side of ascending portion of duodenum; looks upward. Fundus inclines downward and to the right to root of mesentery. Superior and inferior at times blend and make oval opening.

3. *Para-Duodenal Fossa*.—Lies to left and some distance from ascending portion of duodenum; caused by raising a fold from inferior mesenteric vein; a mesentery to the vein; looks downward with wide orifice.

4. *Mesenterica Parietal Fossa*.—Generally formed by the meso-jejunum immediately behind the superior mesenteric artery and just below the duodenum.

5. *Meso-Colic Fossa*.—Formed by a fold containing the ascending branch of the left colic artery; extends to the left between layers of transverse mesocolon—uncommon.

A small hernia into any one of these fossæ could very well

have existed in this case, and been unconsciously relieved by the process of "going over the intestines." The extremely critical condition of the patient precluded a protracted search for a cause that had been already relieved.

The question of the proper management of these critical cases of intestinal obstruction is one of the most difficult in surgery. The temptation to immediate resection is always great, but the results are frequently disappointing. This applies particularly to resection for acute obstruction, associated with gangrene or thrombosis. In the best hands, the mortality for immediate enterectomy is 50 per cent., and in some clinics runs as high even as 85 per cent. Septic peritonitis is the cause of death. This is the result of the lowered resistance of the peritoneum, and also is due to the fact that gangrene once started often extends beyond the line of sutures. Sutures also placed in congested swollen tissue (as not infrequently they are) become loose and leak when the inflammation or induration rapidly subsides.

The emptying of the bowel by a fæcal fistula does more than simply relieve the obstruction; it immediately relieves the acute congestion, and unquestionably checks a fulminating or spreading peritonitis. Probably the best method to follow in these cases of early gangrene is that of von Mickelitz, by which he anchors the questionable loops of gut parallel in wound, the gangrenous portion being outside the abdominal cavity. Thus, after the diseased area is removed, the continuity of the gut may be re-established by the simple application of a clamp, each blade of which enters the afferent and efferent bowel. Pressure necrosis causes union after the manner of the Murphy button. In my own case, an effort was made to close the fæcal fistula in this manner, but the forceps, when applied, caused so much pain and shock that they had to be immediately removed.

The use of Paul's tubes would probably have prevented in some measure the great excoriation of the skin, had they been available. Hockenegg's method of inserting a glass tube into the afferent end of the bowel, and the closure of the fistula after

12 days, I can hardly see, would have been any improvement on a simple fistula and the procedure followed in my own case.

Acute gangrenous ileus from whatever cause is always one of the gravest conditions that the abdominal surgeon has to encounter. Treated by whatever method, the mortality will always be high. Immediate resection is the ideal procedure, theoretically, but its failure in so large a percentage of cases practically precludes its application in all but the most favorable conditions.

The establishment of a fæcal fistula can be done with the minimum of risk, and after the acute symptoms have subsided, the closure of the fistula can be accomplished with very little, if any, additional danger.

In cases of gangrene from thrombosis, the only recorded cases of recovery have thus been (with one exception) treated by resection in two sittings. (Elliott, *ANNALS OF SURGERY*, vol. xlii, no. 5.)

My own case, herein reported, it is true, is incomplete in the fact that the exact case of ileus and thrombosis was not incontrovertibly demonstrated. Its rapidly developing gangrene, however, places it among the critical cases of intestinal obstruction, that are best treated by operation in two stages, and it is offered as additional evidence of the wisdom of this method of procedure.

AN ENORMOUS CYST OF THE URACHUS.

EXTIRPATION AND RECOVERY.

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THE following case is reported on account of some unusual features, and because it should be added to the list reviewed by Dr. W. R. Weiser, in a most interesting and instructive article published in the ANNALS OF SURGERY for October, 1906.

Miss —, æt. forty. History of slowly growing abdominal tumor, beginning in the region of the bladder and growing upward, with gradual onset of pressure symptoms, especially difficult respiration, pain and impaired digestion. The abdomen was enormously distended, but not tender, nor did it bulge much in the flanks. It was rather firm, and was flat on percussion from the pubis to the ensiform cartilage. Its appearance is well shown in Figure 1.

Operation, October 6, 1907.—Through the usual incision the cyst wall was perforated, and the fluid drawn off. Two-thirds came away clear; the remainder was turbid, and, lastly, thick cheesy masses were wiped out. Investigation of the inside of the sac disclosed several thick nodular masses, which were strikingly carcinomatous in character. So far, the peritoneal cavity had not been opened, the sac being situated in front of it. The task of separating the cyst wall from the peritoneum and viscera was begun by first stripping and cutting it from the epigastric region, and from beneath the ribs; and here the peritoneal cavity was opened. It was hoped that from this point downward, the dissection would be less difficult, but it was more so. The anterior surface of the peritoneum seemed to be fused with the sac, and the posterior with the viscera generally; and the character of the adhesions was the most dense ever encountered by the writer. These were followed deeply into the pelvis, in all directions, and freed; and finally the firm, fibrous attachment to the bladder was severed, and the sac removed. The appendix,

FIG. 1.



Gives a fair representation of the abdomen before operation.

FIG. 2.



The sac turned inside out, showing the nodular masses. $\frac{1}{4}$ size.

six inches in length, bright red, and surrounded by adhesions, was also removed. The abdomen, now presented a most unusual sight. With the exception of the anterior surface of the stomach, not a vestige of normal peritoneum was visible. All the abdominal contents, including tubes, ovaries, uterus and bladder, could be seen outlined through the thin, raw film of peritoneum to which they were firmly attached. The abdominal cavity was filled with normal salt solution, and closed with three layers of buried, absorbable sutures, without drainage.

Figure 2 shows some of the nodular masses. There are others on the opposite side. These were on the inner surface of the sac, which was photographed in this way: The cyst was turned inside out, and, through the incision, which had served for the evacuation of the contents, a large, thin, collapsed rubber punching bag was thrust, then inflated, thus distending the sac for photographic purposes.

The report of our hospital pathologist, Dr. Birdsall, shows the cyst wall to be fibrous; and the nodular masses, which, during operation, we feared were carcinomatous, were papillomata. Of course, in a cyst of this size, which had been growing, presumably for forty years, and subjected to the ever-increasing pressure of the accumulating fluid, we could not expect to find the normal histological features of the urachus. Naturally, all except the fibrous structures, would disappear by pressure-absorption; even bone has been known to do the same.

Post-operative Course.—The patient's condition was critical for the two following days, active stimulation and intravenous saline infusion being demanded. The wound healed by primary union, the bowels were loose; the temperature ranged from 101° to 102°. Daily palpation of the abdomen revealed fluctuation, and the percussion note was flat, showing that the salt solution was not being absorbed. This was observed with much interest. On the seventh day a chill occurred, followed by a rise in temperature to 104°. Assuming that the unabsorbed solution had become infected through the raw surface of the intestines, the lower end of the now healed wound was cocaineized and cut through, allowing the escape of quarts of the salt solution, which had become purulent, and which presented the colon bacillus characteristics. This was followed by prompt improvement. Drainage and irrigation were continued for a week, after which

the wound closed, and convalescence and return to health were satisfactory.

COMMENTS.—The density of the adhesions cannot be appreciated unless encountered. It is true incision, evacuation and drainage would probably have been successful after a long period of waiting for the cavity to undergo obliteration. The assumption, however, that portions of the sac had become carcinomatous, made extirpation seem imperative.

Extirpation is evidently not commonly resorted to. Among the 86 cases reviewed by Dr. Weiser, only 8 were extirpated. None of these were said to be large, and with one or more the history and result were lacking.

I believe it is well known that the intra-intestinal bacteria can make their way through the walls of the injured intestine; and that the normal peritoneum has most remarkable powers of absorption; but it may well be doubted if the traumatized peritoneum is capable of this performance. In spite of this it seemed better to fill the abdomen with saline solution, as there was undoubtedly great risk of bowel obstruction, if the raw surfaces were allowed to fall together.

The non-absorption of the salt solution, and its infection by the colon bacillus were phenomena which were neither unexpected nor unnatural under the circumstances.

URETERITIS CYSTICA CHRONICA.*

REPORT OF A CASE WITH BILATERAL DOUBLE URETERS.

BY BOND STOW, M.D.,

OF NEW YORK,

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THE object of this short paper is to review the conclusions reached on this subject by well-known authorities, and particularly to invite consideration to some recent experimental work by Dr. R. Giani, of Turin, Italy, which throws considerable light on this much-debated pathological problem.

The subject is one that has proven thus far solely of pathological interest, although the writer sees no reason why under certain conditions a skilled cystoscopist should not detect this condition during life.

Morgagni,¹ Rayer,² and Rokitansky³ were the earliest writers to mention this affection, the latter describing the same in the following clear, concise manner :

“In the mucous membrane of the urinary tract, especially of either ureter, generally in large numbers and groups, there sometimes arise cysts varying in size from that of a grain of wheat to that of a pea, and others of microscopical dimensions. They contain a thin serous or thick colloid, clear or yellowish brown fluid, or gluey resinous clumps.”

Virchow⁴ maintained that these cysts are true retention cysts, the same as the ordinary mucoid cysts of the vagina, and are caused by a closure of the crypts of the mucous glands of the bladder and ureter.

Litten⁵ was the first to give a careful microscopical study of these cysts, and concludes without reservation that the inflammatory catarrh of the mucous membranes of the ureters led to a closure of its crypts and glands, retaining within their lumen their secretions, thus leading to a cystic formation.

Why these cysts occur so rarely in comparison to the

* Read before the New York Pathological Society, Feb. 13, 1907.

great frequency of inflammation and catarrh of these mucous membranes he explains on the ground of the very wide openings of these crypts and the scarcity and uncertain distribution of the glands in these mucous membranes.

R. v. Limbeck,⁶ as early as 1887, gives an accurate description of this disease and its etiology as judged in the light of Giani's experiments, to be explained later on. He mentions two ways whereby these cysts take their origin :

First, through a union of folds of the proliferating mucous membrane; and second, by a budding process of its epithelium with later a central degeneration and liquefaction of these newly formed epithelial nests and sprouts.

That glands might possibly occur in these mucous membranes and thus by closure of their exits become a source of these cysts he does not deny, but he states that he with many others has failed to find any such glands.

The English writers, Silcock,⁷ Eve,⁸ Clarke,⁹ Bland-Sutton,¹⁰ have accurately described cases of this affection and have drawn particular attention to certain peculiar round or ovoid bodies that are constantly found within the cystic contents, which bodies they interpreted as forms of sporozoa.

Clarke claimed to have found bodies with large nuclei, a well-marked network, and a nucleolus; conditions only compatible with a perfect state of vitality of cell life. He believed there was an appearance as though the cell was in the process of mitosis, although he failed to discover any mitotic figures. He thought it highly improbable that such bodies arose from degenerated epithelium and strongly maintained that they were some variety of protozoa and the direct cause of this disease.

Prof. G. Pisenti ¹¹ describes a case of cystic pyelonephritis, the right ureter containing numerous irregularly distributed cysts, and the left likewise, though fewer in number. The neck of the bladder also possessed numerous thickly placed small cysts whose contents were a clear fluid. In these various cysts he found the same bodies interpreted by the English writers as protozoa, and he coincides with them as regards their etiological importance. He offers no proof that he ever discovered

any signs of life in these bodies or that by experiment he was able to reproduce the disease through their agency. His conclusions are simply based upon microscopical observations, whereby, claiming not to have found within these cysts any transition forms of epithelium, he concludes that these peculiar bodies must be of parasitical and not cellular origin.

V. Kahlden,¹² in an exhaustive monograph on this subject, also concludes that in his case the histogenesis rests upon a parasitic basis, although he does not definitely attempt to classify these supposed parasites, but simply states it as his belief, because of the great similarity between the bodies he found within these cysts and the myxosporidia (a psorosperm found in the bladders of fishes, particularly the pike), that therefore they are either a variety of this class of sporozoa or identical with them. He produces no evidence to support his conclusions from artificial cultivation of these parasites, nor from the reproduction of this disease through their agency by inoculation of lower animals.

One fact opposing the parasitic origin of this disease and prominently claiming our attention is, that no one as yet has found any of these protozoa in or among the epithelial cells of the mucous membrane of the genito-urinary tract or even the cells lining the walls of these cysts. They always appear in the colloidal mass within the cysts. It certainly seems reasonable to expect to find them occasionally (if only by accident) in or among the cellular epithelium when they are present in such large numbers and are supposed to be the causative factor in the formation of these cysts out of the epithelium of the mucous membrane of this tract.

A. v. Brunn's¹³ studies on the normal mucous membrane of the genito-urinary tract have proven of great service in elucidating this problem, by showing the existence of certain epithelial bodies found beneath the superficial layer of cells of the mucous membrane, either disconnected therefrom or in direct continuance with the same. He claims that they are in no sense secretory glands, as was formerly held by Virchow and Litten, since they fail to show a constant exit duct or

central lumen, which is generally present in most glandular structures, and that there is never present within these cells any of those changes frequently observed in glandular organs while functioning. He believes these cellular accumulations are the result of a simple budding process of the normal mucous membrane, due to an excessive stimulation and consequent proliferation of the surface epithelium. When these bodies are not disconnected from the surface he speaks of them as epithelial buds or sprouts, and the others, disconnected by an intervening layer of connective tissue, as epithelial cell nests. It is from these cellular formations, he maintains, that the condition of cystitis and ureteritis cystica chronica arises.

Lubarsch¹⁴ strongly contends against the parasitic origin of these cysts and agrees with v. Brunn, as he has observed all stages of degenerative transition of these epithelial cell nests from solid to complete cystic formations. Clear and forceful is the conclusion to be drawn therefrom, that this is the true origin of these cysts, the two things necessary being the presence of v. Brunn's cell nests and the continuous action of some injurious agent, the most frequent being inflammation arising from the existing calculi. The cysts arise by, first, a destruction of the centrally located cells, out of which later is formed a colloid and granular detritus. Since this material finds no exit, by its increment the cyst increases in size until there is but a single layer of epithelial cells that bound the lumen of the ureter. He concludes from microscopical examination and the peculiar action of stains on these cell contents that the same is not a true secretion, but simply a colloid mass originating from degenerated epithelium.

Lubarsch by no means thought that this was the sole method of origin of these cysts, for at the close of his article he really speaks of three ways: namely, those cysts that arise from the closure of mucous crypts as described by Virchow and Litten, those that come from a degeneration of v. Brunn's cell nests, and those that are found at the trigone of the bladder, due to misplaced prostatic glandular tissues.

Aschoff's¹⁵ extensive studies on the mucous membrane of the genito-urinary tract would go to prove that in the newly born and those of early life no epithelial budding of the mucous membrane or cut-off epithelial nests, as described by v. Brunn and Lubarsch, can be found in the genito-urinary tracts, and even in adult life he found them to be very inconstant and chiefly confined to the upper third of the ureter.

Marckwald¹⁶ found cystitis and ureteritis cystica in the newly born, and claims, as does Aschoff, that an inflammation is not first necessary to originate these cell nests and cysts.

Stoerk,¹⁷ on the other hand, after a most painstaking and exhaustive study of this subject, differs from v. Brunn in that he claims these cell buds and nests are secretory in nature as well as their contents, and that it is by the retention of their secretions that a transformation of these gland-like cell nests into cysts occurs.

He also differs from the views of Aschoff and Marckwald in that he strongly maintains that there must be first an inflammatory reaction to cause these cell nests, even though traces of such a reaction may have entirely disappeared from present view. He draws attention to one very significant fact that certainly requires explanation, which is, that during extra-uterine life nowhere in the body in any of the other mucous membranes can any analogy to v. Brunn's findings be discovered. What explanation can be offered that the mucous membrane of the genito-urinary tract solely and frequently undergoes this proliferating budding process?

Giani,¹⁸ in a purely accidental way, was surprised to find a condition simulating in every respect cystitis and ureteritis cystica chronica caused by some experiments he had instituted for a study of tuberculosis of the genito-urinary tract. He performed a suprapubic cystotomy upon rabbits, and placed within the bladder some gelatin capsules containing a pure culture of tubercle bacilli. The external wound and bladder healed regularly. Free passage of urine occurred a few hours after the operation. In one case about 30 days later the capsule was passed through the urethra. In all the other cases the

capsules became the seat of salty incrustations from the urine, and were the centres of well-formed and quite large calculi. The rabbits, twelve in all, were kept alive from fourteen days to three months. After fifteen days he discovered a chronic cystitis, and scattered here and there in numerous places the mucous membrane showed marked tendency toward proliferation of its epithelial cells in more or less bud-like processes dipping down into the stratum proprium. Later these became wholly separate from the mucous membrane. Still later he found degeneration and liquefaction taking place within their centres, and thus the beginning of a small cyst. These epithelial submucous nests varied very materially in size. Sometimes they remained throughout one solid mass of epithelial cells. Complete cystic formation rarely occurred before the fortieth day, from which time on they increased considerably in size and number. He universally found these cysts, in toto or in part, filled with a fine granular detritus composed of red blood corpuscles, leucocytes, fragments of nuclei, and broken-down epithelial cells. Besides these, he frequently found in these cystic contents peculiar bodies, whose form was generally round or elliptical, averaging in size about 20 to 25 micra, though sometimes they were as large as 40 and some were as small as 7 or 8. The protoplasm of these bodies possessed no particular structure. It was more or less coarsely granular and refractory against aniline dyes, having a hyaline, almost glassy, appearance, coloring intensely with eosin. Sometimes they contained no nucleus, then again he found a body simulating a nucleus, which stained deeply with hematein.

This description corresponds very closely to that of the so-called parasites (protozoa) supposed to have been found in the cysts by certain English and Italian writers and claimed by them to be their cause. Such bodies were found only in the cysts and never free in the epithelium of the mucous membrane, nor in the solid cell nests above spoken of and out of which cysts eventually arose, nor in the cell accumulations on the surface of the mucous membrane.

In the light of these experimental findings it is not possi-

ble further to give credence to the parasitic origin of this affection. The chronic irritation due to the inflammation set up by the capsules that acted as foreign bodies seems an essential etiological factor.

Giani found the cysts greatest in number where the irritation would appear to have been the greatest.

Further experimentation by ablation of the mucous membrane of the bladder by a Volkmann sharp spoon produced similar results.

Giani also observed in the case of hypertrophy of the prostate where the middle lobe was removed by suprapubic cystotomy that the mucous membrane of the bladder over this lobe was covered by numerous epithelial indentations and epithelial nest formations in the submucosa, either isolated or in direct communication with the surface epithelium. These undoubtedly arose from chronic irritation of the mucous membrane of the bladder at this part, due both to the hypertrophic middle lobe of the prostate and the daily repeated catheterizations which had taken place for the past three years.

In conclusion one question appears difficult to answer, and I cannot help but believe that there is still a very important factor in the etiology of this disease that is yet to be explained.

Ureteritis cystica chronica is a very rare affection. Lubarsch in over 3000 autopsies met the condition but four times. The writer's experience, which certainly covers many hundreds of autopsies, has met with the condition but once; the specimen shown in figure 1. I find in the entire literature not over 50 cases reported.

If we are to believe that inflammatory irritations of mucous membrane of the genito-urinary tract set up a proliferation of its epithelial surface so that buds and cell nests are formed, out of which later cysts are formed, then why, knowing as we do that inflammation of this tract is of very frequent occurrence, is cystitis and ureteritis cystica chronica so rarely met with? There are several cases reported in the literature of double ureter on one side in which this affection was found.

The specimen which is the basis of the present communication is one of bilateral double ureters in which there is complete cystic degeneration of all four ureters. So far as I have been able to glean from the literature, it remains the only specimen of its kind. The cystic degeneration in this case is confined to the ureters. Why?

Is the presence of ureteritis cystica in these cases of reduplication of the ureter purely a concomitant circumstance, or has the congenital malformation some etiological significance?

I am not able to answer these seemingly pertinent questions.

Microscopical examination of many sections showed all the finding of the authors above reported, especially the round and ovoid bodies in the cyst contents, the budding sprouts and cell nests in the mucous membrane of the ureters with degenerated cell and detritus material in their centres. Nothing was observed that would appear to enhance further the microscopical findings already reported, illustrations of which are plentiful in the literature herewith appended, nor to throw new light on the etiology of this much-vexed problem.

Clinical History.—Anna Palil, 40, Hungarian, houseworker. Admitted to Metropolitan Hospital, New York, May 17, 1906. Died, May 22, 1906, 9.25 A.M.

Family history negative. Does not use alcohol. Moderate tea and coffee drinker. No drug habits. Had usual diseases of childhood. Had an attack of articular rheumatism in adult life. No history of any venereal diseases. For the past three years has been complaining of her stomach. Refuses solid food. Says same causes her much distress. No history of any vomiting. No localized pain anywhere in body. Poorly nourished. Subcutaneous and muscular tissues wasted. Œdema of both lower extremities. Abdomen presents a large ventral hernia. Face has a pained and distressed appearance. Complexion is generally sallow with some cyanosis. Mucous membranes congested. No œdema of face. Reflexes are all normal. Apex beat in sixth interspace and slightly to the left of the mid-clavicular line. Border of dullness to the right reaches the mid-sternal line. Slight



K. L., the two sides of the bladder after bisection; A. B., two ureters on left side; E. F., two ureters on right side; C. D., opening of ureter into bladder.



epigastric pulsation. A rough systolic murmur is heard at the apex, the same being transmitted to the left axilla. The second pulmonic sound is accentuated. The chest expansion is poor and appears slightly greater on the left side than the right. The apices are somewhat sunken. The interspaces are very much retracted and the ribs correspondingly prominent. Over the entire chest is heard a broncho-vesicular respiration except a small area anteriorly on the right side corresponding to about the location of the right middle lobe and the base of the left lung where no respiratory murmur is heard. Large inspiratory moist rales heard over the entire lungs. Expectorates a thick muco-purulent sputum. No tubercle bacilli. Examination of abdominal organs proved negative. Urinalysis showed: light amber color, 1.028 specific gravity, albumin, no sugar, and 1 per cent of urea. Amount was 24 ounces in 24 hours.

Diagnosis.—Mitral insufficiency with failing compensation, chronic bronchitis and œdema of the lungs, chronic Bright's disease.

Autopsy.—Autopsy demonstrated the presence of chronic bronchitis, passive congestion and œdema of the lungs. Unresolved pneumonia of the middle lobe of the right lung. Chronic pleurisy. Hypertrophy and advanced fatty degeneration of the heart muscle with acute endocarditis of the mitral valve. Muscular insufficiency of the mitral and tricuspid valves. Cyanotic induration of the spleen. Early stage of cirrhosis of the liver. Chronic atonic gastritis. Passive congestion of the intestines. Chronic cystitis. Ascending pyelonephritis with hydronephrosis and advanced arteriosclerotic granular nephritis. Complete bilateral reduplication of both ureters. Extensive ureteritis cystica chronica of all four ureters. The bladder contained a foul, stinking, greenish fluid. Its walls were intensely congested. The ureters and pelves of both kidneys likewise contained a foul, stinking, greenish-yellow pus.

There is a reduplication of the ureter on both sides. Each of the four ureters arises from a separate pelvis of the kidney. The two ureters on each side remain entirely separate and distinct throughout (being divided by ordinary connective tissue and unite in one common exit at the usual normal ureteral opening at the trigone of the bladder. (See illustration.)

Each of the four ureters is very thickly studded from origin

to within 4 cm. of their exit into the bladder by innumerable cysts varying in size from that of a millet seed to that of an ordinary pea.

These cysts are both individual and massed in groups. Some are transparent and contain a clear serous fluid. Others are of an opaque greyish-yellow color containing a thick ropy colloid material. A few seem harder than the others and contain a gluey resinous-like hard substance.

The pelves of both kidneys contain likewise a few scattered similar cysts whereas the bladder is entirely free from cysts of any kind. The right kidney is very firm in consistence, of a dark mahogany brown color and weighs $62\frac{1}{2}$ grams. It measures 8 by 5 by 3 cm. It is coarsely granular on its external surface and the same is studded with numerous small individual and grouped abscesses.

Its capsule is thickened and cannot be removed without adhering kidney tissue. The cut surface is granular. The cortex ranges from 1 to 3 mm. The pelves are intensely congested and inflamed. The one pelvis is in direct communication with three large well defined abscess cavities that extend to within 1 mm. of the external surface of the kidney.

The pyramids are greatly distorted or entirely replaced by tough connective tissue. The blood vessels are prominent and arteriosclerotic. The left kidney weighs $93\frac{1}{2}$ grams and measures $8\frac{1}{2}$ by 4 by $3\frac{1}{2}$ cm. Its color consistency and other characteristics are very similar to those of the right kidney. Within the kidney and in direct communication with the pelvis of the kidney are large well defined abscess cavities that contain a foul, stinking, greenish-yellow pus.

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OPERATION FOR HYOSPADIAS.
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IN the *British Medical Journal* of November 17, 1900, I published the description of an operation that I had devised for severe hypospadias, with a photograph illustrating the result obtained, in a case on which the operation had been practised. Upon the method I was privileged to bring forward, I founded very high hopes, as will be evident to any one who may care to read my communication. Incidentally I hazarded the remark that the case reported was in my belief the best result that had ever been obtained in a case of complete perineo-scrotal hypospadias. It has been something of a disappointment to me that, since the publication alluded to, I have never seen any account in current surgical literature of a case in which my method has been adopted for the remedying of this dreadful malformation; nor does it seem to have been successful in attracting the favorable notice of surgical authors in general, despite the fact that in the last edition of Jacobson's work on the "Operations of Surgery," the method I allude to receives full description and illustration, in company with that of Duplay. The only other surgical work in which I have seen it mentioned is Cheyne and Burghard's *Manual of Surgical Treatment*, in which it receives mention in a foot-note to the description of Duplay's operation.

I desire now to suggest a modification of my method, which will, I believe, be a great improvement; and I shall seize the opportunity to redescribe the operation, as amended, with the utmost detail. My aim will be to provide any surgeon who desires to adopt this method with a trustworthy and sufficient guide in this paper. Let me frankly confess, also, that I desire to place my method side by side with that of Duplay, and claim the judgment of surgeons as to the respec-

tive merits of the two operations. I would only remark further, before beginning my description, that in introducing a new operation for hypospadias, one labors under a great disadvantage owing to paucity of opportunity for testing the method and of gaining experience in matters of technique; for cases of hypospadias do not come very frequently for operation. Hence it is not altogether surprising that in the two cases in which I have had the opportunity of performing my operation, the results obtained have fallen short of perfection; nevertheless, they are such as to convince us, I think, that results so excellent as to approach very near to perfection will assuredly be obtained by this method, and without very much difficulty.

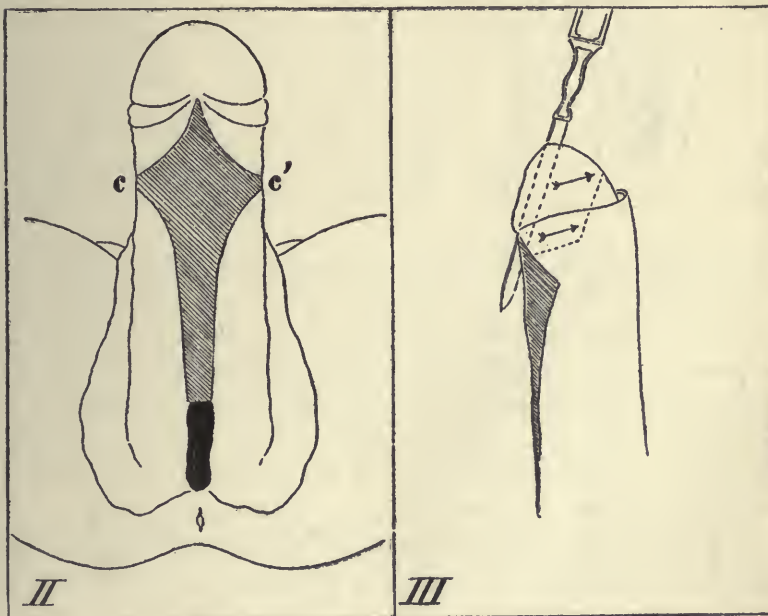
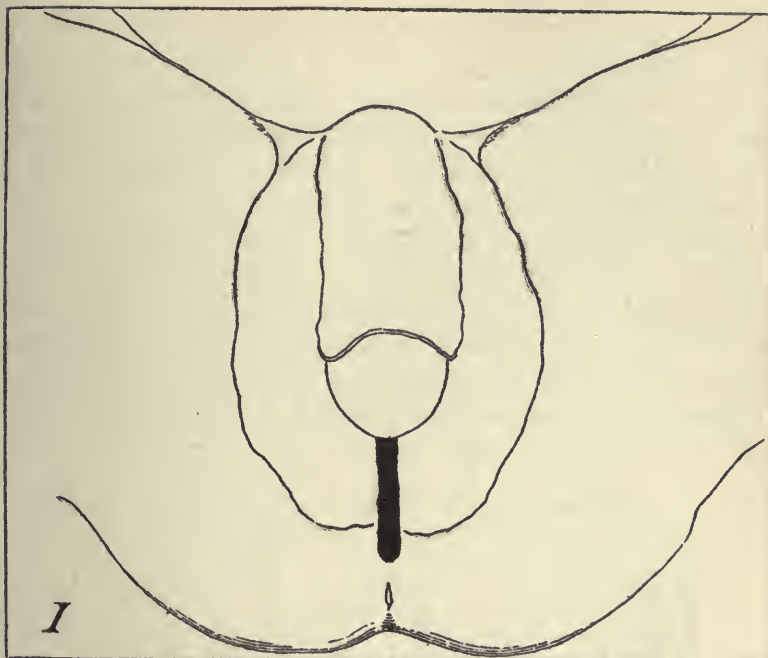
The conditions present in a case of complete perineo-scrotal hypospadias are shown diagrammatically in Fig. 1. The scrotum is cleft, simulating the labia of the female; the urethra opens far back in the perineum, but from the orifice an open perineal urethra passes forwards as a sulcus lined with mucous membrane towards the pubic arch. At this point it terminates in a short fold of skin, a kind of frænum, which holds the glans penis incarcerated. The penis is thus bent into the form of an almost complete circle, the frænum alone intervening between the glans and the root of the organ. From the frænum, the skin spreads out fan-like in the concavity of the organ, to surround the corpora cavernosa. The corpus spongiosum and urethra are absent, but the place of those structures is taken by short dense bands of fibrous tissue, which are met with in the operation, and will be duly referred to. In the peno-scrotal form of hypospadias, the urethral orifice will be immediately in front of the scrotum, but the penis will be malformed, and incarcerated in the same manner as in the more complete form just described. It will also be amenable to operative treatment, such as I am about to describe, with only such modifications as are obvious. In the milder penile forms of hypospadias, in which the organ is perfectly free, and in which there will be no obstacle to its utility as a sexual organ, no operation is, in my opinion, called for.

The Two Aims of the Operation.—It is obvious that the

victim of hypospadias suffers from two grave disabilities. He can never be capable of sexual congress; and he will be unable to micturate as other men perform that act. The two aims of the operation must therefore be (1) to release the organ from all its bonds, so that when erect, it shall be straight; and (2) to continue the urinary channel forward from the perineal opening to the end of the penis. My method consists of two operations. At the first operation, the penis is released and straightened and the glandular portion of the urethra is formed, and lined with preputial skin. At the second operation, the perineal and penile portions of the urethra are formed and closed, so as to complete the channel from the perineal opening to the glandular urethra. For this operation, suprapubic drainage is employed. A year or more should be permitted to elapse between the two operations. In all the diagrams, the mucous membrane of the open perineal urethra is represented black; the shaded areas represent raw surfaces.

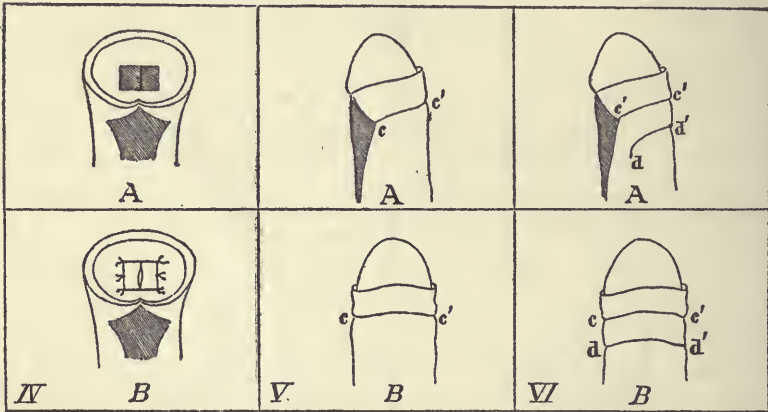
First Operation.—Preparatory to the operation, the patient, if a child, should be put into a double long splint for a day or two beforehand. The position at the operation will be the extreme lithotomy position, with the buttocks well raised on pillows to suit the surgeon's convenience. The steps of the operation are indicated by Roman numerals.

I. The glans is seized in a suitable tenaculum and drawn upwards with the left hand. The surgeon feels the fan-like frænum of skin binding down the penis and divides it transversely, liberating the glans. He continues the division of the skin freely on both sides until the body of the organ is reached; it will then be only partially straightened. He now finds the organ held down by dense fibrous bands, which occupy the place of the corpus spongiosum in the concavity of the penis. The more prominent of these bands are dissected out clean, and any remaining portions, together with tight portions of the sheaths of the corpora cavernosa are snipped with scissors, as they are felt to be made tense by the upward traction on the glans. This process is continued until the penis is completely released and can be drawn out straight. The result of this proceeding will



be the long diamond-shaped raw surface represented in Fig. 2; the lateral angles of the diamond ($C C'$) are formed by the ends of the transverse cuts through the fan-like frænum. Note that the transverse incisions must be so directed as to bring the lateral angles moderately high up near the glans and not down near the root of the penis.

II. The cutting of the channel through the glans for the reception of the glandular urethra. (Fig. 3.) Take a fine knife, and, holding the glans firmly in the left fingers, enter the knife at the tip of the glans where the floor of the meatus is to be, and thrust it through until the point emerges in the apex of the raw surface, just at the base of the glans. The edge of the knife is towards the dorsum. Cut freely towards



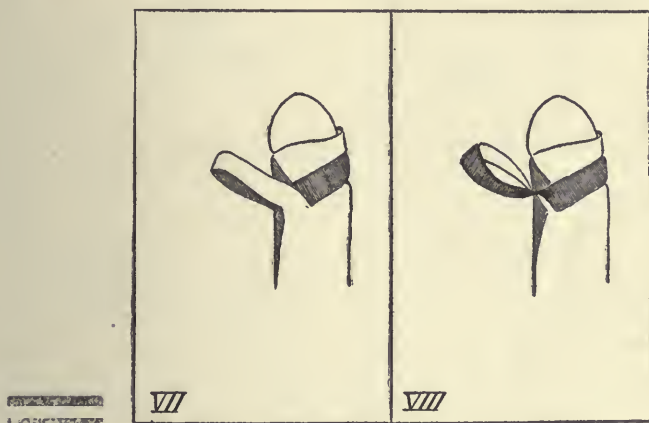
the dorsum as the knife is being withdrawn (as indicated by the arrows in Fig. 3).

III. Raw a small area of the glans on either side of the new meatus; this may be done by grasping the glans firmly and shaving off a fine layer that includes the meatus. (Fig. 4, A.) In these two diagrams (Fig. 4, A and B) the meatus is drawn much too small. The incision of the glans should be much more free than is here shown.

IV. The first step in the cutting of the preputial loop with which the glandular channel is to be lined. Carry the knife

from one lateral angle to the other (c to c') across the dorsum of the penis, giving the incision a slight curve upwards as in Fig. 5, A and B.

V. Second step in the cutting of the loop. Parallel to the last incision make another below it (d to d') as in Fig. 6, A and B; but in this case neither extremity of the incision is to reach the raw surface, but will rather take a slight deflection downwards at either end as represented in Fig. 6, A. Thus the dorsal loop of prepuce marked out by these two incisions retains a substantial connection at either end with the skin of the body of the organ. The width of this loop should be one-fourth to one-third inch, according to the size of the organ.



VI. Detach this loop from its bed, until it can be lifted up and passed over the end of the penis (Fig. 7).

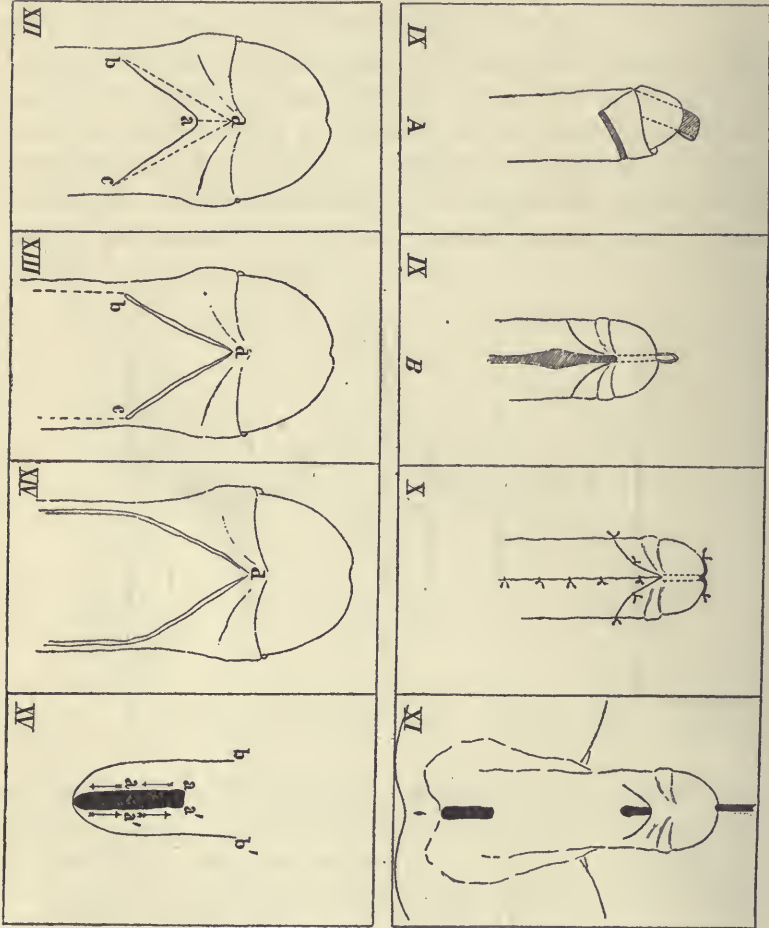
VII. Turn the loop inside out, so that the cutaneous surfaces are opposed to one another. (Fig. 8.)

VIII. Pass a sinus forceps through the channel in the glans, seize the loop and draw it through. (Fig. 9, A and B.)

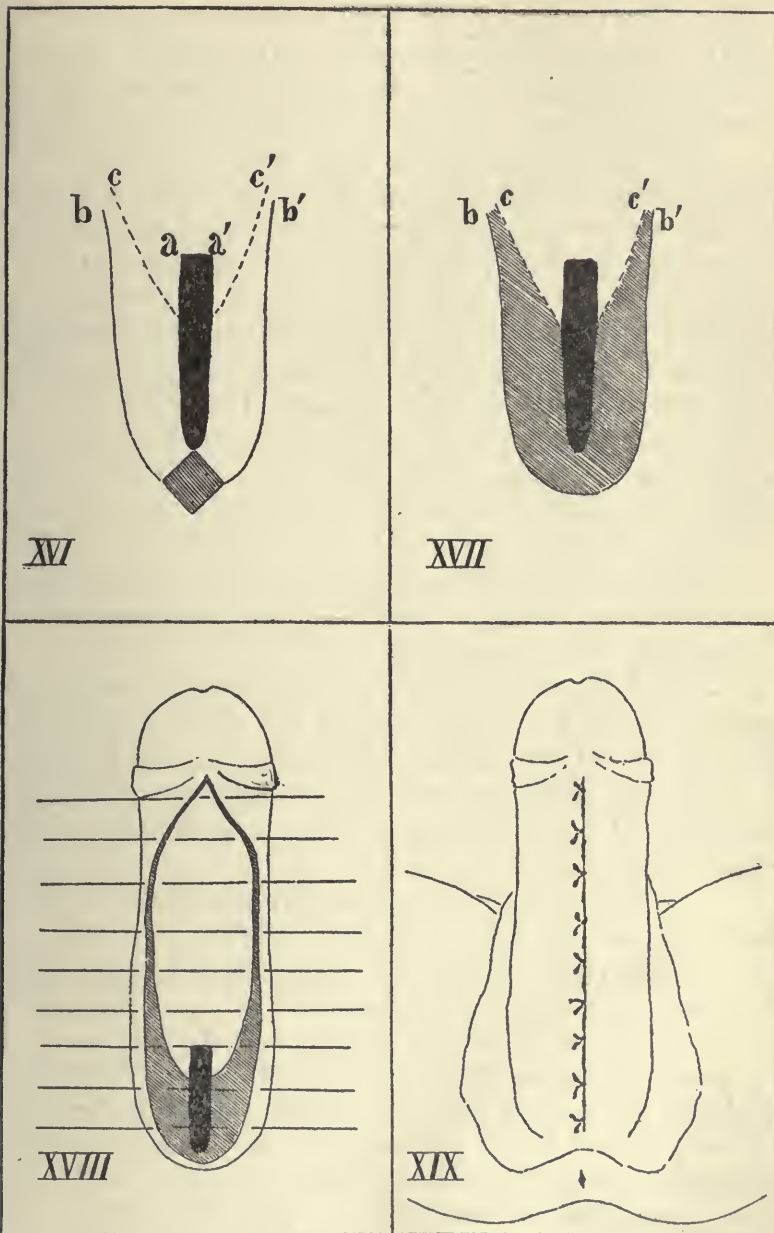
IX. The loop now protruding from the end of the glans is to be divided, and the two strips laid down over the raw surfaces on either side of the meatus, as shown in Fig. 4, B. They are neatly affixed with sutures, and the redundant portion

of each strip removed. The result of this step is portrayed in Fig. 10.

X. It will now be found that all the skin edges will fall



nically into position, and are easily adjusted with sutures. The drawing of the loop through the glans will be found to have brought the lateral skin edges close together over the large raw surfaces, while the triangular flaps of skin attached to the



glans will fit readily into the angle made by the loop with the skin of the body of the organ. (Fig. 10.) A narrow bandage of iodoform gauze wound a few times round the organ makes a suitable dressing.

The child is put back into the splints on returning to bed and a rubber self-retaining catheter passed into the bladder through the perineal opening. In a patient old enough to be trusted, it would suffice for the catheter to be passed at intervals. No rod or any such appliance is to be placed in the glandular urethra. The reason for step III and the subsequent bringing of the strips of prepuce that line the glandular urethra well over on to the surface of the glans (step IX, Fig. 4, A and B) may require some explanation. It is designed to obviate the contraction of the meatus that will follow if the urethra terminates in a cicatricial ring, exactly at the meatus. By this device, stricture of the meatus is completely prevented.

The final result of this operation after healing has taken place is depicted in Fig. 11, in which a bougie is shown passed through the glandular urethra.

Second Operation.—The problem is now to construct a perineal and penile urethral channel that shall be continuous posteriorly with the existing urinary channel, and anteriorly with the new glandular urethra. The operation is divisible into the three following stages, which will be described in the order named:

I. The preparation of the anterior penile urethra and the point of its junction with the glandular urethra.

II. The preparation of the posterior penile urethra and the point of junction with the existing channel.

III. The final closure by suturing.

Suprapubic cystotomy must be performed and the bladder efficiently drained; this may be done as a preliminary measure, or preferably (I think) left until the second stage has been completed, prior to the suturing. A pair of fine ophthalmic scissors and toothed forceps I have found very useful. The steps of this operation, which are not quite so easy to describe or to follow as those of the first, are as follows:

I. Starting anteriorly, note in Fig. 12 the two folds of skin (ab, ac) that diverge from the opening of the glandular urethra to be lost on the body of the penis; these are guides for the direction of incisions for making the penile urethra.

Fig. 12 represents this region enlarged for clearness of demonstration; a is placed at the urethral orifice beneath the apex formed by the two folds of skin ab, ac.

Make first the short incision ad, which slits up the new urethra for about one-eighth inch. This will make the angular flaps dab and dac. Mentally complete the two triangles dab and dac by the dotted base lines db and dc.

II. With fine forceps and scissors seize each triangle in turn and cut it away along the base lines db and dc respectively. The appearance will be that portrayed in Fig. 13, which shows the cut edges of the two layers of skin of which the folds are composed; the inner layer is part of the preputial loop which has become the lining of the glandular urethra; the outer layer is continuous with the skin of the body of the penis.

III. Start the lateral incisions for the penile urethra from the points b and c respectively, and carry them down the penis as indicated by the dotted lines (Fig. 13). It is clear that the penile urethra will be perfectly continuous with the glandular portion (Fig. 14). We now leave this part of the field and turn to the perineum. Draw apart the cleft scrotum and observe the two following landmarks, which are represented enlarged and very diagrammatically in Fig. 15.

(1) The fine ridge or crest (a a') that separates the mucous membrane of the perineal urethra abruptly from the skin of the perineum. (Note that I wish a a' to indicate, not the short straight line at the anterior extremity of the urethra, but the long u-shaped a a' that passes backward round the urethral orifice, and forward again, as indicated by the little arrows in the diagram).

(2) The surface line of the skin of the perineum (b b') which overlaps a a' posteriorly more than is shown in the diagram. Between these two lines, a a' and b b', there is an area of skin, broad behind and gradually narrowing anteriorly,

that is to be removed, leaving a raw surface. Proceed as follows:

IV. A short median incision backward through the skin only, so as to completely expose to view the hinder part of the perineal urethra and the existing orifice. This incision will create the small quadrilateral raw surface shown in Fig. 16.

V. Separate accurately the perineal mucous membrane from the skin, along the u-shaped line a a'. A good way to do this is to take fine scissors and clip away the thin crest that separates mucous membrane from skin along the line a a'. Note that this procedure must be carried forward only so far as to the point where the dotted lines meet the perineal urethra (Fig. 16). At this point the mucous membrane must be left and the demarcation continued forward in the form of an incision along the dotted lines (c c'). This is to obviate undue narrowing of the urethra, with which we are threatened at this spot. The line of separation between urethra and other structures having been thus laid down, dissect away all the skin intervening between a a' and b b', as indicated by the shading in Fig. 17. This will leave a broad raw surface in the perineum, narrowing as it passes forward.

VI. The operator must now strike a line for the lateral incisions that have been already made in the penile portion. In doing this, he for the first time seems, as it were, to leave the track and travel across country through, it may be, rather doubtful-looking scrotal tissue. He must just plan his incisions so as to make the junction of the penile with the perineal urethra uniform in calibre with the rest. Although this has been the only point in the procedure at which I have experienced some feeling of uncertainty, healing has been quite satisfactory in this part in both my cases.

VII. The entire length of the new urethra has now been marked out. The skin composing it is now to be carefully raised on either side, working towards the median line, sufficiently to permit it to fold easily over to make the new urethra, without the least tension. All is now ready for the suturing.

VIII. Fig. 18. The new urethra and the skin of the

penis are now brought together throughout by a series of sutures. Each suture includes four layers of skin, the needle passing in order through outer skin and urethral skin of one side, then through the urethral skin and outer skin of the other. I need not dwell on the necessity for extreme delicacy and accuracy in the performance of this final step of the operation on the penile portion of the urethra, which is the only part of the operation in which the result is at all precarious. The perineal portion, where the surface is broad, scarcely needs any suturing; the sutures there will, of course, just miss the mucous membrane.

Fig. 19 shows the operation completed.

The penis is dressed as before by bandaging with an iodoform gauze bandage, and a pad of the same material is applied to the perineum. The patient is placed in his splints with the bed-foot-raised. The after treatment is that of a case of suprapubic drainage. It should be possible to dispense with the drain in a week or ten days.

It will be noted that the foregoing description is somewhat different from that given in Jacobson's "Operations." My experience in my second case has shown me that it is wiser to be content with forming only the glandular portion of the urethra at the first operation, leaving the penile and perineal portions to be formed together at the second, as I have here described. My original suggestion was to form the penile and glandular portions together at the first operation, leaving only the perineal portion for the second. The new plan is the better, if for no other reason than that the patient will be older, and the conditions more favorable to the good healing of the penile portion of the urethra, which is the only precarious part of the undertaking. Had I done this, the result would, I think, have been perfect in the second case, instead of imperfect.

Age at Which the Operation Should be Undertaken.—

Other things being equal, the larger and more substantial the parts and the tissues, the better; therefore, the nearer to manhood the better. Social considerations, however, indicate strongly that the operation should be undertaken about the age

of 8 or 9 years or thereabouts, provided the parts are fairly well-developed; for it is obvious that a boy will be in a large measure debarred from association with his fellows if he is unable to micturate in masculine fashion. Under no circumstances, however, should any attempt at operation be made at an earlier age; and if the penis is ill-developed, operation must be postponed until the child is older. An operative failure will mean not merely that the operation will have to be repeated, but what is of greater importance, that any future operation will be gravely prejudiced by the presence of cicatricial tissue.

My first case has been already published (*vide British Medical Journal*, November 17, 1900), but I am enabled to give the following recent notes:

After History of Case I.—This boy was operated upon in 1899, being then in his ninth year. The result was a perfectly released penis, and complete closure of the urethra with the exception of a small hole just behind the glans. I have been fortunate in obtaining a report on his present condition through the kindness of Dr. Bush, of Rutherglen, Victoria, who visited him at my request, and has furnished me with the following interesting particulars. The boy has now turned 16 years. The glandular urethra is patent and the greater part of the urine passes through it, but some comes through the hole in the urethra; this hole would just about admit a small wax match. The left testis has descended, and is apparently normal in size and shape, and is contained in a definite scrotal sac. The right testis has not descended, and the position of its sac is occupied by a labium-like eminence seemingly composed of scrotal tissue. Dr. Bush formed the opinion that the penis would be quite efficient as a sexual organ, provided the rest of the sexual apparatus becomes normally functional, but he adds the following remarkable but somewhat disquieting particulars. The boy has developed feminine breasts; "not a mere slight swelling of the male breast, but such a breast as you would expect to find on an average virgin of the same age. There is a well-developed nipple, surrounded by areola in each case, and the breast has the lobulated glandular feel of a virgin breast. The diameter of each is approximately 5 inches, and they are noticeable by their size when only a shirt

FIG. 20.



Case II. Result.

is worn." The boy's appearance in general is feminine. I had asked Dr. Bush to inquire whether he had been always able to micturate in the presence of other boys, or to strip in their company, without the secret of his malformation being detected; but Dr. Bush ascertained that he had never done either of these things, owing to bashfulness. So far as was ascertainable by cautious questioning, there did not seem to have been any kind of sexual awakening, but Dr. Bush very wisely did not pursue this line of investigation.

Case II.—This patient passed the first three years of his life as a girl; his true sex was only discovered on his being brought to me at the Children's Hospital to be operated on for an inguinal hernia. The male organ was very small, but it subsequently developed well, and I performed the first of the two operations for hypospadias in the eighth year. The method followed was that described in my original article and in Jacobson's "Operations." The formation of the glandular urethra was perfectly successful, but the bringing together of the long flaps to form the penile urethra was not satisfactory, and to this fact is due, I believe, the incomplete success of the second operation. In fact, the first operation resulted only in the formation of the glandular urethra, so that I was left with the penile and perineal portions to be formed at the second, exactly as I have described above, but with the great disadvantage that the penile skin had been damaged. The result is shown in the photo taken by my house surgeon, Dr. Balcome Quick (Fig. 20). It will be seen that there are one or two holes in the penile urethra, and I do not consider this a good result or a fair indication of what is to be expected from this method. Nevertheless, the boy's two great disabilities have been so far removed that it is doubtful whether it is worth while to do anything further. I intend to wait until the period of puberty has passed, and if he then desires it, it should not be difficult to remedy the defects in his penile urethra with the aid of another suprapubic cystotomy.

Comparison with Duplay's Method.—Duplay's method consists of three operations, of which the aims are as follows:

- (1) The releasing and straightening of the penis.
- (2) The tunnelling of the glans without any attempt to make a lining membrane to the urethra.
- (3) The covering in of the perineal urethra, the forming

of the penile urethra, and the end to end junctioning of the three portions of the urethra as may best be managed. It is scarcely to be wondered at that this last operation is admittedly liable to multiply itself almost indefinitely and I suspect usually to fail ultimately. I wish to be scupulously fair, but I am honestly at a loss to determine whether the success or the failure of this last part of the operation would be the greater misfortune for the patient.

Thus, I hold that the defects of Duplay's operation are that the glandular urethra is a mere sinus through cicatricial tissue, and that there is very imperfect continuity between the three portions of the urethra. Either of these defects alone would, I submit, be absolutely fatal to any claim for excellence that could be put forward on behalf of Duplay's operation. Both these objections are met in the foregoing method of two operations that I have described. Moreover, I would further point out, what any surgeon who has closely followed my description will perceive, that the two operations I have described are not really difficult. Surgeons leaning towards plastic work will easily obtain perfect results by this method.

Duplay's operation, on the other hand, is not merely extremely difficult; it is in my opinion virtually impossible. By this I mean that although doubtless the patient's condition would be greatly improved by the releasing and straightening of the penis, it is impossible to obtain a satisfactory result in respect of the urinary passage. Surgeons are always gratified at achieving successes in plastic work and pleased to display them, and there is no class of surgical cases so suitable and interesting to submit for inspection at medical societies and so forth. I have, however, never in my life known a surgeon anxious to show a result obtained by Duplay's operation for hypospadias. Is it vain for me to cherish the hope that I may hear of very gratifying results obtained by the skilful carrying out of the procedures that I have described with, I fear, almost wearisome minuteness, in this paper?

For the beautifully executed diagrams that illustrate this paper, I am indebted to my friend, Dr. Oswald Shields.

A MALE PSEUDO-HERMAPHRODITE.*

BY JAMES S. STONE, M.D.

OF BOSTON

Surgeon to the House of the Good Samaritan; Assistant Surgeon to the Infants' Hospital; Junior Assistant Surgeon to the Childrens' Hospital; Assistant in Surgery in the Harvard Medical School.

MARY X., 2 years old, living in Boston, was admitted to the General Surgical Service of the Children's Hospital on March 24, 1905.

When 2 months old a lump had been noticed in the right inguinal region, which was tender to touch. A truss had been fitted to hold back the mass, but little benefit had come from its use. The child was in excellent general condition. The right inguinal canal was larger than the left. A hernial sac could be plainly felt. Occasionally a firm rounded mass appeared which was supposed to be an ovary.

At the operation for the cure of the hernia the mass was found which it was thought must be an ovary. It was so intimately connected with the hernial sac that it was excised and the wound closed exactly as in any operation for the radical cure of hernia. The convalescence was normal; the child was discharged well. The report of Dr. H. C. Low, given below, showed the mass removed to be a normal testicle.

Specimen consists of an oval piece of tissue resembling an ovary. It is covered with a glistening membrane; it measures 2.1 cm. x 1.1 cm. x 0.4 cm. Attached to one side of this in a rounded cord of tissue. Although resembling an ovary there is no sign of the Fallopian tube. Microscopical examination made from three different parts of the tissue shows that it is a testicle; the characteristic lobules and tubules of the organ are clearly seen; the epididymis is shown in two of the sections; the vas deferens and part of the corpus Highmori can be recognized in one part. The whole free surface is covered with a layer of flat epithelium. *Anatomical diagnosis:* Normal testicle.

On August 16, 1906, she was readmitted. A similar hernia

* From the General Surgical Service of The Children's Hospital, Boston, Mass., Service of Drs. H. L. Burrell, H. W. Cushing, and J. S. Stone.

had appeared on the left side, containing a similar mass which was this time supposed unquestionably to be a testicle. Under ether a most careful examination was made of the external genitals. The vagina was found to admit a probe easily for an inch. The vagina was, as is normal in a child not 4 years old, too small to admit the finger. Through the rectum it was impossible to feel any uterus or ovaries. Neither could any be felt by the finger introduced into the abdomen at the time of the second operation to be described.

The question presented was interesting. The hernia required operation. The testicle had to be dealt with in some manner.

Here was a child named and brought up as a girl for 4 years. The external genitals offered not the slightest variation from those of an absolutely normal girl. The vagina was 1 inch deep. There was no uterus. One testicle had been removed. The other testicle must be removed or left. It seemed wiser to remove the remaining testicle and allow the child to grow up as a girl without male characteristics than to attempt to undertake to convert her into a boy with one testicle and female genitals or leave her a girl with the probability that at puberty male characteristics would develop. The left testicle was therefore also excised and the hernia cured. The photographs, taken by Dr. A. W. George, show the facial appearance and the external genitals. (Figs. 1 and 2.) The report of Dr. Low follows:

August 22, 1906.—Specimen consists of piece of tissue, measuring 1.9 m. x 0.9 cm. x 0.5 cm., covered with a smooth, shiny membrane; and from one side extends a short cord of tissue, 3 mm. in diameter and 1.5 cm. long.

Microscopical examination shows the typical tissue of the normal testicle; the lobules, the epididymis, and the vas deferens are easily recognized. The wall of the vas deferens is somewhat thickened and there is some exudation of round cells in it. *Anatomical diagnosis:* Testicle with slight chronic inflammatory process.

FIG. 1.



Photograph showing features of Mary X.

FIG. 2.



Photograph showing the external genitalia. Note the entire absence of the male sex characteristics.

A NEW RETRACTOR TO BE USED IN SUPRAPUBIC CYSTOTOMY.

BY GEORGE WALKER, M.D.,

OF BALTIMORE, MD.,

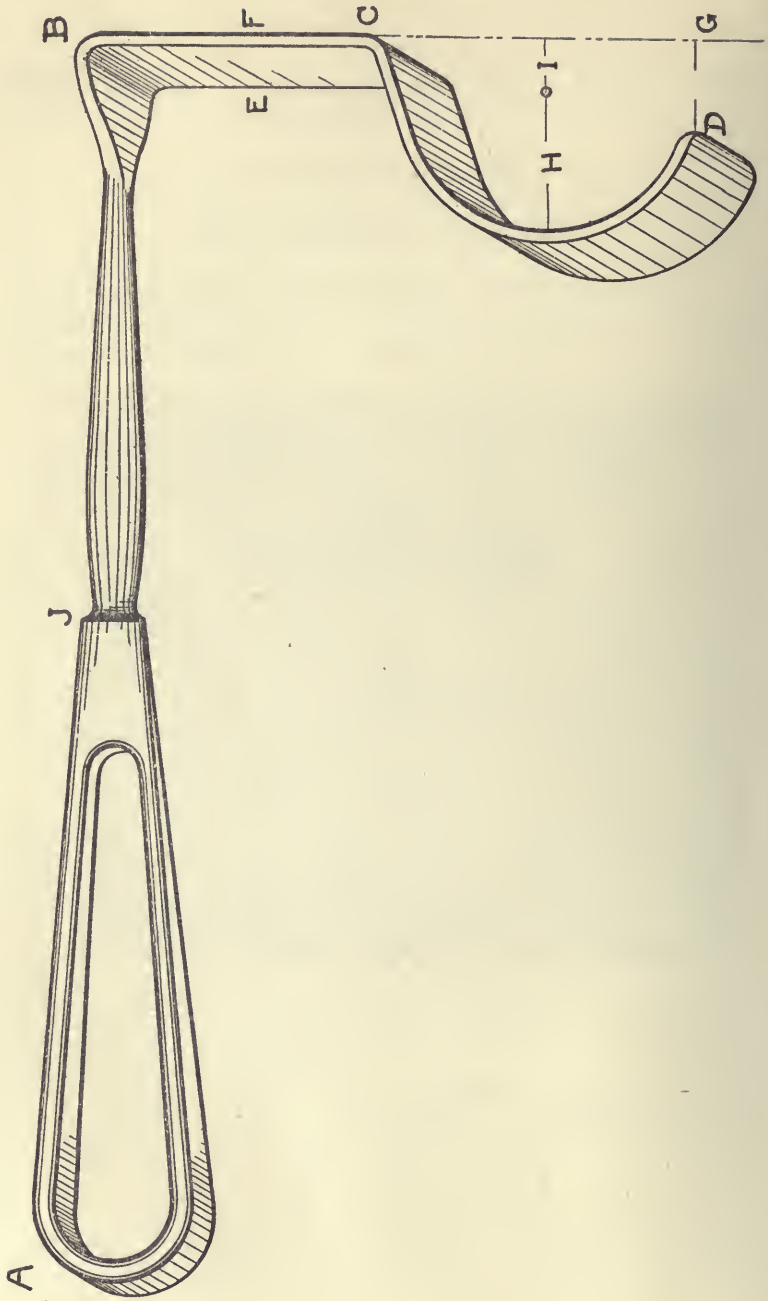
Associate in Surgery, Johns Hopkins University.

HAVING experienced much difficulty after a suprapubic opening in obtaining a good view of the floor of the bladder by means of the ordinary retractors, Dr. William Fisher and I had made, to facilitate this exposure, a new one, a cut of which is herewith given.

Description of the instrument: Length of the handle *a, j*, 10.5 cm.; length of the whole shaft *a, b*, 20 cm.; width of blade *e, f*, 2 cm.; length of straight vertical piece, *b, c*, 4.5 cm.; length of whole vertical piece, including curve *b, g*, 9.5 cm.; radius of curve *h*, 3.3 cm.; distance from lower end of straight vertical piece to tip of curve *c, d*, 5 cm.; distance from tip of curve to perpendicular drop from straight vertical *d, g*, 2.5 cm.; the lower end of the curve is cut off so as to set back and in this way gives equal retraction without obscuring the view.

The size of the instrument herein described I have found well adapted for average individuals. For very fat abdomens the retracting blade should be made deeper; that is, the straight vertical piece longer.

This instrument has proved very satisfactory and much superior to the ordinary retractors. It not only gives a most excellent view, but by its peculiar shape it raises the floor of the bladder and makes it more accessible to the operator. Three are usually necessary—one on either side and one in the upper angle of the wound.



MULTIPLE FRACTURES.

WITH AN ANALYSIS OF 240 CASES AND A REPORT OF SIX PATIENTS WITH
MULTIPLE FRACTURES OF THE UPPER EXTREMITY.*

BY ASTLEY P. C. ASHHURST, M.D.,

OF PHILADELPHIA.

VERY little is to be found in systematic works on surgery on the subject of multiple fractures; and, though there have been isolated reports of such cases, the subject, it seems to me, has not received the attention which it deserves. My own attention has been called to it from the unusual experience of having under observation at the Episcopal Hospital during less than five years, six patients with multiple fractures involving one upper extremity.

Malgaigne, almost alone among the writers of special monographs, consecrates some paragraphs to the questions of the frequency and prognosis of cases of multiple fractures. Among 2358 fractures from the records of the Hôtel-Dieu, he found 30 cases of multiple fracture, or 1.28 per cent. of the whole number. Among 5057 fractures which have been treated at the Episcopal Hospital within the last five years (1902-1906 inclusive), I have found records of 73 instances of multiple fractures, or 1.44 per cent.

According to Bruns, a series of 124 cases of multiple fractures was collected by Weber, Moritz, and Leisrink. Bruns found that among these patients the mortality was 40 per cent., no cases, of course, being included in which the original injury produced immediate death. The rarity of multiple fractures is due to this very fact, that so many patients die almost immediately after the injury. Among the 73 cases at the Episcopal Hospital, there were 20 deaths, a mortality of 27.4 per cent. In calculating this percentage, not only have cases of crush of

* Read before the Philadelphia Academy of Surgery, April 1, 1907.

the extremities, calling for immediate amputation, been excluded from the list, but those patients admitted in a state of profound shock, and dying in a few hours without reaction, have also been omitted; so that I think it is fair to conclude that 27 per cent. is close to the true mortality at the present day from multiple fractures themselves, without the added deaths that would be attributed to lesions of the brain and internal organs.

For the sake of comparison, the mortality of fractures in general may be seen from the following figures, which show that multiple fractures are just about ten times more dangerous than others:

PROTESTANT EPISCOPAL HOSPITAL, CASES OF FRACTURE 1902-1906.

Year.	Cases.	Recovered.	Died.	Mortality per cent.
1902.....	943	910	33	3.5
1903.....	927	899	28	3.0
1904.....	954	931	23	2.4
1905.....	1114	1088	26	2.3
1906.....	1119	1094	25	2.2
Total	5057	4922	135	2.7

Multiple fractures in general may be conveniently classified in three groups, as follows: I. Fractures of the skull or trunk and the extremities; *e.g.*, of the pelvis and the thigh, of the skull and the arm, of the spine and the foot, etc. II. Fractures of different extremities, including (*a*) Similar fractures, *e.g.*, of both legs, of both forearms, of both clavicles, etc.; and (*b*) Dissimilar fractures, *e.g.*, of the leg and the forearm, of the arm and the thigh, of the thigh and the opposite leg, etc. III. Multiple fractures confined to one extremity, as of the femur and one or both bones of the leg; of the humerus and one or both bones of the forearm, etc.

It is not usual to consider a fracture of two or more parallel bones, as of the ribs, or both bones of the forearm, or of the leg, as an instance of multiple fracture; still less should

a comminuted fracture, or even a multiple fracture of a single bone, be so considered. The latter injury is more correctly designated as a double fracture, a triple fracture, etc.

The accompanying table gives the distribution in 240 cases of multiple fractures, which have been collected from the following sources: Malgaigne, 30 cases; Index Catalogue of the Surgeon-General's Office, Series I, 100 cases; Series II, 37 cases; Records of the Episcopal Hospital, 73 cases.

DISTRIBUTION OF MULTIPLE FRACTURES.

	Mal- gaigne.	S.G.O.,I.	S.G.O.,II.	P. E. H.	Total.	Per cent.
I. Skull and extremities .	7	13	8	11	39	16.25
Trunk and extremities .	3	38	6	10	57	23.75
Skull and trunk	1	8	3	1	13	5.41
Trunk alone	0	5	3	2	10	4.20
II. Different extremities :						
Similar lesions	10	6	6	7	29	12.08
Dissimilar lesions	6	20	9	35	70	29.16
III. One extremity :						
Upper extremity	0	7	1	7	15	6.25
Lower extremity	3	3	1	0	7	2.90
Total	30	100	37	73	240	100.00

In addition to the above cases, Dr. W. J. Taylor and Dr. H. R. Wharton have each reported a case of such extensive multiple fractures that they deserve a class to themselves. Dr. Taylor's patient, who recovered, had in the left upper extremity fractures of the humerus through the surgical neck and through the middle of the shaft, and also of the radius and ulna close to the wrist; while in the right upper extremity she had a T-fracture involving the condyles of the humerus, a fracture of the radius and ulna in their upper third, and of the radius in its lower third. Dr. Wharton's patient, besides a compound fracture of the nose, had a fracture of both bones of each forearm, and a fracture of both thighs; he did well for a week, and then died rapidly, possibly of fat embolism.

The mortality of the various combinations of fracture may

be seen in detail in the following analysis of the Episcopal Hospital cases :

MORTALITY OF MULTIPLE FRACTURES AT THE EPISCOPAL HOSPITAL,
1902-1906.

	Total.	Rec.	Died.	Mortality per cent.
I. Of skull or trunk, and extremities :				
1. Skull and				
{ Upper extremity.....	6	6	0	.....
{ Lower extremity.....	5	2	3	60.00
2. Trunk and	8	3	5	62.50
{ Upper extremity.....				
{ Lower extremity.....	2	1	1	50.00
3. Skull and trunk	1	0	1	100.00
4. Trunk alone	2	2	0	.....
II. Of different extremities :				
1. Similar Lesions :				
Both forearms.....	3	3	0	.....
Both femora	2	0	2	100.00
Both legs.....	2	2	0	.....
2. Dissimilar Lesions :				
Upper and lower extremities....	20	15	5	25.00
Both upper extremities.....	6	6	0	.....
Both lower extremities.....	9	7	2	22.50
III. Confined to one extremity :				
Upper extremity	7	6	1	14.30
Lower extremity	0	0	0	.....
Total.....	73	53	20	27.4

The great amount of violence which attends the production of all these fractures makes the prognosis necessarily grave, and renders the prospect of recovering useful limbs more dependent upon the character of the injury than upon the treatment employed. When the head or trunk is involved, the injury is more apt to be due to a fall from a height, or to the patient being caught in machinery and tossed against the walls of the room. It is often due to the patient being struck and thrown by a locomotive or a trolley car. In the second class the patient is more apt to have been injured by a crushing force, as the passage of a wheel over the extremities, or the fall of a heavy beam. In the third class, which is the smallest of all, and to which all of the patients reported to-night belong, falls and machinery accidents hold about equal place. In the 18 examples of this injury which it has been possible to find

recorded, the cause in 4 is unknown; in 7 the patients were caught in revolving machinery, in 5 they were injured by falls, and in 2 the accident was due to their being knocked down, run over, and dragged by moving vehicles.

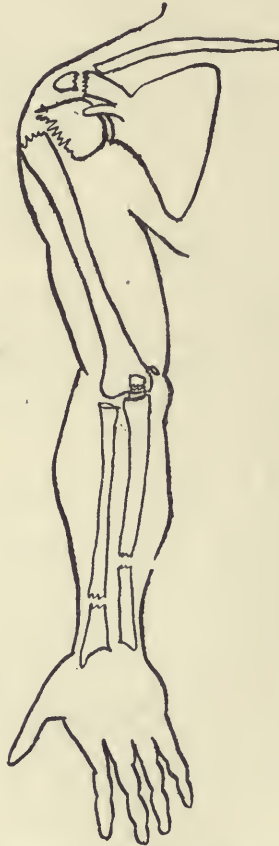
In such severe injuries as these it is frequently impossible to do more for the patients when they are first admitted than to combat the shock. Thus in one of the cases reported to-night, reduction of a dislocated hip was not accomplished until the third day after admission; and in another patient over three weeks elapsed before his precarious condition made it seem advisable to have him removed to the second floor for skiagraphic examination. It is on this account that accurate coaptation of the fragments cannot always be obtained, as well as for the reason that the injuries to the soft parts are often of more pressing importance.

The chief difficulty in the treatment of multiple fractures involving the upper extremity consists in the fact that many of these patients are necessarily confined to bed for a number of weeks after the injury, and that therefore deformity in the humerus is hard to prevent, since the weight of the forearm, which is available in the ambulatory treatment of fractures of the humerus, cannot be used when the patient is confined to bed. This fact, together with the absolute obliteration of all landmarks from œdema, was the cause in Case I of the projection of the lower fragment at the shoulder joint, so as nearly to penetrate the skin, necessitating excision. In Case III the muscular contraction was so violent and spasmodic that even the use of weight extension to the lower fragment of the humerus, while the patient was in bed, suggested by Dr. Hutchinson, together with heavy shot bags over the seat of fracture, was not sufficient for a long time to keep the fragments in position.

In spite of the gravity and extent of the injuries, if once the patient survive the immediate effects of the accident, there is no good reason why union of the fractures should not occur, and the limbs prove eminently useful. Indeed, Dupuytren contended that the very multiplicity of the fractures tended

to promote rapid healing, since the pain, discomfort, and inflammatory reaction are distributed among many parts, instead of being concentrated in one: somewhat upon the same principle, I suppose, that it is said a man does not feel the dentist treading on his toe while his tooth is being pulled.

FIG. 1.



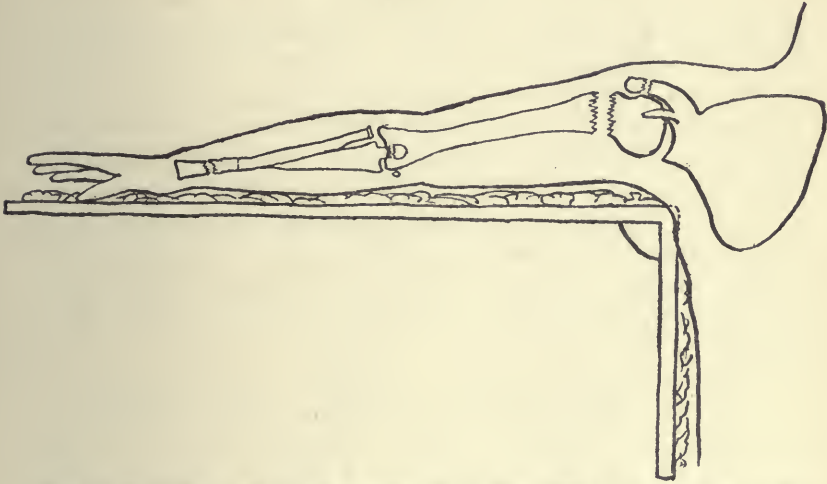
CASE I.—Fracture of acromion, of surgical neck of humerus, of internal epicondyle, of olecranon, of radius, and compound fracture of ulna.

Dupuytren says (I quote from Packard's translation of Malgaigne) "that the danger of wounds and fractures, although doubtless increased by an increase in their number, is still not in direct ratio with that number. At first sight, one would

presume that several fractures complicating one another would naturally react unfavorably, each one thus giving rise to graver symptoms than if it had occurred alone. Now, the contrary is true; when there are several fractures, each one induces slighter symptoms than if it were by itself; and Dupuytren, after at first viewing this fact with astonishment, became assured of it, and looked for it subsequently, as natural and to be expected." These remarks of Dupuytren prove the correctness of that saying of Heister: "*In prædicendis fracturarum eventibus magna utique chirurgis opus est circumspectione.*"

I am indebted to my chiefs at the Episcopal Hospital for permission to report the following cases. The first four, in

FIG. 2.



CASE I.—After excision of part of shaft of humerus, arm was dressed at right angle with chest.

the services of Drs. Neilson, Deaver, and Harte, came under my care as resident; and the two last were treated this winter in the out-patient department:

CASE I.—Michael C., 15 years (P. E. H. No. 867), admitted May 6, 1902, had fallen 40 feet from the side of a ship where he was at work, landing on the dock. *Diagnosis:* Fracture of both bones of forearm, in lower third (compound of ulna); fracture of olecranon; fracture of internal epicondyle of humerus; high

fracture of surgical neck of humerus; fracture of acromion process of scapula; shock. The fractures all involved the right side. The dressing consisted of a Bond splint, an axillary pad and a shoulder cap of binder's board; the arm was bandaged to the chest, the elbow being extended and the forearm in supination. The dressings were changed every other day at first, owing to the very great œdema. Ice-caps were applied to the arm from shoulder to elbow. The œdema in a few days became so great that it was uncertain whether gangrene might not ensue.

May 11.—The œdema is less. The wound of compound fracture of ulna is healing.

May 22.—Union progressing. Bone projecting beneath skin of shoulder thought to be comminuted acromion. Shoulder very black and blue. No landmarks palpable yet.

May 29.—Anterior obtuse angled splint, and posterior straight splint to forearm. Binder's board shoulder cap as before. Union apparently firm throughout. At normal site of coracoid process, below clavicle, is a bony prominence, apparently too large for coracoid, but it seems hardly possible that it is the head of humerus in subclavicular dislocation. The comminuted acromion moves with, and seems immovably fixed to shaft of humerus.

June 1.—Skiagraph of shoulder joint shows high fracture of surgical neck of humerus, upper end of lower fragment almost jutting through skin below acromion. The head of humerus is apparently in glenoid cavity. (Fig. 1.) Out of bed in wheelchair.

June 3.—Walking about ward. Four weeks since injury.

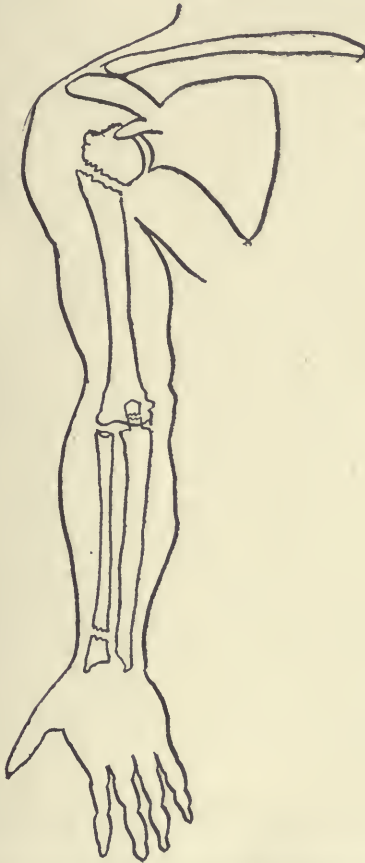
June 5.—*Operation*: Partial excision of right humerus, by Dr. Thomas R. Neilson. Ether. Incision in line of deltoid fibres from acromion down about 5 inches. Muscular fibres separated and bone bared. Shaft of humerus united by fibrous union in malposition with head of humerus. Fracture below anatomical neck. Fragments separated, shaft turned out through wound, and about $1\frac{1}{2}$ inches excised, subperiosteally, with saw and nippers. End of shaft returned and fractured parts put in good position. This was accomplished by abducting the arm to a right angle with the body. (Fig. 2.) Iodoform gauze drain, silkworm gut sutures. Arm dressed in semipronation, and held at right angles with body by long right angled splint. Short posterior splint to forearm, and shoulder cap of binder's board.

June 6.—Dressings reinforced on account of bloody ooze. Much pain all night, none to-day.

June 9.—Dressed. Parts in excellent condition; about half of gauze drain removed. The fractures of forearm show slight anterior bowing. No special dressing for olecranon.

June 12.—Dressed. Drain entirely removed. No oozing.

FIG. 3.



CASE II.—Fractures of surgical neck of humerus, of olecranon, and of radius.

June 15.—Dressed. Looped stitch at site of drainage tightened. All other sutures removed.

June 19.—Arm put at angle of 45° with body, with acute angled anterior splint in axilla. Slight anterior prominence of head of humerus corrected by a pad.

June 22.—Out of bed. While in bed lay very quietly on back. The best patient I ever had.

June 24.—Dressed with obtuse angled internal angular splint. Considerable pain in flexing elbow to this extent—about 135° .

June 30.—Dressed with right angled internal angular splint (Physick splint).

July 2.—Fergusson's dressing for fractures about shoulder. No splint to forearm, which is carried in bandage sling at wrist.

July 3.—Discharged cured; to return to Dispensary for occasional dressings.

February 20, 1907.—Returned in answer to letter. All functions of upper extremity are perfect, including rotation of forearm, and external rotation of humerus. From the left acromion to the head of the radius measures 29.5 cm. On the injured side the distance is 26.5 cm. There is no visible or palpable deformity anywhere. The patient, now a grown man, does heavy laboring work, and would not know his arm had ever been injured, except that it is a little shorter than the left, and he is therefore obliged to have his clothes made to order.

CASE 2.—E. B., 38 years (P. E. H. No. 1083), admitted June 1, 1902, was a fireman, and had fallen from a ladder. The height is not known. *Diagnosis*: Fracture of radius in lower third, fracture of the olecranon, and high fracture of surgical neck of humerus, all on the right side. *Dressing*: A straight anterior and short dorsal splint to forearm, the fracture of humerus being masked by great swelling.

June 5.—Skiagraph shows fracture of shoulder. Dressed with long straight anterior splint, from axilla to finger tips, and short dorsal splint to forearm, which was held in semipronation; shoulder cap of binder's board, and arm fastened to chest by broad binder. Lies on back very quietly. Redressed from time to time.

July 2.—Out of bed, elbow still in full extension.

July 3.—Obtuse angled internal angular splint applied; short posterior splint to forearm, and shoulder cap.

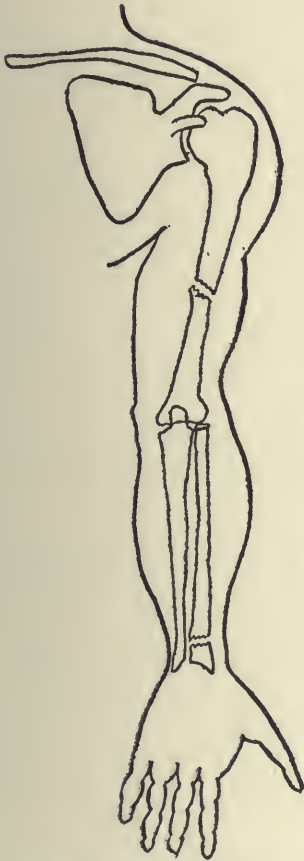
July 5.—Right angled internal angular splint, other dressings as before.

July 7.—Fergusson's dressing applied. Over 5 weeks since injury; all fractures firm, little deformity. Discharged.

It has been impossible to trace this patient.

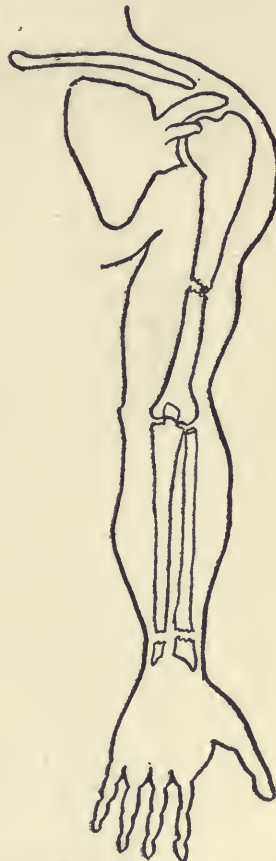
CASE 3.—J. C., 38 years (P. E. H. No. 2029), admitted September 27, 1902, was a pipe-fitter, and fell 40 feet from scaffolding, striking earth with left arm and shoulder. No unconsciousness. On admission: mind clear, considerably shocked.

FIG. 4.



CASE III.—Fracture of L. humerus below insertion of Deltoid, and Colles's fracture of L. radius. (Also dislocation of R. hip.)

FIG. 5.



CASE IV.—Fracture of L. humerus below insertion of deltoid; Colles's fracture L. radius, and fracture of L. ulna, lower fifth.

Diagnosis: Fracture of humerus below insertion of deltoid, and Colles's fracture of radius, both on left side; dislocation of right femur into ischiatic notch, where head of bone is easily felt: shortening $1\frac{1}{2}$ inches, adduction, and inversion of the affected

limb. Deformity of fractures easily corrected by extension and manipulation. *Dressing*: Bond splint to forearm; short internal splint to humerus, with shoulder cap of binder's board. Dislocation of hip not reduced on account of shock.

September 28.—Patient has reacted well. Under ether an unsuccessful attempt made to reduce dislocation by flexion and circumduction.

September 30.—Dr. Harte, with Drs. Neilson and Deaver in consultation. Patient again etherized, and hip successfully reduced by manipulation and vertical traction. Buck's extension and sand bags.

October 1.—Arm dressed. Colles's fracture in good position, forearm in semipronation. Fracture of humerus below deltoid in very bad position indeed, lower fragment drawn up into axilla, and upper jerking out against skin. With considerable difficulty fragments were brought into position and maintained with firm bandaging of shoulder cap. Hip painful. Patient very restless. Temperature 100° to 101° F. Ordered to take potassium bromide, gr. xx, every 3 hours.

October 4.—Dressed. Humerus recurs to its deformity as soon as bandages are removed, and probably was not in good position even before unbandaging.

October 5.—Dr. Hutchinson recommended weight extension from elbow. This was applied, with forearm in full pronation, and with upper arm abducted from body to angle of 45° . This dressing completely corrects the deformity. Shot bags laid on top of arm, over shoulder cap. Temperature nearly normal.

October 10.—Dressed. No union in humerus; deformity is apparently fairly well corrected when shoulder cap is in place. The upper fragment of Colles's fracture is in dorsal deformity, being supinated by the biceps, whereas the forearm must be kept in full pronation while weight extension is maintained. Patient is extremely contrary; will not lie still, pulls off bandages, kicks sand bags on floor, and seems to do everything possible to retard his cure. He has no delirium, and seems to be restless for the mere sake of aggravating his disorder.

October 17.—Dressed; some union of humerus. Extension to arm continued. Deformity less. Patient very much quieter. Hip extension removed. Three weeks since injury.

October 24.—Dressed. Four weeks since injury. Radial union good; position good; wrist a little stiff. Lower fragment

of humerus still tends to draw upwards and inwards. Patient of model deportment.

October 31.—Extension removed from arm. Five weeks since injury; 26 days since extension was applied to arm. Union in humerus quite firm. Little visible deformity; fair amount of callus. Arm brought in to side of chest; Bond splint left off; elbow flexed with difficulty to nearly a right angle; and a modified Fergusson's dressing applied. During use of extension to humerus, forearm was at angle of about 105° with arm, and elbow is now quite stiff. Sitting up makes patient faint and giddy. Right knee and leg feel somewhat numb. Functions normal, no pain at hip.

November 14.—Soon after last note got out of bed, and to-day was discharged.

February 19, 1907.—Returned in answer to letter. Still employed at Cramp's ship-yard, and says his arm is perfectly useful. There is no noticeable deformity. There is 0.5 cm. shortening in the fractured humerus, none in the forearm. No callus felt anywhere. Can completely extend elbow, but flexion beyond 80° is impossible. Pronation of forearm is complete, but supination is only about three-fourths complete—that is to say, there is rotation of about 135° instead of 180° .

CASE 4.—A. W., 65 years (P. E. H. No. 2387), admitted November 12, 1902, fell against the steps of the house where she lodged, while intoxicated. History of accident is incomplete. *Diagnosis*: Fracture of humerus below insertion of deltoid, Colles's fracture of radius, fracture of ulna in lower fifth—all on the left side; acute alcoholism, general contusions, acute bronchitis, lacerated wound of left eyebrow. *Dressing*: Bond splint, forearm in full supination; elbow extended; shoulder cap, axillary pad, arm bandaged to side. Lies on back in bed.

November 14.—Developed delirium tremens.

November 15.—Dressed. Fractures in fairly good position.

November 17.—Dressed. Delirium tremens worse.

November 29.—Pulse failing.

December 1.—Chill. Temperature 105.6° F.

December 2.—Diffuse bronchitis. Dressed.

December 6.—Stuporous. Temperature 101° F.

December 7.—Uræmic. Urine very scanty. Temperature 103.4° F. Fractures united in good position.

December 11.—Died. Temperature 108° F.

CASE 5.—H. D. E., 57 years (P. E. H. No. 3579), admitted November 26, 1906. Was knocked down and run over by coal wagon, while intoxicated. Admitted in semi-conscious condition. *Diagnosis:* Lacerated scalp, comminuted fracture of left humerus above insertion of deltoid; compound comminuted fracture of both bones of left forearm in middle third. Seen in Dispensary 5 days later, with no union of any of the fractures, overlapping of fragments of humerus, and deformity of forearm. Forearm was dressed in full supination, with long palmar and short dorsal splints; moulded coaptation splints of binder's board to humerus, with shoulder cap of same material, and arm bandaged to chest. Wrist supported by sling. Progress of case uneventful. Forearm alone was redressed December 10, and whole upper extremity redressed on December 13. All fractures were then found to be knitting. Redressed December 20 and December 27, on which latter date all fractures were found solid. There was considerable deformity from œdema below elbow, and apparently some outward bowing of bones of forearm. Only the long palmar splint and the shoulder cap were replaced.

January 5.—Dressed. Long splint on ulnar side of forearm, short dorsal splint, and a third splint on external (radial) surface, to overcome the outward bowing.

January 8.—œdema much less. Lower fragment of radius apparently united to upper fragments of both radius and ulna, leaving lower fragment of ulna partially ununited. Same splints continued. Skiagraph made laterally shows some dorsal displacement of both lower fragments.

January 15.—Ulna seems firmer.

January 22.—Radius very firm. Skiagraph made antero-posteriorly confirms notes made January 8.

February 1.—Ulna is decidedly firmer. Rotation of about 45° from full supination. Only long dorsal splint continued.

February 12.—Referred to Orthopædic Hospital (Dr. G. G. Davis) for massage and passive motion.

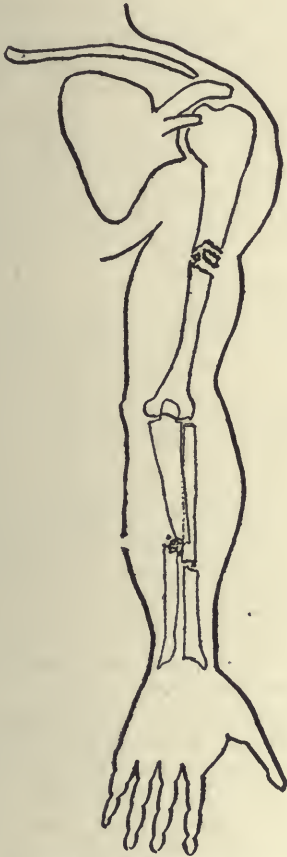
February 23.—Can almost make a fist. Rotation a little more extensive. To continue treatment.

March 25.—Has been working as usual, for some weeks, at saw-making. Finds little disability from injury. There is considerable deformity in forearm, the bones being bowed to radial

side. Rotation a little more extended. Can make a fist. Strength is normal.

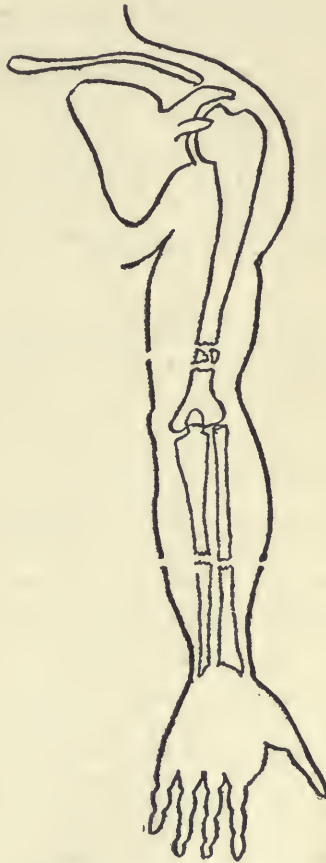
CASE 6.—A. M., 14 years (P. E. H. No. 3860), admitted December 22, 1906. Caught in belting, carried around and thrown to ground. *Diagnosis:* Compound comminuted fracture

FIG. 6.



CASE V.—Comminuted fracture of L. humerus, above insertion of deltoid; compound comminuted fracture of both bones of L. forearm.

FIG. 7.



CASE VI.—Compound comminuted fracture of L. humerus, lower third; compound fracture of both bones L. forearm.

of left humerus in lower third; compound comminuted fracture of both bones of left forearm at junction of middle and lower third. Seen in Dispensary nine days later. Some union in forearm, but

both bones were bowed to ulnar side. No union in humerus, the lower fragment being drawn up and back by triceps, upper fragment being pulled forward and in by deltoid and muscles of axillary folds. Dressed precisely like Case 5.

January 9.—Dressed. Position of all fragments excellent. Wound over inner surface of humerus healing, that over ulna scabbed. Fair union in all fractures.

January 16.—Dressed. All fractures firm. Moderate amount of callus over humerus; wounds all healed solid. Rotation of forearm from full supination to mid-pronation good.

January 23.—Dressed.

January 30.—Dressed. Long dorsal splint and shoulder cap only. All fractures solid, and motions good.

February 6.—To wear only a handkerchief sling. All functions perfect, except extension of elbow, which is possible only to 140° .

February 16.—Elbow can be extended to 150°

March 2.—Arm normal in every respect, but elbow can be extended only to 165° , owing to callus around comminuted fracture of humerus.

N.B.—Patients 1, 5 and 6 were exhibited to the Philadelphia Academy of Surgery, April 1, 1907.

For the sake of completeness the following abstracts of cases of multiple fractures confined to one upper extremity are added. These, with the six original cases just reported, comprise all examples of this injury it has been possible to find.

7. ALQUIÉ (Gaz. Méd. de Montpel., 1846-1847, vii, 84). Fracture of clavicle and humerus. (Access has not been had to this journal.)

8. BLUM (Arch. Gén. de Méd., 1887, xx, 214). Patient caught in revolving wheel: compound comminuted fracture of left humerus, fracture of left radius, and compound fracture of left ulna. Shoulder joint amputation on third day for traumatic emphysema. Recovered.

9. DAVIS, G. G. (Records of Episcopal Hospital, Phila., No. 320 of 1906). Male, 14 years, caught in revolving machinery. Admitted January 27, 1906. Shock; transverse fracture of left humerus in lower third, fracture of both bones left forearm in upper third, compound fracture of both bones left forearm in lower third, compound fracture of several fingers. Dressed on posterior splint; irrigation for 1 week. Recovered with good rotation of forearm, and flexion and extension of elbow. Discharged March 8, 1906.

10. GREEN (N. Y. Med. Record, 1880, xvii, 538). Caught in a re-

volving wheel: fracture of left humerus through surgical neck and in lower third; fracture of left ulna in upper third; compound fracture of left radius and ulna in lower third. Dressed in plaster of Paris; elbow in full extension for a week, then flexed to right angle. Recovered with good functions.

11. LABORIE (Bull. Soc. de Chir. de Paris, 1866-1867, 2 sér., vii, 297). Patient seen 3 months after injury, which had produced multiple fractures of right scapula, clavicle and humerus, and a posterior dislocation of right shoulder. Fractures all had united except in humerus, where false joint persisted.

12. MARIANI (Rev. de Med. y Cirug. práct., Madrid, 1882, vi, 110). Double comminuted fracture with wound of forearm and arm. (Access has not been had to this journal.)

13. NICHOLLS (Lancet, 1873, i, 877). Knocked down and dragged by horses: fracture of left humerus above deltoid, compound fracture below deltoid; posterior dislocation of left elbow, and fracture of both bones left forearm in middle third. Dressed in full extension for three days; splints then abandoned on account of œdema. Recovered with much deformity and poor function.

14. PACKARD (Internat. Encyclop. of Surg., Ashhurst, Revised Ed., N. Y. 1888, V. iv, p. 18). Male, 22 years, caught around a revolving shaft: fractures of humerus, radius, ulna, and metacarpus. Recovered with almost perfect functions.

15. PEZEVAT (Jour. Compl. du Dict. des Sc. Méd., Paris, 1831, xl, 276). Caught in revolving wheel: fracture of left clavicle, posterior dislocation of left elbow, and fracture of both bones of left forearm in lower third. Arm laid on pillows; recovered with fair function.

16. ROBERTSON and FIFIELD (Bost. Med. and Surg. Jour., 1877, xcvi, 570). Fall; fracture of right humerus above condyles, Colle's fracture of right radius. Dressed in full extension: good recovery.

17. SCHWARTZ (Bull. et Mém. de la Soc. de Chir. de Paris, 1904, xxx, 1102). Fracture of surgical neck of humerus, and fracture of lower extremity of radius. Plaster cast to forearm; and on sixteenth day after injury weight extension to humerus. Union reported progressing.

18. Since the above was written there has been admitted to the Surgical Dispensary of the Episcopal Hospital, another patient with multiple fractures of the upper extremity, for notes of which I am indebted to my Resident, Dr. Price. Male, 20 years, was caught in a revolving shaft on March 16, 1907. He sustained fractures of the left humerus in lower third, and of both bones of left forearm in middle third. He was treated precisely as were Cases 5 and 6: progress satisfactory.

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FRACTURES OF THE HEAD AND NECK OF THE RADIUS.

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THAT fractures of the head and neck of the radius occur occasionally has been demonstrated positively by dissection, but that they are more than surgical curiosities will probably be disputed by many. Skiagraphic evidence collected by the writer¹ tends to show that they deserve a place among the common fractures.

It is remarkable that so important a fracture should have escaped the attention of the profession until 1834, when Berard² discovered the first reported case, at autopsy, almost by accident. In 1880 Bruns³ could collect only 21 cases from the literature, 20 of which had been proven by anatomical investigation, and in 1905⁴ the writer could find only 48. In skiagraphic collections in Philadelphia 55 more were discovered.

The essential facts concerning vertical fracture of the head, to which the writer has called attention, may be briefly summarized as follows: The approximation of the fragments may be so close that the skiagraph may fail to show the line of fracture, especially if the rays are directed in an incorrect plane. It is always intracapsular, and frequently fails to give crepitus or deformity, the fragments moving together as one piece within the closely fitting orbicular ligament. In a fall on the hand with the elbow extended only the anterior part of the radial head is in contact with the humeral condyle, and when the head is fractured it is this part which is broken off. Since the forearm is almost always in pronation in a fall forward on the hand, and since most falls on the hand are forward, the

¹ University Medical Bulletin, September and October, 1905.

² Diction. de Med., 1835, en 30, vol. t. lx, p. 228.

³ Centralblatt f. Chirurgie, 1880, vol. vii, p. 353.

same part of the head is broken off in most cases. Although the X-ray, when available, should always be employed, the diagnosis in an uncomplicated case may be made by the symptoms. A history of a fall on the hand is important. The resulting swelling will not be commensurate with the degree of pain and impairment of function, and will be most marked on the outer side of the elbow. Exclusion of fracture of the humerus, ulna, and shaft of the radius, will be possible without great difficulty. There will, however, be severe pain and tenderness localized to the head of the radius, and limitation of all the movements of the elbow will be evident, more particularly of pronation and supination. Crepitus when present is not marked. Ankylosis of all the movements of the elbow, more or less marked, during the first month or two following the fracture, is almost pathognomonic.

Dr. Henry K. Pancoast, skiagrapher to the Hospital of the University of Pennsylvania, has kindly placed at the disposal of the writer his collection of skiagraphs of this fracture. Because of the absence of histories in most of the cases, and the obscurities necessarily associated with the skiagraphs, positive conclusions are reached with some difficulty. The greatest difficulties arise from the close approximation of the fragments and the fact that the fragments moving together as one piece within the orbicular ligament, it is exceedingly difficult to determine with anything like accuracy in what direction the line of fracture runs. It is thus evident that in directing the rays for the exposure of the fracture there is considerable risk that no fracture will be shown by the skiagraph. The skiagraphs which illustrate this paper will, however, emphasize forcibly some important points, *e.g.*, the close approximation of the fragments, and the absence of deformity. We have only to imagine the closely fitting orbicular ligament in position to obtain a sufficient explanation for these conditions, and for the frequent absence of crepitus. The writer would call particular attention to the relative frequency with which the faint line of fracture is shown by a lateral exposure of the elbow to the X-ray, although it is more

or less obscured by the coronoid process of the ulna. An effort will be made later to explain the advantages of this position.

When the writer read his first paper on this subject before the State Medical Society of Pennsylvania in 1906, Dr. Pancoast reported that he had skiagraphs of 19 cases. Those for 23 are now available, while several more have been loaned to physicians who have not yet returned them. He considers that he has now about 30 in all. Of these 23, 11 may be positively included among the vertical fractures of the head. Five more are probably of the same type, 2 are injuries of the upper epiphysis of the radius, and 5 are fractures of the neck.

Of the 23, 10 are uncomplicated fractures of the head and 3 are uncomplicated fractures of the neck, while the two cases of epiphyseal injury are also uncomplicated. Four are complicated by posterior dislocations of the elbow, and one by an anterior dislocation of the radius. Two are complicated by transverse fractures of the humeral condyles. These figures corroborate to a marked degree the facts already shown by the literature.

In about 7 of the uncomplicated fractures of the head, so far as can be judged from the skiagraphs, the small detached fragment is anterior in the prone position of the forearm. In the 4 cases complicated by posterior dislocation of the elbow, the fragment is anterior and below its normal position. The writer concludes that it was driven downward by the impact of the condyle, when the forearm was in pronation, as in a fall on the hand.

In order to emphasize more forcibly the difficulties in skiagraphy of the vertical fractures of the head, the writer has prepared two skiagraphs of an experimental fracture of this type (see Fig. 1 a and b). They will serve to call attention to the necessity for care in the interpretation of a doubtful skiagraph. The specimen represents a complete fracture separating the anterior third of the head, with the forearm in nearly full pronation, *i.e.*, in the position taken by it in the usual fall on the hand, which accident is probably responsible for most of the cases. For one skiagraph the forearm bones were placed

FIG. 1-A.



Vertical fracture of the head of the radius, experimental. Antero-posterior view. Forearm in nearly complete supination.

FIG. 1-B.



Vertical fracture of the head of the radius experimental—lateral view. Forearm in pronation.

FIG. 2.



Line of fracture.

Vertical or oblique fracture of radial head in a young subject without injury of upper epiphysis. Lateral view.

FIG. 3.



Vertical fracture of head of radius without injury of upper epiphysis. Lateral view.

FIG. 4.



Vertical fracture of head of radius. Coronoid process of ulna obscures greater part of fracture. Lateral view.

FIG. 5.



Vertical or oblique fracture of radial head. Lateral view.

FIG. 6.



Uncomplicated fracture of radial head in adult.

FIG. 7.



Uncomplicated vertical fracture of radial head in adult. Non-union.

FIG. 8.



Transverse or oblique fracture of radial neck in young.

FIG. 9.



Fracture of neck of radius with typical deformity.

FIG. 10.



Line of fracture

Fracture of head of radius complicated by fracture of humerus and olecranon.

FIG. 11.



Fracture of head with anterior luxation of the radius. Lateral view.

FIG. 12.

Detached fragment of head.



Fracture of head with post. luxation of elbow.

in the position of nearly full pronation, the detached fragment being then anterior, and the line of fracture passing transversely. A lateral view was then taken; that is, the rays were made to pass as nearly as possible in the line of fracture, this line being slightly angular. For the other skiagraph, the bones were so placed that the line of fracture passed as nearly as possible in an antero-posterior plane, *i.e.*, the bones were placed in a position about midway between full supination and the mid-prone position. An antero-posterior view was then taken. If the forearm were in full supination, the detached fragment would have occupied a postero-external position and the line of fracture would have passed obliquely from about the external surface of the head to the posterior surface, and would, therefore, have been in an unfavorable position for an antero-posterior or a lateral view.

In comparing these two skiagraphs with those occurring in the living, it should be borne in mind that all the soft tissues were removed from the specimen, the bones being cleaned by scraping and the ligaments by close dissection. The elbow joint had been opened freely, which explains the abnormal relations of the bones, but the orbicular ligament was in place and the fragments closely approximated, as they frequently are in life. In the living there will probably always be some slight movement of the limb, because of the flash and noise of the X-ray machine, so that the absence of movements in the specimen added to the clearness of these two skiagraphs. Moreover, the obscurities from over and under exposure have been well avoided. It is evident, therefore, that we have here two skiagraphs of this obscure fracture, made under the best possible circumstances. How much more obscure would such a fracture have been in the living, with all the tissues, now swollen, in place, the slight movements during the exposure to the X-ray, and the practical impossibility of knowing the exact direction of the line of fracture.

If the rays are directed at right angles to the line of fracture, the skiagraph will probably be negative in most cases. Is it possible to determine the direction of the line of fracture.

so that we may pass the rays directly through the line of fracture or nearly so? If the fracture is due to a fall forward on the hand, and most of them probably are, then we know that at the moment of impact the fragment is anterior, and that the forearm is in pronation; since in all positions of the forearm with the elbow in extension, only the anterior part of the radial head is in contact with the external condyle, and in a fall forward on the hand the forearm is in pronation. With the forearm in this position, therefore in a lateral exposure the rays should pass directly or almost directly in the line of fracture. In the writer's opinion this is the best view to obtain, in most cases. Because the direction of the rays will vary more or less in each case, sometimes the fracture shows above the coronoid process, sometimes below, or both, sometimes through it, and at other times in front of it. Another advantage in favor of this position is the fact that owing to the disturbance within the joint, the pain is so great that for some days at least no other position will be permitted by the patient.

If the forearm could be so placed that the detached fragment was exactly external, an antero-posterior exposure to the X-ray would give a skiagraph of the line of fracture not obscured by the coronoid process. One of the great difficulties, however, is in judging accurately the position of the forearm, when an attempt is made to supinate it. It should be borne in mind that the shoulder is responsible for a considerable degree of rotation and to what extent the shoulder and elbow are contributing in a particular case has not been easy to decide. The writer has seen only one case in which a satisfactory result was obtained with an external fragment, and that was in his first case, which was quite the result of chance, as nothing was then known of the mechanism of the fracture by the writer or the skiagrapher. On the other hand, he has repeatedly obtained a satisfactory exposure by a lateral view with the forearm in pronation.

Unfortunately all falls on the hand are not forward, and the hand is not always in pronation at the moment of impact. As it is always the anterior part of the head which will receive

the brunt of the force from the external condyle, whatever the degree of rotation, it is evident that a different portion of the head will be involved at the moment of impact with each change in the degree of rotation. It is a fact, therefore, of the greatest importance that most falls are forward, when the hand is usually in pronation, since from that fact we know the positions of the fragment and the line of fracture.

In some cases it was observed that in the first week following the accident, after the acute symptoms had subsided, a considerable degree of rotation was possible. This is due to the close approximation of the fragments, and their inability to move on each other, the head moving as a whole within the orbicular ligament. The more perfect the approximation, the more quickly will rotation be permitted. It is probable, however, that only in very rare cases will complete supination be possible until some weeks after the fragments have united. In this type, the vertical fracture of the head, rotation is most disturbed at the time of the accident and for some weeks later, but it is more rapidly restored than is flexion and extension. While the acute symptoms at the time of fracture are distinctive of this injury, it is this persistent limitation of flexion and extension and less markedly of pronation and supination, for some weeks following union, that is most characteristic, in the absence of crepitus or a skiagraph showing a line of fracture. When there is wide separation of the fragments or the neck is broken, the skiagraph will have little difficulty in disclosing the fracture. Much care will be necessary in the taking and the interpretation of the skiagraph, in the ordinary vertical fracture of the head, and due attention must be given to the symptoms, if overlooking this frequent and important fracture is to be avoided.

The following case occurring in the practice of Dr. H. A. Smith, of Philadelphia, illustrates a condition in which the skiagraph will be of no avail, however carefully and skilfully it is taken:

A boy, 6 years old, fell from a height of three steps on his left side, without knowing what part of his body struck the

ground. When he was brought into the house his mother says that the affected arm hung helpless at his side and that the pain was very severe. He could not then move the elbow. When Dr. Smith saw him some hours later, there was considerable swelling on the outer side of the elbow. Palpation of the condyles of the humerus, the whole of the ulna and the shaft of the radius, did not reveal a point of tenderness or pain. But directly over the head of the radius the pain and tenderness were very severe, both on direct pressure and any attempt to move the forearm. Dr. Smith made the diagnosis of fracture of the head of the radius. At the doctor's request the writer examined the patient and reached the same conclusion. Since ossification in the radial head does not begin until the fifth year, the skiagraph did not promise help in establishing this diagnosis. Two skiagraphs, however were tried, one giving a lateral and the other an antero-posterior view. No shadow of the head was obtained in either. In such a case, if the diagnosis is to be made, it must depend on the symptoms; and in this case they were typical at this stage. Twenty-four days later the writer examined the patient for the characteristic limitation and found it distinct and typical. The early marked limitation of rotation had disappeared almost entirely, but the flexion and extension, as is also usual, were more distinctly limited, both to about ten degrees of the normal. There was now no pain on movement, and the patient could lift an ordinary kitchen chair with both hands, the affected arm apparently doing as much work as the right. Every sign of fracture of the head, therefore, peculiar to those cases in which the skiagraph had shown positive fracture, was present in this case, and in the writer's opinion pointed to a positive fracture of the cartilaginous head.

A case, somewhat similar to the preceding, occurred in the practice of Dr. W. Drummond of Philadelphia, in a man about middle life. It was the writer's privilege to examine this case also. There was a distinct history of a heavy fall on the hand from a wagon. Every symptom pointed to a severe injury of the radial head and of no other bone, while the later history showed the typical limitation of movement for some weeks after union. The skiagraph showed only the slightest sign of fracture on the under surface of the head, although this was distinct. If the skiagraph were absolutely negative, the writer would still make a positive diagnosis of fracture of the head as in the previous case.

In most cases of this type union occurs in about 4 weeks and the limitation of movement rapidly disappears in a few weeks following the removal of the dressings. This was so in cases seen by Drs. A. C. Wood, W. Drummond, H. A. Smith, E. Y. Rich, of Philadelphia, and A. B. Donaldson, of Bala, Pa. In two cases already reported by the writer, union occurred in the usual time in one, while in the other during rough manipulations by the masseur a refracture occurred, showing that the union was probably fibrous. In both the return of function was equally rapid and complete, although in the latter slight crepitus shows that non-union is still present.

The writer succeeded in following up two of Dr. Pancoast's cases. In connection with one the mother of the boy said that the patient failed to return for dressings after the first visit. The original dressing was kept in place for a week or two and was then taken off, the mother thinking the injury trivial. Full function returned. In the other case the fracture occurred about 10 months ago. When the writer found him recently, the patient had become very much discouraged, and he was contemplating giving up his usual occupation to take up lighter work. There is a constant annoying pain in the elbow, and when using the limb vigorously at his work the pain is transferred down the forearm (probably from pressure on the posterior interosseus nerve, which winds closely around the head and neck of the radius). Occasionally there is pain in the wrist and at rare intervals the pain in the elbow is very severe. Extension could be carried only to about 30 or 35 degrees of the normal. Limitation of rotation was slight and almost inappreciable. It is worthy of note that at the time of the fracture, 10 months ago, slight but distinct crepitus was elicited, showing that there was some movement between the fragments. The skiagraph now shows an ununited fracture.

If these fractures of the upper end of the radius have been common, then it would be interesting to know how many or what percentage leave permanent disturbances, as in the preceding case. Again the question naturally arises as to whether an injury so obscure at the time of its occurrence will give signs long afterward sufficient to warrant a diagnosis of fracture of the head or neck of the radius. The writer has a

skiagraph of a fracture of the neck of the radius, taken about 15 months after the accident, when no external signs were present pointing to the original injury, except a slight limitation of rotation. Yet that skiagraph permits no doubt as to the nature of the original injury. What signs should an old fracture of the head or neck present? Since writing his first paper on this subject, the writer has been anxious to find cases of this kind.

The first to arouse his suspicion was in an old acquaintance. He had no pain, but as long as he could remember he had been unable to rotate his forearm. On examination it was found that flexion and extension were free and full, but there was complete inability to rotate the forearm, indicating a probable bony union between the radius and ulna, in some part. The palm of the hand was always turned downward, *i.e.*, the forearm was fixed in the position of pronation, the position in which fractures of the head and neck usually occur. No deformity could be detected in either the radius or ulna, such as would tend to show the seat of an old fracture. He had never had any bone or joint disease. He had heard his parents, now dead, say that he had sustained a severe fall in early childhood, which produced a severe injury of the arm, but its nature had never been understood. He called the writer's attention to a peculiar movement at the wrist. Although he could not supinate the forearm in the least, he could by strong effort turn the hand in the direction of extreme pronation so that the palm looked upward. He further called attention to a peculiar deficiency in the lower end of the ulna, which the writer could not explain, but was inclined to consider as a gradual disappearance of bony obstruction to the repeated efforts that he had probably made, during many years, to turn the hand in the direction of extreme pronation, in his attempts to compensate for the loss of supination in the forearm.

It is evident that such complete ankylosis of rotation as exists in this case, following a severe injury, with no history or evidence of bone or joint disease, must have been caused by a fracture. A fracture at the lower end of the radius or ulna or both, which would leave such a result, would almost cer-

tainly have been recognized at the time of the accident or later. A fracture of the shafts of the forearm bones to produce so much disturbance of rotation would probably have resulted in union of both bones across the interosseous space, and that could hardly have escaped detection. A fracture of the condyles of the humerus or of the olecranon would probably have been recognized at the time, and if ankylosis followed, flexion and extension would have been most markedly disturbed, whereas in this case they are not at all disturbed. In the writer's opinion, only a fracture of the head or neck of the radius or both would have so limited rotation alone, and at the same time have been so obscure as to escape the attention of the physician. Owing to the fact that the patient lives in a distant city, the writer has so far failed to obtain a skiagraph of this patient's elbow. The fact that the forearm is fixed in pronation is significant, since we know that most of these fractures result from a fall on the hand with the forearm in pronation. It is probable that the head or neck of the radius, or both, were severely injured, and that immediately following the accident he could not rotate the forearm because of the pain, and later because of the change in the shape of the head of the radius, or its union with the ulna.

While the writer was treating a patient for a sprain of the knee, his attention was called to an obscure injury of the elbow, which the patient had received about twenty-five years before, and which had left him with limitation of rotation ever since. The diagnosis had never been made. He had fallen from a horse on his hands and had injured his elbow severely. He experiences very little trouble now, but notices that during boxing exercises, in which he indulges frequently for pastime, there is one blow he avoids because his thumb is in the way and is unduly punished. On examination the writer found that pronation was complete, but that supination was not quite complete, and that it was owing to this incomplete supination that his thumb suffered during boxing. Flexion and extension showed nothing abnormal. Suspecting an old fracture of the head of the radius, a skiagraph was taken and that part of the head broken off in the usual fracture, showed in the opinion of the writer, slight evidence of an old

fracture which had united leaving too little evidence of deformity to be positively recognized by the skiagraph.

In a third case the skiagraph was more positive. A medical student informed the writer that at his boarding house was an old man, who had asked to have his forearm examined. The student could not make a diagnosis, and after stating the circumstances of the case, asked the writer for a suggestion as to the cause of the trouble. Suspecting a fracture of the head or neck of the radius, the patient was brought to the University Hospital, when Dr. Pancoast took two skiagraphs of the elbow, one a lateral view with the forearm in pronation and the other an antero-posterior view with the forearm about midway between full supination and the mid-prone position. The latter was the more satisfactory, and a corresponding view of the opposite elbow was taken, for comparison. (See Fig. 13—a and b.)

The patient is a man, 64 years of age. About 50 years ago he injured his forearm, he thinks by a wrench while at play with another boy. Although his memory is very vague as to the exact circumstances, he thinks that it was while his arm was still in a sling that he fell a considerable height from a beam in a partly constructed new building. This fall could easily have produced a fracture of the head or neck of the radius. All that he is certain of now is that he has not been able since to properly rotate his forearm. Flexion and extension are free and complete. The condition has considerably disabled him as a carpenter. He has never known the nature of the injury, the diagnosis never having been made. The skiagraph shows clearly, in the writer's opinion, that the radial head has been fractured, and that the deformity shown is sufficient to account for the limitation of rotation.

In fractures of the neck, which, unlike those involving the head, are transverse or nearly so, impaction is relatively common. That part of the head which is detached in fractures of the head, only, is driven downward and forward by the impact of the humerus, so that the head forms an angle with the shaft. Pratt,⁵ who wrote at some length on this subject, did not say anything of impaction, but observed that there was a displacement of the upper fragment, which it was difficult or impossible to reduce. He advised excision of the head in these

⁵ Revue d'Orthopedic, March, 1906.

FIG. 13-A.



Old fracture 50 years ago.

FIG. 13-B.



Normal elbow, the uninjured side for comparison, with Fig. 11-A.

cases. He observed also that crepitus was sometimes absent, and accounted for it by assuming that owing to the pull of the biceps muscle on the lower fragment, the fragments were not in contact with each other. From the histories of two cases and from the skiagraphs of these two and a third case, the writer is inclined to believe that impaction is frequent in uncomplicated fractures of the neck. Three of the four cases in this group seem to show it. The impaction would account for the difficulty in reducing the displacement and for the absence of crepitus which Pratt observed. We know that impaction is common in fractures of the lower end of this bone. The same cause, a fall on the hand, will explain its presence in both fractures. While theoretically the biceps might pull the fractured surfaces of the lower fragment out of contact with that of the upper, as Pratt says, the writer cannot find any evidence of it in any of these skiagraphs. The writer has already referred to a specimen of this fracture in the Mutter Museum of Philadelphia, showing the typical deformity which Mutter accounted for by the pull of the biceps. The deformity in that specimen corresponds in a marked degree with the deformity shown in all three of the probably impacted fractures of the neck in this group. Much attention was given to this by the writer in his first paper. The angulation in the neck is probably due to the downward impact of the external condyle against the anterior part of the head of the radius, which is driven downward and forward, producing the angle in the neck. Even if the pull of the biceps was responsible for the deformity in the museum specimen, as Mutter says, it was not instrumental in separating the fractured surfaces from each other. Pratt also says that usually the greatest prominence of the upper fragment was posterior and external. This statement has very little meaning, since it does not give the position of the forearm. When the fracture is due to a fall on the hand in the prone condition, the greatest prominence of the head will be anterior in pronation, and by partial supination will be placed in an external position. If full supination could be produced it would occupy a postero-external position.

ISOLATED FRACTURE OF THE GREAT TROCHANTER.

BY GEO. E. ARMSTRONG, M.D.,

OF MONTREAL,

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J. M., AGED thirty-three years, was admitted to the Montreal General Hospital November 3, 1906, complaining of pain in the right thigh and inability to move the right leg. Physically, he was an unusually well-developed muscular fellow. While performing his duties as shipper in a large milling company, he was struck on the right thigh just behind the trochanter major by a falling bag of flour, weighing 140 pounds. He was alone at the time, but succeeded in walking on the left leg with the support of a flour-carrier to the stair, where he got help. On examining him a marked swelling was observed in the region of the right trochanter. Light pressure caused pain and there was considerable surrounding ecchymosis. There was no shortening of the leg. He could move his leg a little in all directions. No crepitus could be made out. There was no outward rotation or any relaxation of the tensor vaginæ femoris fascia. The X-rays showed a separation of the great trochanter from the femur at the outer part, the inner part apparently remaining attached by periosteum and fibrous tissue. The leg, slightly flexed at the hip and knee, was strongly abducted, and together with the pelvis immobilized in a plaster-of-Paris spica bandage. The limb was neither rotated outward nor inward, the toes pointing in a normal direction.

He left the hospital January 18, 1907. On March 20 he returned for examination, walking perfectly well; no limping was discernible. Another X-ray photograph was taken which seemed to show bony union between the apophysis and shaft.

This fracture is one of unusual rarity. Morris was able to collect only 6 undoubted cases. Stimson¹ refers to 7 museum specimens, 2 of which were obtained in the dissecting room without history. Ewart² reports a spontaneous fracture through the great trochanter of the left femur in a female

sixty-five years of age, a subject of mollities osseum. While walking with a stick and leaning on her daughter's arm they both heard a crack and the patient subsided to the ground.

FIG. 1.

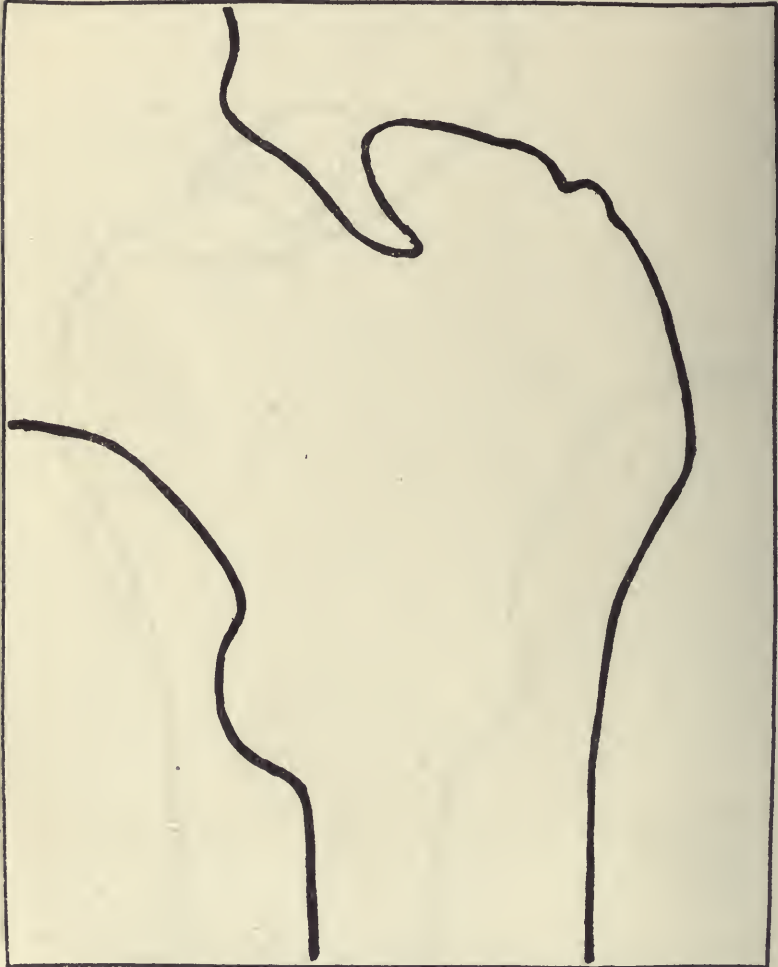


Tracing of X-ray taken shortly after admission to hospital.

A diagnosis of extracapsular fracture of the femur was made. A skiagram taken three weeks later showed the fracture to be through the great trochanter. Another skiagram taken at the

ninth week showed the fracture had united with osseous union, a large amount of osseous callus being present. Eleven weeks after the accident the patient was able to go out in a chair and suffered no pain.

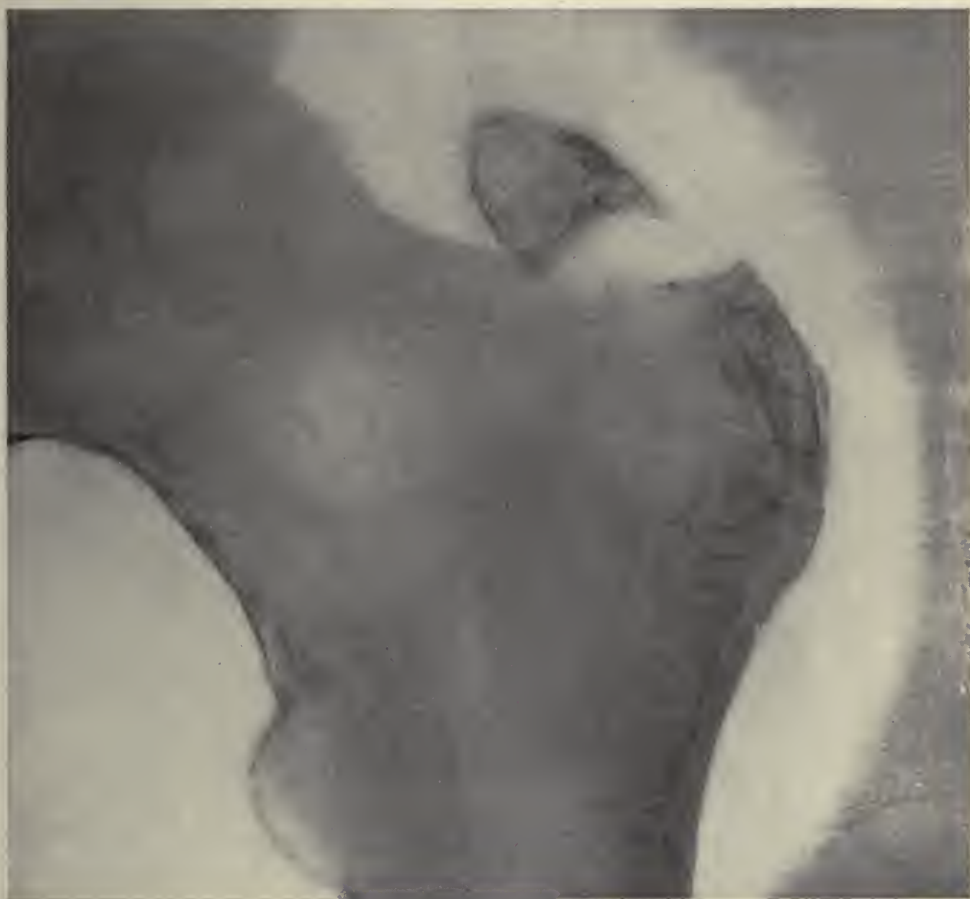
FIG. 2.



Tracing of X-ray taken four and one-half months after the accident.

As there was one inch shortening in this case, it may be objected that the fracture here extended through the neck and

FIG. 3.



X-ray taken shortly after admission to the hospital.

so was not an example of isolated fracture of the great trochanter.

The fracture has generally been the result of direct violence applied outside and behind the trochanter or from a fall upon the hip.

Neck³ reports an instance of fracture of the trochanter major from muscular contraction. It occurred in a laborer twenty-four years of age, who while engaged with another man in lifting a heavy sack, twisted his body and felt a severe pain in the region of the left hip. The injury did not compel him to stop work immediately, but the pain continued, was increased by movement and sometimes a creaking noise was felt. Seven weeks after the injury there was felt on the outer side in the neighborhood of the trochanter major a disc-shaped piece of bone the size of a two-mark piece. During rest in bed a strong callus was thrown out and fourteen days later, through an incision made with a view to suture, the piece was found to be no longer moveable. In this case it seems probable that while the leg was fixed in a position of inner rotation, the forcible twisting to the left of the body while lifting the heavy sack caused a piece of the great trochanter to be torn off.

The amount of displacement of the fragment varies and depends upon whether the epiphysis together with the periosteum and fibrous tissues have been completely torn away from the diaphysis or not. When there is no marked displacement of the fragment (the patient is a stout, well-muscled individual) and a good deal of swelling is present at the time, the condition may very readily be mistaken for a severe contusion. When the fragment is completely torn away from the femur, it may be drawn upward and backward as much as 6 cm. from its normal position. There may then be apparent a depression in the normal situation of the trochanter not present in the opposite side. Crepitus may sometimes be obtained by pushing the fragment downwards while the leg is well abducted and rotated outwards.

The prognosis would seem to depend partly upon the degree of detachment of the fragment. If completely separ-

ated it is altogether likely that union occurs by pseudoarthrosis. When the periosteum and fibrous tissues are only partly separated bony union may take place. The separation generally follows the epiphyseal line.

In regard to treatment it would appear that when the fragment remains partly attached to the shaft a perfect functional result may be obtained by rest in bed and immobilization of the limb in an abducted position. I have seen no reports of the functional result in cases where the fragment has been completely detached and elevated several cm. from its normal position, and in which union has occurred by means of a false joint. Modern technique, however, renders it safe to replace and retain the fragment by sutures passed through it or through its tendinous attachments or by holding it in place with a peg.

Bennett reports a specimen of fracture of the trochanter minor in the museum of Trinity College, Dublin, associated with intracapsular fracture of the neck.

Traumatic separation of the epiphysis of the trochanter major under the age of eighteen has occurred more frequently than has fracture in adults. Poland⁴ was able to collect 12 cases of separation of the epiphysis of the great trochanter. Thienhaus⁵ reports an instance in a little girl eleven years of age who was violently thrown down on the floor by her schoolmate who pushed her unexpectedly from behind. During her fall she struck heavily upon her left hip. Although suffering pain she was able to limp home, a distance of one mile. The following morning she was unable to rise from her bed. A diagnosis of contusion was made by her physician. Thienhaus was unable to reach a definite diagnosis without a skiagram, which showed an incomplete separation of the epiphysis of the great trochanter. In 5 cases death followed within a few weeks after the violence which was thought to have caused the separation, and was preceded by fever and suppuration along the upper part of the bone.

The only definite means of positive diagnosis is a Röntgen-ray picture. It is quite possible that the lesion occurs more

frequently than thought, and is treated under the diagnosis of contusion.

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POST-OPERATIVE TREATMENT.*

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PROBABLY no part of surgical work offers a better opportunity for the display of individuality than the post-operative treatment of our patients. Many of us attribute our good results as much to our particular after-care as to our individual operative technique. There can be no question regarding the importance of this subject, and after many operations and in certain conditions its importance becomes prime.

The welfare of a patient after an operation depends not only on the skill and accuracy with which the operation is done, but also on the means employed during the operation to conserve his strength, maintain the normal resisting power of his tissues, and render his early hours after operation peaceful and free from pain. The operator who works regardless of time and the amount of anæsthetic his patient is taking, or who pays no attention to the patient's posture on the table, the protection of the body not involved in the field of operation, or who uses large quantities of fluid regardless of whether it drains away properly or accumulates under his patient, is laying up for himself many post-operative complications which he who employs "speed without haste" and is thoughtful not only of the operation itself but his patient's condition, will seldom see. I do not advocate a want of thoroughness in operating in order to accomplish the closure of the wound in a certain number of minutes, or the constant shifting of the mind from the operation itself to the patient's condition, but I do mean that we should not drag an operation along over an unnecessarily long period, and that we should establish in our operating rooms a habit among our assistants and nurses of

* Read before the Philadelphia Academy of Surgery April 1, 1907.

carefully looking after the comfort and condition of the patient. The post-operative treatment really begins when the patient is still on the table. This is prophylaxis, the best of all treatments. We sometimes see patients anæsthetized long before the operator and his assistants are ready to begin their work. Again, we see patients put on the table with an unnecessary exposure of the body, with scant covering for the portion that is covered, and the whole or a large portion of the trunk, if it is an operation on the upper abdomen, deluged with water which quickly loses its temperature and chills the patient. Not infrequently we see patients placed on the operating table with nothing between the body and the glass or metal table but a thin, wet sheet, and more frequently still with the arm hanging over the edge of the table in such a way that the musculo-spiral nerve is pressed upon sufficiently to produce a palsy. These are only some of the thoughtless things of which we are occasionally guilty, and which go later to spell disappointment and sometimes disaster. Who has not seen a troublesome wrist drop which long outlasts the convalescence from a simple operation, or a pneumonia from exposure and cold on the operating table or during transit to the ward or room, without appreciating the importance of the thought of the post-operative period before and during the operation? We should never become so wrapped up in our operation and in demonstrating its steps to onlookers as to forget our patient's condition.

The choice of an anæsthetic to suit the individual case is a matter of great importance from a post-operative point of view, as many of our complications in this period have their origin in the anæsthetic, such as pneumonia, suppression of urine, vomiting, etc. It is a great mistake to confine ourselves exclusively to one anæsthetic. Many a feeble patient who could not stand ether or chloroform anæsthesia can be operated upon with impunity under infiltration anæsthesia or with the morphia-chloride of ethyl and ether, or the morphia-scopolamin-chloride of ethyl and ether sequence. I have been able with the latter sequence to remove a large ovarian cyst from a very old lady to whom I should have hesitated to

give the required amount of ether alone. In this case one hypodermic of morphia, $\frac{1}{8}$ gr., and scopolamin, $\frac{1}{100}$ gr., was given 2 minutes before operation. She was rendered unconscious with chloride of ethyl in about a minute, but one-half ounce of ether was employed during the entire operation, and the patient slept for an hour or more after it. In another case I was able by intraneural injection of cocain to amputate the leg without shock in a tuberculous patient to whom I feared to give ether lest his lung condition should be rendered active. In many cases of empyema chloride of ethyl will suffice for a rapidly performed thoracotomy. The same applies to the drainage of other collections of pus, and to amputations where time is an element and ether is contraindicated. It is well to familiarize ourselves with the different anæsthetics in order that we may be able to choose the best for the individual case.

Another factor in operative technique which has a marked post-operative influence is the way we handle the tissues and close the wound. A potent element in producing pain and predisposing to suppuration is the ligation of large masses of tissue and the tight suturing of wounds. There is no doubt that a comparatively clean wound, such as a lacerated wound of the scalp, which would otherwise heal by first intention, can be made to suppurate simply by tight sutures. All that Nature requires is a gentle approximation of wound edges, and more than this is detrimental. The present custom of closing wounds in layers has done much to reduce suppuration and to increase the patient's comfort.

Among the chief complaints after operation are pain, nausea, and thirst. The pain of course varies greatly according to the site of operation, and the individual disposition. Probably abdominal operations produce more pain than others, but this may be only because of the aggravation of the discomfort caused by the movement of the diaphragm, especially such excessive actions of this muscle as take place in retching and coughing. One of the surprising things about post-operative pain is that it is not more marked in certain plastic operations, such as hernia, repair of the perineum, etc. In all

of these, however, it can be made very severe by too tight constriction of wound edges. Too much attention cannot be given by the surgeon to the prevention of pain at the critical period when quiet and sleep do so much to aid a prompt convalescence. There was a time not long since when it was the rule of most surgeons to withhold pain-relieving drugs, such as morphia, after abdominal operations. To give a hypodermic of morphia in these cases was thought to be a great mistake, but now we have learned that when properly employed in the post-operative treatment it is a great boon both to the patient and to the surgeon. All the bad effects formerly attributed to this drug, such as the production of flatus, bad effect on the kidneys, etc., we seem now to have forgotten, or at least we have learned that it was our own faulty technique which produced much of the trouble attributed to the morphia. It was usually infection and not morphia that caused the trouble. I am glad to say that I have never done an abdominal operation without administering a hypodermic of morphia and atropia before the patient has recovered consciousness, and I have never observed in any single case a bad effect, and my results generally have not been so bad as to make me change this plan of preventing, to some extent at least, the post-operative discomfort of the patient. When I was a hospital interne and assistant it was the custom of most of the operators after a laparotomy to order morphia, probably a small dose, to be given only if absolutely necessary. My experience was that it usually became necessary, and then, the patient having learned the relief to be obtained by its use, begged for a repetition of the dose. My present custom is to give a single hypodermic of morphia, $\frac{1}{4}$ gr., and atropia, $\frac{1}{150}$ gr., before anæsthesia is started or certainly before the patient regains consciousness. The result is that the patient passes from the sleep of the anæsthetic to the morphia sleep, gets comfortably over the most distressing hours after operation, those first few when ether is being eliminated by the lungs in large quantities and nausea and vomiting are common, and never knows that morphia has been given. The idea that morphia causes vomit-

ing after an operation is absurd. Formerly I only used this plan in abdominal cases, but the vomiting was so much less than in the other cases where it was not employed, and the patient's comfort so much greater and his return to consciousness so much quieter, that I now give the hypodermic after any operation of magnitude or long duration, or where I expect much after-pain. It is seldom that I am obliged to give a second dose, and this I try particularly to avoid, for I think it is better not to let the patient learn the comfort of morphia. It is largely for this reason that the drug is given before the close of the operation, and this time is also chosen because I want the drug to act before the patient begins to regain consciousness and vomit. A large majority of patients after this treatment never vomit at all. All one has to do to become convinced of the advantages of this method of treating post-operative pain is to employ it in a few cases and compare the results with those obtained when no morphia is used, or when it is given late and in small quantities. The repeated small dose of morphia does not appeal to me, because it would seem that the patient would become dependent upon it. Where the single full dose is given before the close of anæsthesia the patient if not disturbed will often sleep for from one to three hours, and remain quiet for a much longer period.

Pain developing some hours after an operation is not to be treated by the administration of an anodyne, but its cause should be carefully sought and removed. A careful and considerate nurse can do much to relieve such pain. Oftentimes the simple change of posture, the cutting of a tight bandage, the relief of pressure on some bony prominence, straightening out the clothing, and such little attentions will give relief. I have seen a patient kept awake all night by pressure on the heel after fracture of the leg, and by pressure on the internal condyle by an internal angular splint. Pain under such circumstances is absolutely unnecessary, and its possible cause should always be considered. I have known a safety pin to be passed through the patient's skin in fixing a bandage and to remain in this position for days. Therefore, instead of putting

down the patient's complaint of pain to nervousness or to want of pluck, we should always make sure that there is not some actual cause for the complaint.

Nausea and vomiting are not nearly so troublesome after operations as they once were. This has largely been due to the improved methods of administering our anæsthetics, and it can be largely obviated by making the quantity of anæsthetic employed as small as possible. The amount of ether and chloroform administered has much to do with the continued vomiting after operation, and it can easily be reduced by the judicious use of morphia and atropia administered either before or during the anæsthesia, or by administering chloride of ethyl or nitrous oxide before the ether or chloroform. It is my invariable custom to employ chloride of ethyl first, and in this way the amount of ether is reduced nearly one-half. The less ether there is for the patient to eliminate, the less nausea and discomfort he will have and the less likelihood of interference with the eliminating function of the kidneys. As I have indicated before, the use of morphia at the close of the operation before the patient regains consciousness will entirely obviate or greatly reduce vomiting. Inhalations of vinegar have long been employed to reduce nausea, and do seem to be productive of some good. So simple a means as elevation of the head will often reduce the sensation of nausea, and a draught of water will sometimes not only not increase the nausea, but will reduce it. Where it is possible for the patient to be placed in the sitting position nausea will frequently be relieved. This is particularly true after operations on the stomach itself. A drainage tube placed in the abdominal cavity may produce continued reflex vomiting, which will cease on removal of the tube. In my own experience troublesome vomiting is rare where a full dose of morphia is given at the close of the operation.

Thirst, too, is a symptom which is much less troublesome now than formerly where water was withheld for long periods after operation. The thirst can be largely relieved by giving large quantities of salt solution by the rectum. There are few operations, however, after which water cannot be given

promptly by the mouth. If a patient is not nauseated I allow him water within a few hours in quantities of an ounce. It has not been my experience that this is apt to start up vomiting. This early administration of water applies after abdominal operations as after others. I think the giving of a considerable quantity of water at regular intervals is preferable to the continual sucking of ice. Liquid food should be given as soon as the patient has a desire for it, or as soon as the nausea has passed away.

Confinement in one position, with the restriction of all movement after an operation, is extremely trying on a patient, and often results in insomnia and nervousness. Any movement that does not directly interfere with the healing process of the wound should be allowed. It does not hurt a properly closed abdominal wound if the patient is early placed upon his side, or if the shoulders are elevated, or the legs drawn up. When a patient is very anxious to change his position and you are sure this change will not be comfortable, it is not a bad plan to allow him to try the new position, when he will be convinced of his own error and more contented in the position he had first occupied. Too much care cannot be given to obtaining a comfortable attitude in bed after an operation. Restraint in an unnatural position gives rise to the greatest restlessness and discomfort. This is well illustrated in the tight confinement of the arm to the chest after breast operations. The patient is much more comfortable, the wound heals better, and there is less restriction of subsequent motion of the shoulder, if the arm is dressed at a right angle to the body.

One of the problems after abdominal operations is the best time at which to open the patient's bowels. Formerly it was the custom of most surgeons to give some laxative, usually calomel, on the day following the operation. This was due to the fact that an early movement of the bowels usually meant that no infection of the peritoneum had occurred, or that such an infection was not extending. The mere movement of the bowels, however, is in no way curative under such circumstances, and it is far better to allow the intestine to rest quietly

after an operation than it is to stir up painful peristalsis by means of laxatives. This, of course, applies to the cases in which a proper preparation for the operation has been made. A movement by a glycerin suppository, or an oil or soapsuds enema is much more comfortable to the patient and less disturbing to the healing viscera than a purgative. If nothing but liquid food is given for two or three days after operation the third day is early enough to open the bowels.

Inability to empty the bladder is of common occurrence in the post-operative period, and resort to the catheter is often necessary. To resort to catheterization when the bladder is not painfully distended is a mistake, and it is far better to have the patient empty the bladder himself than to pass the catheter. Some surgeons even go so far as to allow the patient to get out of bed for this purpose, and where it is possible I believe it to be good treatment. I avoid the use of the catheter as much as possible. When the catheter is employed the greatest care should be exercised and the catheterization done by experienced orderly or nurse. Even under the best circumstances infections of the urethra and bladder occur, and it is the surgeon's duty to see that all necessary aseptic precautions are taken to avoid these unfortunate complications. No nurse or orderly should ever be allowed to use a metal instrument. Catheterization in children is to be particularly avoided, as injury of the male urethra in childhood is easily accomplished. In children I would much prefer to have the patient get out of bed to having a catheter used.

The time at which a patient is allowed to get out of bed varies with the operation which has been performed. A few rules, however, can easily be laid down. In the first place, old people should be gotten out of bed as soon after operation as possible. The advantage of this is easily shown in the present-day results from prostatectomy, where the patient is gotten out of bed on the second or third day. In abdominal operations on old people a change of posture and early transference from bed to couch or chair is very important. There has been a marked tendency during recent years to shorten the period

which a patient spends in bed after an abdominal operation. After simple appendectomies many surgeons allow their patients to get out of bed on the following day. I have not been able to bring myself quite to this point, but I am constantly shortening the period. In clean cases where the abdominal wound is accurately closed and no muscle cut across its fibres, I get the patient out of bed on about the eighth or ninth day with the abdomen well supported by a binder, and allow moving about on the tenth or eleventh day. In this particular I think the individual disposition of the patient must be taken carefully into account. There are many patients who are benefited by a longer rest in bed, whereas to others, such as old people, and those who are inclined to magnify their ailments, a prolonged rest may be harmful.

In closing I would say that I think we are often guilty of paying too little attention to our patients during the post-operative period, and during the convalescence which follows. Many good results are spoiled by this neglect. For instance, take the tuberculous lesions for which the surgeon is frequently operating. If the after-care of these patients is not properly carried out, especially the hygienic treatment, an early recurrence is the rule. And again, after operations for syphilitic lesions we too frequently fail to instruct the patient in the necessity of continuing his specific treatment. A proper restoration of function is frequently not realized because of our neglect of such agents as massage and passive movements. Recurrences after operations for knock-knees and bow-legs often take place because no brace to prevent the recurrence is employed. These are only a few instances which show the importance of treatment after operations.

TRANSACTIONS
OF THE
NEW YORK SURGICAL SOCIETY.

Stated Meeting, April 10, 1907.

The President, DR. GEORGE WOOLSEY, in the Chair.

INTUSSUSCEPTION.

DR. J. D. RUSHMORE presented a boy, 13 years of age, who was seized about 5 A.M., January 8, with severe paroxysmal pains in the abdomen. He was up and about during the first few hours and after that kept his bed. Vomiting soon began and the vomited matter consisted at first of food (mostly custard pie, a large quantity of which he had eaten the evening before), then bilious and brownish fluid without much odor; bowels failed to act naturally or by enema or cathartics; no gas was passed; took no nourishment and slept little. There was tenderness and distension of the abdomen. No passage of blood or mucus from the bowel, and no desire to go to stool. A tumor does not seem to have been recognized until the 13th, five days after the onset of the symptoms.

Entered hospital late in the evening of January 13, at which time his temperature was $97\frac{1}{2}^{\circ}$; pulse 90 and of fairly good quality; face pale; abdomen tense, some distension, large tumor, rather ill-defined but tender, on the left side following the direction of the descending colon, but nearer the median line. Immediate laparotomy through left rectus muscle, and the delivery of a large iliac mass, very dark in color, well distended, and twisted on its mesentery. With some difficulty the intussusceptum was by traction and pressure delivered from its sheath, and about an ounce of very dark and offensive fluid escaped and soiled the intestine and mesentery. This fluid was sponged off with gauze

and saline solution. The intussusceptum was found empty and gangrenous, but not perforated.

The contents of the bowel, solid, fluid, and gaseous, were pushed back from the gangrenous area by a pair of intestinal roller-clamps made by Tiemann & Co. Each clamp consists of two rollers revolving freely in their respective frames. By means of four check nuts these frames can be rigidly held in any position, the two guides constantly keeping them parallel; the rollers therefore exert a uniform pressure across the intestine when it is clamped between them. The surface of the rollers is slightly roughened to overcome any tendency to slide, and by a simple slide at the handle portion of the instrument they can be released from their bearings to facilitate sterilizing. The total length of the instrument is about $5\frac{1}{4}$ inches, and the line of contact of the two rollers is $2\frac{1}{2}$ inches. (Fig. 1.)

The healthy intestine on each side of the gangrenous portion was slipped between the rollers and the rollers were screwed

FIG. 1.



together sufficiently to merely bring the opposite walls of the gut into coaptation; then by steadying the gangrenous portion with a long Keith's forceps the clamp was rolled away about 5 inches and screwed down a little in order to avoid slipping. The intestine between the clamp and forceps was flat and empty. The gangrenous part was thus excised in the usual way, except that any deep cut into the mesentery, which was not gangrenous, was avoided, and thus secured a better vascular supply of the ends to be sutured. A continuous glovers' silk suture was used to unite the cut ends, and a secondary continuous Lembert's peritoneal suture of the same material was introduced and the clamp was removed; the intestine was replaced and the abdominal wound was closed by layer sutures.

The clamp worked to entire satisfaction. It was easily and quickly applied, did not damage the wall of the intestine, and its use avoids the risks of a tape ligature, which necessitates a perforation of the mesentery with the possibility of injuring a vessel

and the necessity of suturing the wound after the removal of the tape. If, however, the clamp is screwed down too tight at first there is probably a danger of tearing the peritoneal coat of the intestine when the clamp is rolled. This accident will not occur if the clamp is properly used. It might be better to screw the clamp tight at first, cut between the clamp and forceps, and not do the rolling until the gangrenous mass has been removed and the sutures are to be employed. The field of operation will then be left free from more or less mucus that always escapes between the clamp or forceps or tape and the cut end of the intestine. If this method is employed a narrow strip of gut that may have been pressed on unduly by the clamp can be trimmed off, giving a fresh surface for the suture. It has also been suggested that the intestine might be emptied by substituting the first or ring and middle fingers for the clamp; but it is doubtful if the fingers will do the work as satisfactorily as the clamp.

After the dressings were applied the boy was put to bed with a pale and perspiring skin and a pulse of 180. Artificial heat and adrenalin solution hypodermically were employed, with good effect. The temperature was 102° on the morning following the operation and gradually dropped from day to day and reached 98° on the fifth day, with a slight evening rise for a few days. The pulse dropped gradually, but rose again about three weeks after the operation for a few days from no apparent cause. Faecal vomiting occurred on the first day, then ceased after a thorough gastric lavage. Rectal alimentation until the third day, when the rectum became irritable and the patient voided involuntarily three or four large and bloody and very fetid stools. Water to quench thirst was used from the first, but not always retained. On the fourth day egg albumin was tried by the stomach and retained. After that the history is of a rapid convalescence. He left the hospital February 15, somewhat anæmic and weak, and has been gaining strength and flesh since, with a little sluggishness in bowel action. The length of the resected portion of the intestine was 40 inches.

ACUTE INTESTINAL OBSTRUCTION FROM STRANGULATION OF MECKEL'S DIVERTICULUM.

DR. GEORGE EMERSON BREWER presented a boy, 8 years old, who was admitted to the Roosevelt Hospital in February, 1907, suffering from acute intestinal obstruction. He had always

enjoyed good health until 8 days before admission, when he experienced an acute attack of abdominal pain which was followed by nausea and vomiting. Up to the time of that attack, the bowels had moved regularly, and there was no history of previous colic or vomiting.

During the eight days which had elapsed between the onset of the trouble and his admission to the hospital he had had many periods of vomiting. During the first two or three days the bowels had moved slightly, and some gas had been expelled, but for the past three or four days before admission, absolutely nothing had passed from the bowels, and there had occurred a gradual distension of the abdomen, with slight elevation of temperature.

On admission, the boy appeared to be seriously ill. The face was drawn, the eyes sunken, the mouth and tongue dry. The abdomen was slightly distended, and on palpation, an increased sense of resistance could be apparently felt over the region of the ascending and transverse portions of the colon. The entire abdomen was moderately tender, but no distinct mass could be felt. Rectal examination was negative. There had been no mucous or bloody outflow.

The patient was immediately prepared for operation, and the abdomen opened by a median incision. The small intestine lying directly beneath the incision appeared to be of a deep purple color, and in spots was matted together by a fibrinous exudate. The cæcum and sigmoid were found to be collapsed, but a portion of the small intestine in the left upper quadrant was much distended. On drawing the congested mass upward, it was found to be tightly constricted by what at first appeared to be a thickened vermiform appendix, the tip of which was firmly adherent to a portion of the ileum, thus forming a loop through which two or three feet of ileum had protruded and had become tightly constricted. A rapid search in the ileocæcal region, however, revealed the presence of a normal appendix entirely free from the structure which formed the constricting band.

The strangulated intestines were released by dividing the constricting band from its attachment to the ileum, and the stump was ligated with chromic catgut. It was then found that the constricting band consisted of an intestinal diverticulum arising from the intestine and extending to the border of the ileum. Its distal extremity was firmly attached to the cæcum just to the outer side

of the implantation of the vermiform appendix. From this point it was divided and removed. It was found to consist of the four coats of intestine, and measured about 5 cm. in length. It was fusiform in shape, its centre measuring about $3\frac{1}{2}$ cm. in circumference. At the point of intestinal attachment, its lumen had apparently been obliterated.

After the released intestine was returned to the abdominal cavity, its color gradually improved, and although at the points where the constricting band had compressed the intestine, there appeared to be a slight superficial necrosis, it was thought that the chance of perforation was so small as not to interfere with the complete closure of the wound.

The operation was followed by comparatively little reaction, and the vomiting ceased almost immediately. After a few hours there was a free passage of gas, and on the second or third day a satisfactory movement of the bowels was obtained by the use of an enema.

The wound healed primarily, and the stitches were removed on the sixth day. During the second week of the patient's convalescence, as the result of some unusual bodily exertion, the wound re-opened and a small loop of intestine protruded. This necessitated the use of anæsthesia, and resuturing the wound. With the exception of a mild infection due to contamination of the wound at the time of its breaking open, further recovery was uneventful.

The pathological examination of the diverticulum showed its lumen to be lined with mucous membrane similar to that lining the adjacent ileum.

In reply to a question, Dr. Brewer said this patient gave no history of any previous intestinal trouble.

DR. CHARLES L. GIBSON said that in looking up this subject of intestinal obstruction from strangulation of Meckel's diverticulum several years ago, he was struck by the fact that most of the cases that came to operation were between the ages of ten and twenty years, and that it occurred mainly in the male sex. It was very much more frequent in males than in females.

DR. JOHN F. ERDMANN said that six or seven years ago he reported three cases of intestinal obstruction due to Meckel's diverticulum. In one of them, a gentleman rider at the Horse Show, it was necessary to excise 7 feet of intestine, the patient dying 2 days after the operation. The second case was a boy of 18 years

in whom the strangulation was relieved without excision, the patient making a rapid recovery. The third case was a man about 38 years old, in whom there was no strangulation of the gut, but gangrene of the tip of the diverticulum, its appearance being very similar to that of a necrotic appendix. The patient recovered.

DR. WOOLSEY referred to the relative frequency of adhesions in Meckel's diverticulum, and said that a possible explanation of the fact noted by Dr. Gibson, namely, that strangulation from this cause was most frequent between the ages of ten and twenty years, was to be found in these adhesions, for if they were so situated as to be a possible cause of strangulation, the latter would be liable to be produced before the twentieth year.

DR. ERDMANN recalled one case in which he had assisted Dr. Joseph D. Bryant to operate, about 15 or 16 years ago, where a typical Meckel's diverticulum was found in a man nearly 70 years old. Gangrene and death followed.

INTUSSUSCEPTION.

DR. JOHN D. RUSHMORE read a paper with the above title, for which see page 210.

DR. JOHN A. HARTWELL said that one reason why the true character of the lesion in these cases was so easily overlooked was the remarkable freedom from shock that these patients enjoyed during the first few hours. That fact had been pointed out by Dr. Rushmore, and as an illustration of it Dr. Hartwell reported the case of a 9 months old infant which he recently saw at the Lincoln Hospital. The history was that the child had suddenly begun to vomit about noon, and when he saw it, at 9 o'clock that evening, it had had one bloody movement from the bowels. The temperature and pulse were normal; there was no abdominal distension, and the child was asleep and apparently comfortable. The palpation of a tumor at the hepatic flexure caused no pain or discomfort. Upon opening the abdomen, an intussusception was found at the ileocæcal valve. It was reduced without much difficulty, and the child was discharged three days later, entirely recovered. At no time was there the slightest evidence of shock.

Dr. Hartwell said that another point in Dr. Rushmore's paper to which he wished to refer was in connection with the attempts

that were frequently made to reduce these intussusceptions by means other than a laparotomy. Such attempts usually left the operator in doubt as to the condition of the gut, and were at times attended by an apparent relief of the symptoms without relieving the intussusception, and thus valuable time was lost. In corroboration of this statement he mentioned the case of a woman who suffered from symptoms of acute obstruction 10 days after an abdominal hysterectomy.

The diagnosis of intestinal adhesions resulting in obstructive kinking was made. She was placed in the Tredelenburg position and the bowels were inflated with saline and gentle massage of the lower abdomen performed. After this she passed a large amount of flatus and was apparently much improved. Several hours later her symptoms recurred, and upon opening the abdomen he found complete strangulation of the gut due to adhesions, and impending gangrene. It was apparent that the efforts to relieve the obstruction by manipulating had resulted in additional damage to the gut wall. The case recovered, but the patient was placed in a much more critical position than she would have been had the operation been done at once.

DR. CLARENCE A. McWILLIAMS said that about three years ago he attempted to reduce an intussusception by inverting the patient and injecting the bowels with water. He had previously seen two cases successfully treated in that manner which were reported by Dr. Northrop. In his own case, the condition had existed about twenty-four hours. With water injection, the tumor disappeared, and the patient returned to bed. The symptoms, however, were not alleviated, although no tumor was felt. The next day there was a small bloody movement of the bowels, and upon opening the abdomen he found that by his manipulations all but the last inch of the intussusception had been reduced. The speaker said he did not believe he would ever again advocate the reduction of this condition by manipulation or injection. He inquired as to the choice of an anæsthetic in these cases in children under one year—whether it was better to employ chloroform or ether?

DR. ERDMANN said that about a week ago he had been called upon to operate on two cases of intussusception in the course of four hours. Of his total number of 35 cases, twelve had been fully reported in a published paper on the subject. Of the

remaining 23 cases, out of 19 that were operated on, there were five excisions, with five deaths; no recoveries. These patients were all under 1 year old. Out of 16 other operative cases, ten recovered and six died; the oldest of these was four and a half years. Of the 23 cases, fourteen were males; eight females; one not stated. In the majority of cases, the intussusception was of the ileocæcal, ileocolic, and ileocolocolonic type.

In regard to the presence of a palpable tumor in intussusception, Dr. Erdmann said that in his paper on the subject he had made the statement that it was absent in 60 per cent. of the cases; he would now reduce those figures to 40 per cent., providing the examination was made under deep anæsthesia. In the two cases he had seen recently, one was a child of 10 months with an intussusception of 4 days' duration. Reduction in this case proved extremely simple, while in the second case, which was of only 2 days' duration, it was more difficult. Both patients recovered.

In regard to the choice of an anæsthetic in these cases, Dr. Erdmann said he now invariably used ether. He had formerly employed chloroform, and had seen one death result from it.

DR. WOOLSEY said that what was found on operation in reducing an intussusception explained the uncertainty of the injection method, its partial success, and ultimate failure. The greater part of the intussusception in cases of short duration is easily reduced, but the last 2 or 3 inches are reduced with some difficulty, for the walls of the gut are infiltrated and thickened. The injection treatment may reduce the intussusception except the last few inches and not completely, causing temporary improvement in the symptoms, but in such cases the intussusception is soon reproduced.

TRANSACTIONS
OF THE
PHILADELPHIA ACADEMY OF SURGERY.

Stated Meeting, April 1, 1907.

The President, DR. JOHN B. ROBERTS, in the Chair.

- (a) CHRONIC PANCREATITIS RESEMBLING CARCINOMA;
(b) A SERIES OF BREAST CASES, BENIGN AND MALIGNANT;
(c) A SERIES OF GOITRE CASES.

DR. WILLIAM L. RODMAN reported these cases, with presentation of patients. The first patient was a man of 56, first seen one year ago when he was suffering from jaundice and marked cachexia. He had lost 15 pounds and his symptoms were suspicious of carcinoma though no positive diagnosis was made. Opening the abdomen revealed in the head of the pancreas a densely hard mass large as a fist. This appeared to confirm the suspicion of cancer of that organ, but because of the possibility of chronic pancreatitis the gall-bladder was drained. The man was out of bed on the second or third day and made an unusually rapid and gratifying recovery, drainage being kept up for 3 or 4 weeks. In the light of the results, the case is regarded as one of chronic interstitial pancreatitis, probably due to the habits of the man, who used alcohol freely.

Benign Tumors of the Breast.—Dr. Rodman next presented three patients illustrating the results of plastic resection of the mammary gland for benign tumors. He was greatly impressed by Dr. Warren's description of this method at the meeting of the American Medical Association in Portland, and has since employed it in 17 or 18 cases, regarding 15 of which he has full notes. Two of the patients shown were the first and last of the series. All did remarkably well. The diagnosis of benign growth was made

in each instance and there has been no recurrence or evidence of malignancy in any of them. It should be remembered, however, that one cannot always be absolutely sure, hence the clinical diagnosis should always be supplemented by microscopic examination of the removed specimen, as the majority of mammary tumors are malignant and all of them potentially so. One of the patients was in the second month of gestation when operated upon for a fibroadenoma the size of a goose-egg, the largest one seen. Theoretically an incision in the lower part of the breast, and turning up of the organ, might interfere with its blood supply, but this objection does not hold good in practice, as the blood supply comes mainly from above. The incision is made along the line of junction between the gland and the thoracic wall. One might think this method applicable only to tumors in the lower quadrants of the breast, but in most of Dr. Rodman's cases the growth was in the upper and outer quadrant. Such tumors can be reached, as the breast can be turned upward to the clavicle. Functional activity and usefulness have been preserved in all the cases operated upon. The pregnant patient referred to was the sister of a prominent German surgeon, who insisted that this operation be done. Dr. Rodman is better pleased with the operation the more he uses it and believes that the profession too often sacrifices the breast. One has no right to remove that organ in those who use or expect to use it.

Malignant Tumors of the Breast.—A second series included three cases of malignant tumor of the breast. The first is interesting for two reasons. The patient was the youngest he has operated upon for this condition, 25 years at the time of the operation 3 years ago. A second point is that last year he operated upon her mother for scirrhus. The second patient was operated upon in 1900 for a large carcinoma of the left mamma. The third has had both breasts removed, the first one 5 years ago for malignant disease, the other 2 years ago for a benign growth. The patient was so informed regarding the latter, but insisted upon complete removal, which revealed a large cyst with a small area of solid growth. Other interesting cases could not be shown. One was operated on in 1897, another in 1898, both for scirrhus, and both were in perfect condition a few months ago; the first had been operated upon twice before. A third case had been operated upon in 1899 and two others in 1900.

Goitre.—Finally Dr. Rodman presented two patients upon whom he had operated for goitre, of which he has had 7 cases within 3 months, one a large mediastinal growth. The first patient has also a goitre on the left side which was not removed, she nearly dying under ether when the right half was extirpated, it being necessary to stop the ether three times. The woman was pregnant when first seen, operation being postponed until after delivery. Pressure was evidently made by the growth of right side, as difficulty in breathing has passed away and the patient is in all ways better than she was. She was so anæmic that malignant disease was feared, but the microscope showed this not to be the case. Case second was that of a large goitre upon which operation was deferred for a few weeks until the patient, who was profoundly anæmic, had been put in good condition. One of the silk ligatures has lately given some trouble, this being the only one of buried Pagenstecher ligatures, of which he uses 25 to 50 in each case, to cause any difficulty. A piece of the thyroid the size of the end of a finger was left. The patient has since gained eight pounds, a gratifying result. Dr. Rodman has never removed a goitre under cocain, as he is certain general anæsthesia is not so dangerous as many believe it to be. He would hesitate to attack such large goitres under local anæsthesia. He employs ether and puts the patient in the reversed Trendelenburg position, this aiding very markedly in the control of hæmorrhage.

DR. HENRY R. WHARTON expressed his interest in the question of removal of non-malignant growths of the breasts. He has employed this method of turning up the breast in a few cases of small growth. The operation was first recommended by Thomas, of New York, and is very satisfactory, permitting removal of the tumor with little resulting scar.

DR. FRAZIER said that he had used the Warren incision quite recently in two cases. In both instances the tumors were cystic and not solid. The first one proved to be a galactocele, the sac of which was dissected out in toto. In the second case a cyst of considerable size was exposed and removed through the same incision. Microscopic examination of the tissue adjacent to the cyst demonstrated the fact that the cyst removed was only a part of a general cystic mastitis. When this was discovered a second operation was performed, at which the entire breast was removed, together with a mass of enlarged glands near the anterior axillary

fold. He was afraid upon finding these glands that a mistake might have been made in the diagnosis, but subsequent histological study proved that they were not malignant.

DR. JOHN H. GIBSON said that until he witnessed Kocher's operations upon goitre he thought his own failure to relieve pain with infiltration anæsthesia in these cases was due to a faulty technique, but that now he thinks this was not the case. Kocher's local anæsthesia consists entirely in an anæsthesia of the skin; the rest of the operation is carried on practically without an anæsthetic, and can only be borne by the Swiss peasants. Kocher himself admits that in the more highly cultivated and organized patients he is obliged to use a general anæsthetic.

MULTIPLE FRACTURES INVOLVING THE UPPER EXTREMITY.

DR. ASTLEY P. C. ASHHURST exhibited four patients who had sustained multiple fractures, and discussed the subject in a paper, for which see page 263.

DR. JOHN H. JOPSON cited a case of multiple fractures treated in the Presbyterian Hospital as an illustration of the shock that results from such injuries. An Italian was thrown from a wagon and sustained a fracture of the pelvis, the shaft of the humerus, one or both clavicles, and a Pott's fracture. The fracture of the humerus was complicated by paralysis of the musculo-spiral nerve. Shock was great and prolonged, but the patient made a good recovery. There is now under his care in the Children's Hospital a child referred because of supposed rachitic deformities, who was found to have a fracture of the right thigh, both bones of the right leg, and both bones of the left leg, evidently of rachitic origin, and with no history of traumatism. All surgeons are familiar with multiple fractures due to carcinoma. In Dr. Jopson's experience, the double Colles's fracture is the commonest example of multiple fracture encountered.

DR. GEORGE G. ROSS mentioned two cases of multiple fractures. One was in a woman of 65, weighing 250 pounds, and included a fracture of the middle of the shaft of the right humerus, a Colles's fracture of the right side and a Colles's fracture of the left side. The patient recovered. The second case was a multiple fracture of the upper extremity, including a fracture of the middle of the humerus and what corresponded to a Colles's fracture on the same side, though there had previously

been a fracture in that location. The man was violently drunk and no history could be obtained. There was great trouble in controlling the upper fracture.

DR. WILLIAM J. TAYLOR cited the case of a woman who had a fracture of one patella wired by another surgeon and afterward came to him with a fracture of the other patella. He wired that one, but soon after recovery the woman got drunk and refractured it, the bone breaking at the line of union and also in three other places. It was again wired, but the woman again got drunk and fractured the patella a third time.

DR. RICHARD H. HARTE said, regarding the question of repair in these cases, he has noticed in a number of instances that nature appears capable of carrying on only a certain amount of repair; that is, multiple fractures do not unite so quickly as do single fractures. When three bones are broken some one of them will remain practically without union until the others have united, and will then unite in the ordinary manner. It might be said that something was between the fragments preventing union, but that is not the case; the tissues simply lie dormant while the others are healing, and then union promptly occurs. He is surprised that such a close observer as Dupuytren should state that multiple fractures unite as readily as does a single fracture.

DR. ASHHURST, in closing, said that Dr. Harte had apparently misunderstood his reference to Dupuytren's statements. The latter had referred to the union of multiple fractures with less inflammatory reaction in each than is ordinarily the case where only one fracture is present; and by inflammatory reaction Dupuytren no doubt understood the formation of excessive callus, as well as profuse suppuration, the latter of course being a much more prominent feature of compound fractures in Dupuytren's time than it has become since the general adoption of antiseptics. In Dr. Ashhurst's fifth case union did not begin in the forearm until that of the humerus was quite firm. Dr. Ashhurst thought the treatment adopted by Dr. Neilson in the first case reported was interesting in connection with the attempts now being made to secure union in ununited fractures of the neck of the femur without screw or wire fixation, by freshening the bone fragments and then dressing the thigh in a plaster cast in the position of extreme abduction. In the humerus thus treated (Case 1) firm union had occurred without difficulty, and in at least one case of

fractured femur of which Dr. Ashhurst was cognizant, a patient under Dr. Davis's care, the same result was obtained.

RHINOPHYMA.

DR. JOHN H. GIBBON exhibited a case of rhinophyma upon which he had operated. The patient was 57 years of age. The condition had gradually developed in about 4 or 5 years. The lateral aspects of the lower portion of the nose were covered with large pedunculated masses of hypertrophied tissue. The whole lower half of the nose was involved, although over the central portion there were none of the pedunculated tumors.

Dr. Gibbon removed all of the hypertrophied tissue with a scalpel, shaving off the outer layers of the skin over the whole involved area. The bleeding was quite profuse and there was an escape of a large amount of sebaceous material from the divided ducts and glands. The bleeding was controlled simply by pressure. The patient left the hospital without a dressing at the end of a week, and in two weeks the entire area was covered by new skin.

GALL-STONES WITH SUBACUTE PANCREATITIS.

DR. EDWARD B. HODGE reported the case of a man, aged 27 years, who was admitted to Dr. J. H. Musser's service at the Presbyterian Hospital October 30, 1906. Nausea, vomiting, sharp epigastric pain of 12 hours' duration. Subject to similar attacks for some years. Never had typhoid fever. Examination showed moderate distension, slight rigidity of upper right rectus, distinct tenderness in the epigastrium, most marked over gall-bladder. Pain extends to the left side, but not to the back or shoulder. Later, gall-bladder could be felt and slight transient jaundice developed. Highest temperature, 101.4°; pulse, 100; respiration, 20.

Two weeks later, after attack had subsided, operation was performed in Dr. DeForest Willard's service. Right rectus incision. Very extensive fat necrosis in omentum, mesentery, and subperitoneal fat. Collection of purulent material between gall-bladder, liver, and pylorus, amounting to about 2 oz. Gall-bladder not distended, and containing one large and a dozen small stones. Dense adhesions about gall-bladder, ducts, pancreas, and pylorus.

No stones felt in common duct. Pancreas hard and head as large as a fist. Tube drainage of gall-bladder with gauze to abscess cavity and right kidney pouch.

Drainage never very free, but patient did very well until tube was removed at end of three weeks. Then followed fever, enlargement of liver dulness, and slight jaundice, subsiding in a week. This was followed by an attack of pleurisy at the left base and later by the discharge from drainage sinus of numerous pieces of necrosed tissue, reported from the laboratory as probably fat necrosis. This continued for several weeks with general condition poor. Exploration of sinus and aspiration of left chest negative.

Second Operation.—Incision through scar. Adhesions freed. Cystic duct followed down to junction with hepatic, and found kinked and strictured. Hepatic and common duct unobstructed. Cholecystectomy; tube drainage of hepatic duct through stump of cystic. Fat necrosis very much reduced, though some small areas still present. Pancreas reduced to nearly normal size. Condition on table very bad, but reaction took place. Drainage free. Later purulent bronchitis and septic nephritis developed, ending in death on the tenth day. No autopsy.

RUPTURED ECTOPIC PREGNANCY DURING TYPHOID FEVER.

DR. F. O. ALLEN reported the case of a woman who was admitted to the Women's Medical Ward of the Presbyterian Hospital February 22, 1907, and came under the care of Dr. Musser. She was 32 years old, was married, and had been ill for three weeks. She had menstruated last at about the time she was taken sick. The case seemed to be one of typical typhoid fever, with an unusually large number and wide distribution of rose spots.

The second day after admission some tenderness was noted on the left side of the abdomen. At about five o'clock the following morning, the twenty-fifth day of her disease, she complained of severe abdominal pain, her temperature dropped to 98°, her pulse became more rapid and very weak (at times imperceptible), and her respirations increased in frequency. Intestinal hæmorrhage was suspected and she was treated accordingly. An examination a few hours later showed that abdominal breathing was restricted; the abdomen was slightly distended, but not tender; peristalsis was present; there was no loss of liver dulness; there was no

dulness in the flanks. The Widal reaction was reported positive; the leukocyte count was 19,200. The temperature remained subnormal throughout the day. In the evening, the temperature rose again moderately; there was increasing tenderness of the abdomen; rigidity was not marked, but there was a distinct resistance, especially on the left side; she vomited; a bowel movement following an enema did not contain blood. Her general condition became very bad, but improved somewhat after copious injections of normal salt solution beneath the skin.

During the evening the patient was seen by Dr. Wharton, who agreed with Dr. Musser that operation was indicated, and that intestinal perforation was the condition probably present. The speaker was indebted to Dr. Wharton for the privilege of operating upon and reporting the case.

Operation was done twenty-one hours after the onset of acute abdominal symptoms. An incision was made through the right rectus muscle. The peritoneum showed black in the wound; when it was opened, large quantities of blood poured out. The ileum was drawn through the wound and inspected, but no perforation or other abnormal condition was found. On exploring the abdominal cavity, the pelvis was found filled with blood and clots, which were scooped out by the handful. A mass, the size of a small lemon, was felt, springing, apparently, from the left Fallopian tube. The uterus was enlarged to about the same size and was soft. The small mass had a distinct pedicle, and at its upper pole there was a rupture into which the finger could be passed. The pedicle was ligated with silk, the abdominal cavity filled with salt solution, and the wound closed. The mass was a thin-walled sack filled with clot. No fœtus was found.

The patient's condition was considerably better during the following day, but the temperature soon rose and remained high, the lungs gradually became œdematous, and she died on the fourth day after operation.

A complete autopsy was not permitted, but the wound was opened and the peritoneal cavity examined. No signs of peritonitis or other intra-abdominal lesion were discovered; there had been no further hæmorrhage.

DR. HENRY R. WHARTON said when he saw this patient the question was the differential diagnosis between hæmorrhage from an ulcer and perforation. An enema brought away no blood,

hence perforation was considered probable, though it was noted that the pain was in the left side and that there was not marked rigidity of the right side.

DR. JOHN B. DEEVER asked if a differential leukocyte count had been made in the case reported by Dr. Allen. He operated in one case which proved to be typhoid hæmorrhage, the blood being confined to the intestine. There was absolute rigidity. The small intestine was found to be filled with blood and was not opened. The patient recovered.

DR. WILLIAM L. RODMAN cited a case in which typhoid perforation was diagnosed by two medical colleagues, who insisted upon operation, although he did not favor it. When the abdomen was opened hæmorrhage was found in the gut, but no perforation. The patient recovered from the operation, but died from a second hæmorrhage a number of days later. Autopsy showed there had been no perforation. If one opens the abdomen in these cases he is probably warranted under certain conditions in opening the intestine and searching for the bleeding point, but in general the chances are better if the hæmorrhage be allowed to take its course. There is not a large field for operation in typhoid fever and one is not warranted in opening the gut unless there are adhesions or thin places in the wall make the finding of the bleeding point reasonably sure after the opening has been made.

BONE METASTASES IN CARCINOMA OF THE BREAST.

DR. HENRY R. WHARTON read a paper with this title for which see ANNALS OF SURGERY for July, page 81.

DR. MORRIS BOOTH MILLER described a fracture following operation for carcinoma of the breast in a woman of 40, the thorough operation having been performed. The patient when coming from the seashore, where she was during convalescence, was holding on to the seat to steady herself while standing in a street car. A slight jolt was followed by sharp pain in the arm and examination revealed an oblique fracture of the humerus. This suggested a recurrence, though there was no thickening of the bone and only the signs of an ordinary fracture. Demonstrable metastases occurred and the woman died the following winter.

DR. JOHN B. DEEVER said that Osler in 1902 reported 16 cases of carcinoma of the spine following carcinoma of the uterus or breast.

DR. WILLIAM L. RODMAN said that bone metastases in breast tumors are not particularly common, yet they are not extremely rare. Personally he has seen three cases. Two were unquestionably scirrhus carcinoma, the third was a sarcoma. In one of the carcinomas the metastatic growth was in the spine, the other in the left humerus, the same side as the primary tumor. The metastasis of the sarcoma was in the right femur six months after operation. The patient was the daughter of a prominent surgeon and had carried a benign growth for years.

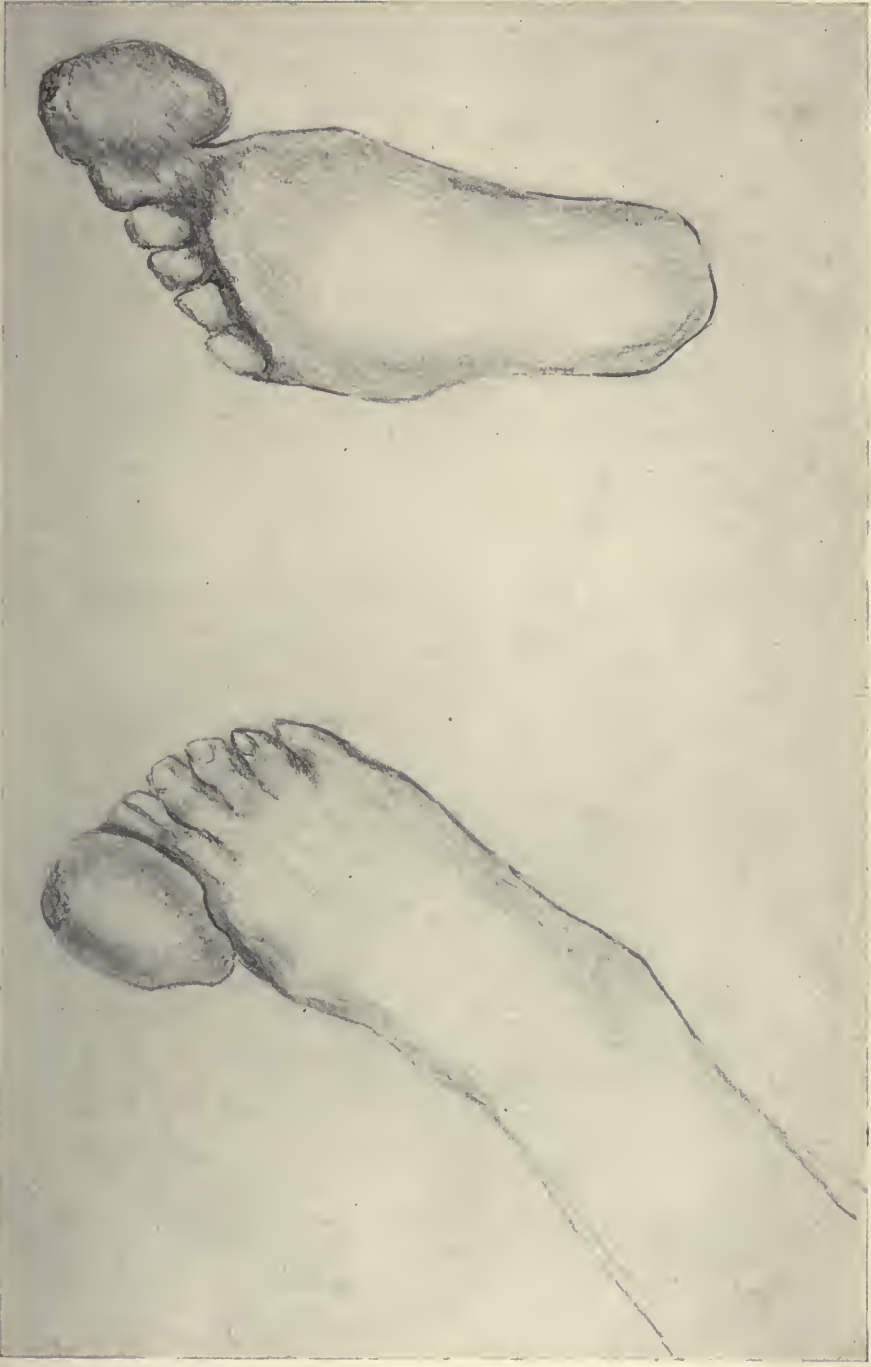
Metastasis in sarcoma is more easily understood as the cells are in contact with the wall of the vessels, while in carcinoma the vessels are in the stroma. He has seen many cases of bone involvement in the sternum, but there the reason is very plain. Of indirect infection he has seen only the two cases, it not being difficult to see how metastasis to the spine occurs. The retro-mammary lymphatics drain through the second and fourth interspaces and then run along the course of the intercostal arteries to the thoracic duct. In this way spinal metastases occur. Dr. Wharton said that primary cancer of the bone is rare; he questions if it ever occurs, as epithelial cells are not found in bone. Such tumors are really endotheliomata or sarcomata. Bone metastases are important as they are never located before operation. The same chains of lymphatics as previously mentioned also explain metastases to the liver; this being the most common site of the secondary growths.

DR. JOHN B. ROBERTS saw eight years ago a case similar to that reported by Dr. Wharton. He was not able to determine if a growth was present, but regarded it as probably a case of spinal metastasis.

FIBROMA OF THE GREAT TOE.

DR. HENRY R. WHARTON reported the case of a man, aged 50 years, who noticed 12 years before he came under the care of Dr. Wharton a tumor of the right great toe; it was painless, but increased gradually in size. He found it necessary to have the shoe for the right foot made upon a special last to accommodate the increasing bulk of the tumor. A casual inspection of the feet with the shoes on showed no marked difference in their size. Within a few weeks a portion of the tumor had ulcerated and gave him pain, which caused him to apply for relief.

The tumor was a fibroma and was attached to the peri-



Fibroma of great toe.

osteum. It was removed without difficulty, the wound being covered by skin flaps dissected from the tumor. See Fig. 1.

POST-OPERATIVE TREATMENT.

DR. JOHN H. GIBBON read a paper with this title, for which see page 298.

DR. JOHN B. DEEVER endorsed much that was said by Dr. Gibbon. He believes, however, that instead of patients being neglected they receive too much attention. His motto for the house physician is, "Let the patient get well." No medicine should be given after an operation as a rule. He is opposed to the indiscriminate and routine use of strychnin. He employs nothing but ether as an anæsthetic, being afraid of chloride of ethyl, as he has heard of deaths from it. Giving the anæsthetic is an important thing and ether usually does no harm. It is best to anæsthetize the patient on the operating table, as it is a mistake to move him there after ether is begun, this always meaning an extra amount of the drug. The patient may be anæsthetized in the high pelvic position even, the intestines thus being floated up and requiring less packing when the operation, being an abdominal one, is begun. When operating upon the upper abdomen he always has the patient wrapped in cotton and put upon a hot water bed; the cotton is at once removed when the patient is taken to his room.

As to scopolamin, Dr. Deaver does not know what it looks like and is thankful he does not. Tight sutures, as stated by Dr. Gibbon, make trouble; he usually places a drain in stout walls for a day. He was sorry to hear Dr. Gibbon say he uses morphin after operations; Dr. Deaver would at once discharge a resident if he did that. Its immediate effect is to make the patient more comfortable; after that it makes him more uncomfortable. It creates more thirst and often more nausea. Occasionally he employs morphia, but never as a routine measure. He administers oxygen immediately after operation and this lessens nausea, that fact being noted in the German Hospital by the Sisters who have been on duty for fifteen to twenty years. A careful nurse is of more moment than a hypodermic of morphia. There is not so much in the use of morphia after gastro-enterostomy as formerly supposed. When this operation is performed by making the communication with the jejunum as near as possible to its commencement vomiting does not occur.

Dr. Deaver never sees shock, except in cases of hæmorrhage or prolonged operation or bad anæsthetization. The pulse of his patients after short operations is always about 84 to 90. Getting the patient out of bed early is an important point. Cases of hysterectomy are gotten out in a week and are encouraged to turn on their side early. Many of the cases of phlebitis, formerly so frequently seen, were due to lack of these measures. As regards passing the catheter, he allows hernia patients to get up to pass urine; worse results than are made possible by this come from catheter cystitis. He never operates upon an empyema without first aspirating it.

DR. WILLIAM L. RODMAN now has largely the opinion of Dr. Gibbon regarding morphia, though formerly he was afraid of it. Since its use he sees much less post-operative vomiting. Perhaps it is unwise, however, to use it as a routine measure. He has never known a gastro-enterostomy to give trouble when morphia is given. There is less shock and less anæsthetic is necessary. A quarter grain of morphia and one one-hundred and fiftieth grain of atropia are invariably given in cases of gastro-enterostomy. Of seven recent cases only one patient vomited, and that one only once. We give anæsthetics much better now than formerly and do not see so much distress from their use. When ether is given by the drop method there is but little post-operative vomiting, with or without morphia. Dr. Rodman prefers chloroform in empyema cases, of which he has operated upon 100 to 150 without losing a patient, and has never seen any ill results; with ether these cases are more unpleasant. Patients should be gotten out of bed early, especially the subjects of cancer, who should be out in 48 hours. If such persons, particularly when the cancer was in the abdomen, are kept in bed a few days they never get out. The possible development of a ventral hernia is not to be regarded in these cases. In gastro-enterostomy for cancer of the stomach, the patient should be out of bed the day following the operation.

DR. WILLIAM J. TAYLOR finds that patients occasionally are benefited by washing out the stomach before they are out of the anæsthesia. This is especially true in cases of intestinal obstruction or in emergency operations where previous emptying of the bowels has not been possible. Food should not be given too soon. He had rather keep a patient three days without food than to give

milk and soup and have it ferment in the intestine instead of digesting.

DR. RICHARD H. HARTE does not believe in the indiscriminate use of morphia in operative cases. He believes that the routine dose of a quarter grain of morphia before a patient is etherized is in time liable to lead to serious results, numerous cases being reported where this dose has been fatal. As a rule, the less medicine given after operation the better for the patient. Invariably the bowels, if left to themselves, will move in the course of two or three days. Their action can, however, be supplemented by the use of a simple enema. Dr. Harte lays great stress on the importance of keeping patients warm and dry during operation, avoiding exposure as much as possible, as shock is often induced by air coming in contact with wet clothing, as well as by prolonged unnecessary manipulation of the intestine. Fortunately this latter is less noticeable now, as the non-operative field is pretty well shut out by the judicious use of pads of gauze.

The early feeding of patients is unquestionably a great error, as food introduced into the bowel too soon only ferments and causes an immense amount of discomfort. Patients are as a rule much better by waiting 24 to 48 hours before any food is ingested, and even then, if there is any question of irritability of the stomach, they can be readily nourished by the bowel. Thirst, which is so common in post-operative cases, can be relieved by keeping the bowel filled with normal salt solution.

DR. JOHN B. ROBERTS said that post-operative backache is not due to operation itself or to the fact that the patient is kept in bed, but is usually caused by the flat operating table upon which the patient lies during anæsthesia and operation. A hard pad should be placed on the table under the lumbar region of the patient. A hard mattress is also too flat. The table ought to be made to fit the curves of the back, so that the muscles and ligaments may not be strained during a long operation. For 18 or 20 years he has given before almost all operations a quarter of a grain of morphia and one one-hundred and fiftieth of atropin hypodermically. Less anæsthetic is required, there is less interference with breathing by mucus, and the heart is strengthened by this preliminary to anæsthesia. He has never known it to hurt a patient. The curse of thirst, due to the operator insisting that abdominal cases should have no water to drink till hours have

elapsed, should be avoided by all sensible surgeons. The unnecessary torture thus induced should meet with the strong condemnation of the profession. Dr. Roberts has always contended, since the rise of abdominal surgery, that its principles are identical with those of general surgery; and has acted on that belief. A little morphia before anæsthesia and water afterwards do no harm in either case. Another point in post-operative treatment is that nurses nearly always put patients on the stretcher without a pillow under their heads; a low pillow surely can do no harm and is much more comfortable to the patient than to lie with the head thrown backward on the bed.

DR. JOHN B. DEEVER said regarding backache being due to flat tables, he has noted that few gall-stone patients complain of their backs after operation. This would indicate that Dr. Roberts is correct in his statement about the lack of support to the back.

DR. GEORGE G. ROSS wondered how many of the surgeons present had suffered as have the patients they were discussing? He had had his appendix removed, and the following night suffered the tortures of the damned. One of his friends surreptitiously gave him a morphin suppository which afforded great relief. The nurse brought in a large bowl of ice, which he did not interfere with until the ice all melted, when he drank every drop of the water. And this was not followed by vomiting.

DR. GIBBON, in closing, said that he agreed with the other speakers that as few drugs should be used after operation as possible. He emphasized the fact that in using morphia in the manner described it formed rather a part of the anæsthetic than of the after-treatment. Dr. Deaver's dissatisfaction with the use of morphia was the result of using it after, and not during or before, anæsthesia. It has not been Dr. Gibbon's experience that distension follows its use in the way described. His own personal experience after an operation for acute appendicitis had confirmed him in the value of the ethyl chloride-ether-morphia sequence. He slept comfortably for four hours after his operation, was not at all nauseated, and had no taste or smell of ether. He said that he should have mentioned in his paper the great value of washing out the stomach, especially in those patients who had not been properly prepared for operation.

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ORIGINAL MEMOIRS.

THE TECHNIQUE OF DIRECT TRANSFUSION OF BLOOD.

BY GEORGE CRILE, M.D.,

OF CLEVELAND, OHIO,

Professor of Clinical Surgery in the Western Reserve Medical College.

THIS paper is based on 225 experiments upon animals and 32 clinical cases. The major part of the work was done in the Laboratory of Surgical Physiology, Western Reserve University. The experimental part was undertaken in conjunction with Profs. Macleod and Haskins and Drs. Dolley, Hitchings, Cole, Lenhart, and Eisenbrey; the clinical part with Dr. W. E. Lower.

Experimental research into the technique included the availability of vessels by which blood could be transferred from one individual to another with the greatest certainty and under the best control. Transference of blood from vein to vein, though easy of technique, was uncertain in the rate of flow and had little power of overcoming resistance. By using an artery of the donor the blood was driven across under a certain amount of pressure, with a uniform rate of flow, readily overcoming a certain resistance and supplying fresh oxygenated blood. In using the peripheral artery of the recipient, it was found that the back pressure and peripheral resistance interfered with the free flow, and the valves of the peripheral veins

interfered with the flow from the artery of the donor. The proximal vein of the recipient, therefore, being the direct channel to the right heart, seemed the natural and most available route. The question of clotting at the site of anastomosis was eliminated by the use of a mechanical device in place of the Carrel suture. Dr. S. J. Mixter presented us with an ingenious device, in principle not unlike a Murphy button. From this and from the original method of Payr was developed our present instrument, shown in the cut, and now made by Messrs. J. C. Ulmer & Company, of Cleveland. By means of this tube anastomosis may be made so that intima is in contact with intima alone, without damage to this structure and without the possibility of any foreign body coming in contact with the blood stream. The tube has proved as successful in the clinic as in the laboratory.



Twice actual size.

In the clinical transfusions we have utilized the radial artery of the donor and the proximal end of any superficial vein of the arm of the recipient. The radial artery was chosen because it is easily isolated and may be readily adjusted to the position of the vein of the recipient. Unless contraindicated the donor and the recipient are each given a hypodermic injection of morphin twenty minutes before the transfusion. Before they enter the operating room, after their arms are prepared, and for the purpose of minimizing the psychic factor, a nurse places over their eyes a wet towel with the diverting explanation that the eyes must be protected from the bright light to prevent headache. The donor is placed upon an operating table of the Trendelenburg type so that should he faint the head may be readily lowered. The recipient is also placed upon an operating table with his head in the opposite direction from the donor. By the use of an infiltration anæsthesia of o. i

per cent. solution of cocain, about 3 c. m. of the radial artery is exposed, and the smaller branches tied with very fine silk; a "Crile" clamp is applied to the proximal end of the artery and the distal end is ligated; the artery is then divided; the adventitia is pulled over the free end as far as possible and closely snipped off; a moist saline sponge now covers this field. Three or four cm. of a superficial vein of the recipient is then likewise freed; the distal part ligated, the proximal closed with a "Crile" clamp; the distal part is divided with scissors, the adventitia drawn out as far as possible and closely snipped off; the vessels are then inspected and a cannula whose bore is larger than the actual tissue thickness of either vein or artery is selected. The vein may then be pushed through this tube, after which the freed end is turned back like a cuff and snugly tied in the second groove. During this time the handle of the cannula is steadied and manipulated by means of a forceps. If the artery is small or atheromatous and, therefore, firmly contracted or if it is contracted for any other reason, its lumen may be dilated by means of a mosquito hemostat, pushed into the lumen and gradually opened. The artery is then drawn over the vein and is snugly tied with a small linen ligature in the first groove. This completes the anastomosis.

The clamp is then removed from the vein, afterward gradually from the artery, when the blood stream will be seen to pass from the artery across to the vein, dilating the latter. However, the exposure and manipulation of the vessels, especially the artery, causes sharp retraction. The artery may contract so firmly as to obliterate its lumen. The constant application of warm saline solution and protection from the air will help materially in bringing about relaxation and, hence, a larger stream of blood. The pulse wave may be palpated in the vein. It is best to introduce the blood very slowly, watching carefully the result.

From our clinical and experimental research into technique we have reached the following conclusions: that the vascular systems of two individuals may be united so that intima comes in contact only with intima; that this may be

accomplished by the Carrel suture or by a special anastomosis tube, which is the method of choice; that blood may be transferred without clotting; that the use of the radial artery of the donor and any superficial vein of the recipient yields the best results; that the operation may be done painlessly; that the blood lost by the donor is regained in from four to five days; that the amount transferred is under the immediate control of the operator; and that the rate of transference should be carefully gauged because of the risk of overcharging the pulmonary circulation.

ARTERIOVENOUS ANASTOMOSIS.

BY GASTON TORRANCE, M.D.,

OF BIRMINGHAM, ALA.,

Surgeon to St. Vincent's Hospital.

ON July 19, 1906, a man forty years of age, while working in a pipe foundry, had both legs crushed by two 10-inch core bars, weighing about 900 pounds, falling on him; there was a simple fracture of the left leg, and a compound fracture of the right ankle. When examined under ether, the bones of the ankle and lower end of the leg resembled ice when broken in a towel; the anterior tibial artery was found to be severed and the tissues around the joint were so badly lacerated that it was questionable whether the posterior was intact or not. There was considerable shock, and it would have been almost impossible to detect any pulsation in either of the vessels. The long saphenous vein was cut also, and I decided to unite the proximal end of the anterior tibial artery with the distal portion of the vein. Blood was flowing from both vessels and I secured them temporarily with lightly tied silk ligatures until I could finish resecting the ankle.

When ready to unite the vessels I resected the artery above and the vein below the ligature, in order to get rid of the bruised part of the vessels. Two small silk sutures were passed through the whole thickness of the artery on opposite sides and then down into the lumen of the vein for about a quarter of an inch, and then out through the wall of the vein, and, when drawn tight and tied, invaginated the artery into the vein. The end of the vein was sutured to the artery by a continuous silk suture.

No clamps were needed to control the circulation, on account of the weak condition of the heart's action. The blood was still flowing from both vessels when the artery was invaginated, but no distinct pulsation could be detected. There was no leakage after the circular suture was introduced. The wound was packed with gauze and the sutured vessel covered with a flap of flesh which could be raised up for inspection of the vessel.

The foot was put under a constant drip of carbolic acid solution $\frac{1}{2}$ per cent., and kept warm with a hot-water bag.

The following day the foot was warm and normal in appearance; the circulation seemed as good as in the other foot. Motion and sensation normal. About half an inch of the vessel could be seen a short distance above the suture line, and slight pulsations could be felt; it seemed to be fully distended.

The artery was intact the eleventh day after the operation and bled some from the outer coats when sponged. No distinct pulsations could be felt, but it seemed to be in a healthy condition, and was thought to be carrying a small current of blood. The walls of the artery were firm and tense, and a clot was in all probability forming, which in the course of the next few days completely filled the lumen of the vessel and caused it to slough, owing to its exposed condition.

I did not attempt to examine it again for several days, and, when I did so, I found only a sloughing cord, which I recognized as the vessels, but its condition was such that it was worthless as a specimen.

I think the vein probably supplied blood to the foot for two weeks until a new collateral circulation was established which grew stronger as the fibrin was thrown down in the vessel, constantly narrowing its lumen.

About four months later the bone showed a somewhat diseased condition, and the patient insisted upon having the foot amputated. Unfortunately this was done while I was in Europe, and nothing was found out as to how the circulation of the foot was carried on.

SURGERY OF THE VASCULAR SYSTEM.*

- I. LIGATION OF THE DUCTUS ARTERIOSUS. By JOHN C. MUNRO, M.D., of Boston. II. ARTERIOTOMY FOR THROMBOSIS AND EMBOLISM. By FRANCIS T. STEWART, M.D., of Philadelphia. III. TECHNIQUE OF BLOOD-VESSEL SUTURE. By J. EDWIN SWEET, M.D., of Philadelphia. IV. ENDO-ANEURISMORRHAPHY. By CHARLES H. FRAZIER, M.D., of Philadelphia. V. ENDO-ANEURISMORRHAPHY. By JOHN H. GIBBON, M.D., of Philadelphia.

I. LIGATION OF THE DUCTUS ARTERIOSUS.

BY JOHN C. MUNRO, M.D.,

OF BOSTON, MASS.

THAT I may be allowed to bring this suggestion for a new operation before your Society, I ask on the basis that it has not been hastily conceived. On the contrary, long ago I demonstrated its technical possibility on the cadaver of newborn children, and felt that it was justifiable on the living. At various times I have tried to inspire the pediatric specialist with my views, but in vain. Now, in view of the recent advances in cardiac surgery, for much of which we are indebted to the surgeons of this city, I will venture to place my ideas before you, asking that you do not dismiss them hastily.

Nineteen years ago I saw a healthy girl baby that, soon after birth, exhibited symptoms of some cardiac lesion, out of keeping with the general appearance of perfect health and development. On severe exertion, such as straining at stool, it would become cyanotic, and the cardiac beat would cease. At times the child would apparently die, only to recover as soon as the heart was stimulated with electricity. In a few weeks atelectasis developed for which I tried artificial expansion of the lungs under negative pressure in a pneumatic cab-

* Papers read before the Philadelphia Academy of Surgery, May 6, 1907.

inet. This met with only temporary success. Auscultation at this time revealed a cardiac murmur with the pulmonary rales, but cyanosis was not a marked feature. After death, which took place without œdema or marked cyanosis, examination showed an open ductus arteriosus lying easily within reach behind the sternum, without any other defect or lesion except a dilated right ventricle. The simplicity of the remedy was so striking that I at once made further dissections, and satisfied myself that it would be possible to ligate the duct provided a diagnosis could be made beforehand. In regard to making a diagnosis, however, my pediatric advisers were not reassuring. In the hope that it may be possible to detect such a lesion in time to allow surgical interference, I would urge those skilled in the diagnosis of infantile lesions to lend their aid.

To attempt to disentangle the confusion of signs that attach to the various congenital lesions of the heart would be folly. Only faint light can be gained from authorities like Vierordt and others.

In the new-born the duct of Botalli is a little over 5mm. in diameter and 10-15mm. long. The length increases generally up to the time of obliteration which normally is complete by the twentieth day. Thus there must be an early period in the infant's life when the patency of the duct cannot be considered as pathological. It seems as though auscultatory signs during this period would throw some light on those which we should expect when the persistence of the duct forms a pathological factor. Townsend, however, examined 100 new-born babies during the first three days of life with this in view, but was unable to hear anything distinctive.

The causes for a persistent duct are not known. It may be due to some histological variation in the circular fibres, or to an absence of the inflammatory reaction that normally obtains. Very rarely is there an aneurysmal condition, or is the duct so short that a direct intercommunication between the aorta and the pulmonary artery exists. The cases collected by Vierordt do not number a hundred, but that must be quite far from a correct estimate. It is not at all necessary that other

congenital anomalies coëxist with the anomaly under consideration. Most writers find hypertrophy and dilatation of the heart, and the pulmonary artery may exceed the aorta in diameter. In typical cases the foramen ovale is closed, but not because of the theoretical reason that an open duct is dependent on a foramen that has closed prematurely.

In typical cases cyanosis is wanting. One finds rather an anemia or later a waxy appearance. Cyanosis is less characteristic of this than of other serious cardiac malformations. In late life it may be present, however. Cardiac dullness is increased laterally, and there may be projection and pulsation of the dullness, leftwards, in the upper costal spaces. This projection is visible by X-ray. The pulse shows little change though Franck considers that there is a fall with inspiration and a rise with expiration. We may find true attacks of suffocation, and bleeding from the mucous membranes as in other serious malformations. A loud systolic whir conducted into the cervical vessels may be heard, but as a matter of fact there are no definite auscultatory signs established as yet.

Of 26 cases recently collected about half lived to puberty, but it seems as though this must be an unduly large proportion owing to the lack of autopsies in infants. Death follows from atelectasis, general œdema, pleural exudate, pneumonia, endocarditis, etc.

Among the cardiac anomalies to be differentiated is, first of all, an open foramen ovale. The distinguishing signs are not well determined and it is useless to take up the question here. In open ventricular septa, in congenital pulmonary stenosis, in persistent truncus arteriosus, where the patient dies as a rule shortly after birth, we must expect marked cyanosis. Congenital aortic-pulmonary communication and stenosis of the various ostia are so rare that they may be disregarded.

Why should we consider surgical interference in cases of open ductus arteriosus? Because in spite of the fact that some cases may live to puberty, the chances of which must be small, we have the one cardiac-valvular lesion which is, relatively speaking, superficial. Furthermore the anomalous vessel is of

good size, its ligation must be followed by instant and permanent restoration to a normal function of the lungs and arteries, and it can be reached by a short surgical route.

The operation I would propose, as demonstrated on the cadaver, is as follows. Under ether, which I prefer to chloroform in any case involving collapse of the lung, the sternum can be easily split along its centre or a little to the right, opposite the second costal cartilage. This is easily done with a knife. The sternal halves are then retracted, ample room for working being obtained. The right pleural cavity will probably be opened but the left one will not. Judging from analogous cases in surgery, this should not be serious, but if necessary the physiologist's apparatus for maintaining artificial respiration could be employed. I hardly believe that it would be needed. After retracting the thymus upward, the pericardium is exposed. Its reflection lies so high on the large vessels that the ductus to all intents and purposes is intrapericardial. In the upper angle the aorta will be seen on the patient's right and the pulmonary artery on the left. By following close to the aorta toward the under surface of the arch the ductus, as large as the aorta itself, will be seen as the first vessel to the left pointing upward and a little to the right. Both pulmonary branches lie too far posteriorly to be seen, and by keeping close to the aorta the main pulmonary trunk will escape injury. On pushing through the tissues by blunt dissection the ductus, theoretically, should be easily surrounded with a ligature. It is a question whether or not simply crushing it would not accomplish as much, and in case of necessity, I believe that it would be worth trying. After closing the anterior pericardial wound the sternum can be sutured or not and the skin closed.

Would it be justifiable to subject a child to this risk without knowledge of the exact lesion? In a case with beginning atelectasis or other evidences of impending death from circulatory disturbances, with a reasonable basis for believing that the duct were open, it seems as though such an operation would be justifiable. I doubt if it would materially hasten a fatal issue in case the diagnosis were not confirmed.

II. ARTERIOTOMY FOR THROMBOSIS AND EMBOLISM.

BY FRANCIS T. STEWART, M.D.,

OF PHILADELPHIA.

THE usual treatment for arterial obstruction involving the limbs and depending upon thrombosis or embolism, is in brief to keep the part dry, warm, sterile, and slightly elevated, in order to prevent gangrene, or at least limit it and cause it to assume a dry and circumscribed form. With the development of aseptic surgery and the progress which has been made in the suture of arteries more active measures demand at least consideration. These measures will vary according to the cause of the arterial obstruction, since the problems to be solved differ with the lesion encountered. We shall confine ourselves to the two forms which we have an opportunity to investigate by operation.

I. *Traumatic thrombosis* due to contusion of an artery.—By contusion we mean an injury produced by blunt violence which does not result in immediate dissolution of the continuity of the external coat of the vessel, in other words, such injuries as are often described as partial ruptures. The lesions found after a contusion of an artery vary with the violence of the contusion and the state of the arterial walls. The slightest grade, in which there is perhaps no change but a little ecchymosis of the vessel wall, may be disregarded, as such causes neither immediate signs nor remote ill effects. The older surgeons explained some of the cases of obliteration of an artery after contusion, by rupture of the vasa vasorum, and extravasation of blood between the vessel and its sheath in sufficient quantity to press upon and considerably narrow the lumen of the vessel. This was supposed to be followed by a traumatic arteritis with consequent thrombosis. It is now known that in practically all instances the inner coats of the vessels rupture and that such leads to thrombosis. As in the application of

a ligature, although the force acts from without inwards, the lesions, owing to the friability of the internal coats are produced from within outwards. The injury may expend itself on the internal coat alone, leaving the outer coats intact and practically normal. The lesion here observed is a fissuring of the intima, which may be complete or incomplete, *i.e.*, involving the entire circumference or only a part thereof. Complete circular division is best seen after the application of a ligature. In contusions by blunt violence the fissures are apt to be multiple, and frequently involve only a portion of the circumference of the vessel, usually that first struck. The sole result of clinical importance is thrombosis with its consequences. If the fissure is small and incomplete, there may be a minute mural thrombus, which causes no interference with the blood current, but simply protects the wound until healing is complete. Obliteration of the vessel by clot is liable to follow, however, if the rent in the internal coat is large, if the fissures are multiple, if the tunic is sufficiently detached to wave in the blood stream, if the detached tunic is infiltrated with lime salts, if tight compression is applied after the accident, or if the state of the heart or the blood is such as to predispose to coagulation. The conditions just mentioned determine also the rapidity with which an occluding thrombus forms. It may immediately follow the injury or it may not develop for several hours or even days. Generally speaking, complete obliteration after a lesion of the internal coat alone is delayed, although in the femoral artery we have observed it to occur within a few minutes. Yielding of the internal and middle coats is much more likely to be followed by immediate thrombosis, since they curl up within the vessel in obedience to the elasticity of the middle coat. The adventitia maintains the continuity of the vessel and prevents extravasation, although the blood may make its way for some distance between this coat and the media, sometimes for an inch or more. Ordinarily the clot extends centrally in a conical form as far as the first collateral branch. Peripherally its length varies; it may fill the main branch and the smaller arteries or it may terminate like

the central portion near a collateral. Upon its extent and upon the activity of the collateral circulation depends the integrity of the limb. If the injury is confined to the artery alone, and the vessels are healthy and the collaterals abundant, no harm need follow. If the clot forms slowly, ample opportunity is afforded for the development of an adequate collateral circulation, which becomes progressively more efficient the more the lumen is closed; thus pulsation may never be absent from the peripheral vessels, even though the vessel at the contused point becomes impervious. If, however, the vessels are narrowed by disease, or if the collaterals are involved in the injury or pressed by extravasated blood or a tight bandage, the collateral circulation will be insufficient and the thrombosis may extend to the finer vessels. In either event the limb falls into gangrene. Another possible factor in the production of gangrene is the detachment of portions of the clot during the formation of the thrombus, the emboli plugging the smaller vessels and leading to circumscribed gangrene. In the absence of sepsis secondary hemorrhage does not occur.

The signs of obliteration of the vessel (pain, pallor, loss of pulsation, loss of heat, hypesthesia or anesthesia, paresis or paralysis) when marked are followed by gangrene, but when present in a lesser degree complete recovery is still possible. Such, however, is the exception and the limb usually perishes for several reasons. Unlike simple ligation, after which gangrene is comparatively rare, in a contusion the accompanying vein also may be involved and thrombosed. The collateral vessels too are apt to suffer from the trauma, or if they escape direct injury they may be compressed by the extravasated blood resulting from the associated laceration of the envioning tissues. Of 34 cases of traumatic thrombosis collected by Lears 18 recovered, and of these only 4 escaped gangrene.

If the pulse alone has disappeared and there are no other signs of impending gangrene, the treatment mentioned at the beginning is all that is needed. A hematoma, however, should always be opened, in order to lessen the compression on the collateral vessels. If the hematoma is of large size, one can

never be sure that the artery has not been opened, hence in these cases incision has a double rôle, to permit evacuation of the blood and to ascertain the condition of the artery. The clots adhere strongly to and infiltrate the surrounding tissues, but the tissues should not be scrubbed in order to remove them. If the bleeding has completely ceased we believe it good practice to suture the wound without drainage, since the latter always predisposes to infection, particularly in bruised tissues.

On theoretical grounds ligation of the artery above the injured part has been suggested in order to prevent the detachment of emboli. If the pulse has disappeared, indicating complete obliteration of the vessel, no reason exists for this procedure; if the pulse is still present, although of lessened force and volume, we believe the chances of embolism should be accepted rather than completely to suppress the circulation. Although the possibility of opening the artery, removing the thrombus, then suturing the wound in the vessel has probably occurred to many surgeons we imagined at the time of our first operation that we were the first to put the idea into practice. On looking over the literature, however, we find that both Sabanajew and Lejars have attempted to relieve arterial obstruction by arteriotomy.

Sabanajew's operation was performed in 1896 (Höpfner, *Archiv f. klin. Chir.* Bd. 70, S. 417, 1903). His patient, suffering with polyarthritis rheumatica, was suddenly stricken with signs of gangrene of the leg depending upon obstruction of the femoral artery, which was believed to be due to an embolus. The femoral artery was exposed, but no occlusion found in the expected situation. Owing to the desperate condition of the patient, further search was deemed inadvisable, and the vessel was closed with sutures and the limb amputated at a lower level. The patient died 19 days later of endocarditis.

Lejars' (*Bull. et mem. de lo soc. de chir. de Paris*, 1902, p. 609), patient was a man, aged 26 years, who was caught between two cars, sustaining a severe contusion of the left inguinal region. Signs of thrombosis of the femoral artery were in evidence, and the foot became gangrenous. Six days after the accident the artery was exposed below Poupert's ligament, a soft black clot removed, and the wound in the vessel closed with sutures. The gangrene progressed, however, and one month later the leg was amputated below the knee.

For our first case we are indebted to Dr. Robert G. Le Conte, who was absent from the city when the patient was admitted to the Pennsylvania Hospital, June 20, 1905. The patient was a man, aged 60 years, who presented all the evidences of advanced atheroma, with mitral regurgitation and hypertrophy of the heart. He had been squeezed between the tail-board of a wagon and a wall. Over the lower portion of the left abdomen and upper part of the corresponding thigh was a diffuse swelling due to extravasated blood. The skin was unbroken and there were no other injuries. Both legs were bluish and covered with a network of small varicose veins. Pulsation in the tibial vessels was as strong and full on the left as on the right side. During the night of the same day, or about twelve hours after the injury, he complained of severe pain, first in the popliteal space, and later radiating down the leg to the foot and toes. The following morning we found the pulse absent from the tibial vessels and popliteal artery. The femoral could not be satisfactorily palpated because of the swelling mentioned above. The pain had disappeared, but the leg as far as the knee was pale and cold, and the toes and foot shriveled. Sensation was present but markedly reduced in the entire foot and leg. There was no power in the toes, and the ankle could be flexed only with difficulty. Movements of the knee were unimpaired. The thigh was warm and apparently in the same condition as on admission. Owing to the condition of the thigh, the very sudden onset of symptoms, and the seat of the initial pain, it was believed that a large clot embolus had been swept from the point of injury and lodged at the bifurcation of the popliteal. About 12 hours after the onset of pain and 24 hours after the injury the patient was anesthetized with ether, and the popliteal artery opened by a small longitudinal incision. There was a slight flow of dark blood, but no clot could be found. A probe was gently passed up into the artery for about 6 inches and no obstruction found nor flow of blood induced. The wound in the artery was closed with through-and-through silk sutures and the skin approximated. A longitudinal incision was next made over the femoral artery, from just above Poupart's ligament downwards. The sartorius muscle had been ruptured and all the tissues were infiltrated with dark clots. The vein was uninjured. The artery was not discolored, but was hard to the touch from Poupart's ligament down to its bifurcation.

Poupart's ligament was severed in order to permit an assistant to grasp the vessel above the thrombus, and the artery was opened by a longitudinal incision.

After removing the clot, which was almost black in color and firmly adherent, it was discovered that, like a valve, a calcified portion of the intima had been turned into the artery from the anterior wall, probably occluding it one-half. The posterior wall of the artery, although calcareous in places, was apparently uninjured. The detached atheromatous plate was removed, and the compression on the artery diminished for an instant in order to wash out any remaining debris. The artery was then closed with through-and-through silk sutures. The circulation was immediately reestablished, but after the lapse of a brief period pulsation below the injured point ceased. The arterial stitches were then removed and the vessel again found filled with clot. This was removed and the artery resutured. The same phenomena were repeated, and the hopelessness of securing a patent lumen by simple removal of the thrombus realized. The injured portion of the artery was therefore excised by a diamond-shaped incision, with the idea of closing the wound transversely. This, however, was found to be impossible, so that the artery was completely severed and each end split on the posterior wall, the flaps thus formed being turned outwards and the segments of the artery united with through-and-through silk sutures, bringing intima in contact with intima. Although the circulation was again reestablished, at the time the skin wound was sutured pulsation in the artery below the site of anastomosis had become very feeble and no pulse could be felt in the tibial vessels. The gangrene, which was of the moist septic type, progressed rapidly and the limb was amputated through the upper thigh 10 days later by Dr. Le Conte. The flaps subsequently sloughed and reamputation was performed about one month later by Dr. Hutchinson. The patient finally recovered.

The chief difficulty in an operation like the foregoing is to prevent the reformation of the thrombus. The clot intimately adheres to the internal tunic and can be completely removed only with some difficulty, thereby subjecting the delicate lining membrane of the artery to further injury. If the artery is

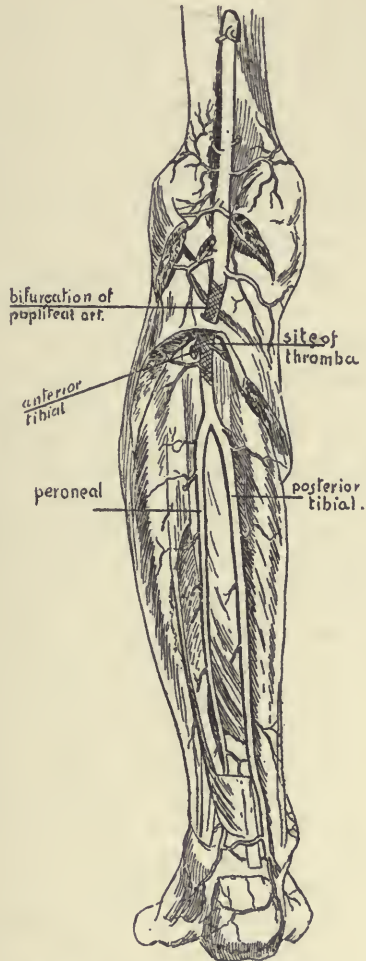
simply opened, the clot removed, and the vessel sutured, the cause of the thrombosis, *i.e.*, the multiple cracks in the intima or the curling up of the internal coat, is not suppressed, and the thrombus will quickly reform as it did in our case. There are several ways in which this may possibly be prevented. If the contusion is sufficiently limited, the injured portion of the artery may be resected, and the vessel anastomosed by Carrel's technic. The advantages of this method over Murphy's anastomosis by invagination are quite obvious, as the latter considerably diminishes the lumen of the vessel and does not permit the removal of as much artery as the former. The extent of vessel which may be excised without exerting too much tension on the sutures will vary somewhat with the situation; thus in resection near joints flexion may be utilized to diminish tension, while in other regions, particularly where the artery is bound to the surrounding parts by branches, it will be impossible to effect anastomosis after the removal of a large extent of vessel. In the latter instance severances of the collaterals would probably facilitate this manœuvre, but generally would be contraindicated. Kummel was able to approximate the ends of a femoral artery after resecting two inches, during an operation for cancer of the inguinal region. Another method of restoring the circulation after traumatic thrombosis which at once suggests itself is to substitute a segment of a vein for the injured portion of the artery, a procedure which has already been employed in the treatment of aneurysm. Whether or not the operation is feasible cannot be definitely stated at the present time. Experimentally varying results have been obtained. Höpfner transplanted a segment of a vein to an artery in 10 animals. The vein at once became twice the size of the artery. The twirling of blood within it could be seen and, as in aneurysm, this led to thrombosis. Efforts were made to prevent the dilatation of the vein by doubling it, *i.e.*, by turning one end back like a cuff, and also by suturing the surrounding tissues over it. The ultimate results were negative, as secondary hemorrhage occurred in one and thrombosis in all the others. The success obtained

by Carrel in the transplantation of vessels in animals is well known and need not be recited here. Whether or not the companion vein should be employed for this purpose would depend upon the artery involved. One would not think of transplanting a segment of the popliteal or the femoral vein to its accompanying artery, as in case of failure both the arterial and venous circulations would be suppressed and the chances of gangrene very great. Probably the best vein to substitute would be the external jugular, although one of the brachial veins or even the opposite femoral vein might be employed. If the saphenous vein is sufficiently large, it likewise might be transplanted. In the arm where there are two venæ comites one of these could be selected.

Embolism.—The difficulty mentioned above would not be encountered in dealing with an embolus soon after its lodgment, indeed the chances of thrombosis would be no greater than after the most favorable form of arteriorrhapy, since the intima is likely to be smooth at the point of impaction of the embolus. Case two we submit as one of embolism, although we have no means of definitely excluding primary thrombosis. As an impacted embolus quickly becomes the nucleus of a thrombus, the exact diagnosis from the standpoint of arteriotomy is unimportant. The important thing is the condition of the intima.

The patient was a man, aged 61 years, who had never been seriously ill before. He was suddenly attacked with generalized abdominal pain, vomiting, and constipation. This persisted for two days, at which time we saw him with his physician, Dr. James M. Montgomery, who feared the case might be one of intestinal obstruction. There was no fever, the pulse was about 100, and the intrathoracic organs normal. The abdomen was flat, soft, and slightly tender in the region of the left kidney. Rectal examination was negative. The blood vessels were distinctly atheromatous. With the use of laxatives and enemas the bowels were finally induced to move, and the abdominal symptoms subsided. In the meantime the patient developed a cystitis with bloody urine, possibly as the result of the catheterization which

was found necessary at the beginning of the illness. About five days after the abdominal pain subsided the patient experienced a sudden excruciating pain in the right foot, which rapidly



Showing thrombus in popliteal artery.

extended to the lower third of the thigh, and was accompanied by pallor, loss of heat, loss of tactile sensation, inability to move the limb, and coldness. We saw him the following day and found the limb cold as far as the middle of the thigh. The foot was

shriveled, and the leg purplish as far as the upper third. Pulsation could not be felt in any of the vessels below the bifurcation of the femoral. Thirty-six hours after the onset of pain the patient was sent to the Jefferson Hospital, and the common femoral artery exposed by a longitudinal incision. It pulsated vigorously to within one inch of the bifurcation. From this point to the bifurcation it was hard, and below the bifurcation collapsed. The vessel was isolated, compressed, and opened by a longitudinal incision about one inch long. The thrombus was Y-shaped, corresponding to bifurcation, the base of the Y being about one inch long and tapering at the tip. The limb corresponding to the superficial femoral was $\frac{1}{2}$ inch long and also tapering at the tip. The limb corresponding to the deep femoral was one inch long and likewise tapering. The color of the thrombus was dirty white, with bright red spots and black blotches, except the terminal $\frac{1}{2}$ inch of the limb corresponding to the deep femoral, which was jet black. The intima was smooth, although the vessel wall was decidedly thickened. On removal of the thrombus blood flowed freely from the peripheral part of the deep femoral, but not from the peripheral part of the superficial. The vessel was closed with a continuous through-and-through suture of silk, and over this a second layer uniting the outer coats only. Pulsation immediately reappeared in the femoral below and in the popliteal, but not in the tibial vessels. The skin wound was closed without drainage. After operation pulsation continued in the popliteal about one-half the strength for three days, then began to grow weaker, finally disappearing on the eighth day. In the meantime a large vessel on either side of the patella (superior external articular, anastomotica magna) pulsated more vigorously as the pulsation in the popliteal became weaker. The pain in the leg continued, being particularly marked in the popliteal space. The line of demarcation which formed was an irregular oval, the inside reaching to the junction of the lower with the middle third of the leg, and the outside to the junction of the upper and middle third. In the deeper structures the gangrene ascended to a higher level. Forty-two days after the first operation the leg was amputated below the tubercle of the tibia, lateral flaps of equal length being employed. About 15 ligatures were necessary, and the bone bled freely on section. The popliteal artery contained a

small clot, and a probe passed up into the artery for several inches caused a slight flow of blood.

Perhaps the first thought which strikes one after reading the above cases is the inability which was encountered in two instances to locate definitely the obstruction by the mere symptoms. In our first case we feel sure that the mistake would not have occurred could we have palpated the femoral artery itself. It seems that the symptoms are caused, not by the thrombus itself or by even the sudden impaction of an embolus, but by the result of the arterial obliteration, *i.e.*, the acute anemia, thus the pain, etc., are referred to the area from which the blood is excluded, and not to the seat of obstruction. It will be seen, however, that the operation of thrombectomy or embolectomy, if it may be so called, can be readily performed without danger of secondary hemorrhage. We believe it to be indicated particularly when the intima is smooth, and that to be of value it must be performed as soon as possible after the arterial obstruction develops. Even though the vessel again becomes obstructed with clot, as in our second case, this may form slowly and give the collateral vessels a chance to dilate, thus saving at least a portion of the limb.

III. TECHNIQUE OF BLOOD VESSEL SUTURE.

BY J. EDWIN SWEET, M.D.,

OF PHILADELPHIA.

IF we will remember for a moment that the first suggestion of repairing wounded blood vessels, as well as the first attempt to carry out the suggestion, dates from the year 1759,—when Hallowel, an English surgeon, at the suggestion of his fellow, Lambert, attempted to repair a wounded brachial artery, and perhaps succeeded,—it is not surprising that many have endeavored, experimentally and clinically, to elaborate a successful technique for the suture of blood vessels.

Longitudinal wounds of blood vessels, and transverse wounds involving only a portion of the circumference, are easily repaired, the technique of such procedure being the common property of all surgeons of experience. The question before us to-night is the technique of the repair of wounds which completely divide the vessel,—the question of the end-to-end anastomosis of blood vessels; a question involving accident cases, the treatment of aneurisms, the transfusion of blood from one human being to another, and, possibly, the transplantation of organs.

A most superficial consideration of the tubular structure known as a blood vessel leads to the conclusion that such a tube may be reunited in one of four ways,—I mean from the mechanical standpoint; 1. the ends may be brought as nearly as possible into their original position, approximating the various coats of the vessel to each other; 2. the edges may be everted, turning the cut edges outward; 3. one end may be inserted into the other end, invagination; 4. a mechanical aid may be employed

I am personally inclined to the belief that the method of exact end-to-end approximation,—the method which has given such remarkable results in the hands of Carrel and Watts,—is easier of execution, and since it accomplishes that great

surgical desideratum, the restoration of tissues as nearly as possible to their original position, is perhaps theoretically correct.

There seems to be unity of opinion as to the choice of suture material,—fine silk, of a size carefully chosen so that it will completely fill the hole left by the needle. The needles should be of the smallest possible size, round, either straight or curved, according to the individual and the site of operation. Experimenters are further agreed that the stitches should include all the coats of the vessel, since the penetration of the intima is a matter of no consequence.

The actual technique is, then, as follows: the exposed vessel is clamped by some means which must be very gentle, the simplest and best clamp being, in my opinion, the one devised by Herrick. The loose connective tissue of the external coat of the vessel must then be dissected away, the best procedure being to draw it down over the cut end of the vessel and to snip it off even with the vessel end; it will then retract, leaving the vessel free. This must be done, else the loose tissue will interfere by being dragged with the suture into the needle holes. All insult to the vessel wall, such as grasping it with forceps, must be religiously avoided. If the edges of the wound have been crushed they should be freshened by resecting a bit with a very sharp scalpel; since the cut of scissors is always a crushing cut they should not be used.

Three tension sutures of fine silk, impregnated with vaseline, are then laid at equidistant points of the circumferences of the vessel ends. An assistant then applies traction to two of these guide sutures in turn, stretching the portion between the two sutures into a straight line, facilitating the laying of the continuous suture, and preventing a narrowing of the lumen. If at this time the third tension suture is weighted by means of a hemostat the circumference of the vessel will be arranged in the form of a triangle, the points of which are determined by the three traction sutures, and there will be no danger of catching the opposite wall while laying the suture. The suture is a continuous, overhand stitch,

through all the coats; the separate stitches should be drawn just tightly enough to secure absolute approximation, but not too tightly else the tissues be everted; they must be laid very close together. After the completion of the suture and the removal of the clamps there will often be some hemorrhage; if this is too free a few interrupted stitches may be laid, but a considerable hemorrhage will almost always stop under gentle digital compression. I wish to emphasize this fact, because of its bearing upon the later theoretical discussion. The danger of aneurism formation is very small; secondary hemorrhage is also as rare.

Now this sounds very easy, and, in truth, it is not very difficult, except for the extreme delicacy of the needles and the silk, and of the vessel walls; it is unusual surgery, since it partakes of the art of the watch-maker. Why, then, cannot everybody succeed in performing these simple, though delicate operations? Why do we read reports varying between absolute failure and uniform success? Why, out of four operations on the neck of the same animal, do we sometimes find the arteries perfect, the veins thrombosed, or the veins patulous and the arteries closed, or only one success, or all failure, or all success? This is the question which, I think, leads us far away, into the fields where fact and theory too often establish a *circulus viciosus*.

In the first place, every author since Jassinowsky, whose work formed the first real contribution to our knowledge of this subject, has emphasized the necessity of a perfect aseptic technique. Carrel goes so far as to express his opinion that under ordinary "aseptic" conditions there are always a few bacteria which gain entrance to the wound; now these are so few that under ordinary conditions the tissues are able to destroy them. Not so in blood vessel surgery,—here we must have "absolute asepsis."

That infection around an uninjured blood vessel will cause thrombosis is banal. But I cannot believe that infection is the cause of the frequent thrombosis after blood vessel suture for several reasons; first, we find thrombosis with none of the

usual macroscopic signs of infection, and, secondly, an early examination will show small non-occluding thrombi, and older specimens will show such thrombi completely healed over. In the third place, I have often observed that a thrombus will form in a sutured vessel, especially a vein, within a few moments after the clamps are removed, certainly hours too soon for these few bacteria to have caused it. Further, if this thrombus be removed by gently "milking" the vessel, another thrombus will replace it. In other words, the causes of thrombosis lie nearer at hand than bacterial action.

Just what happens when a blood vessel is wounded? The final processes of repair have been studied sufficiently to enable us to say that the vessel wall is completely repaired. The wound of the interior is covered with proliferated endothelium; some elastic fibres may regenerate, though the elastica is possibly not as perfectly repaired as are the other coats; the external coats are reconstructed by that excess of reaction so common in Nature as to be universal, and the vessel wall becomes stronger at that point than it was before the injury.

The problem of the coagulation of the blood is an extremely complex one. We know various factors in the process; we know that foreign bodies and roughenings of the intima favor coagulation; that an interference with the free current of the blood is a favoring factor. We know that the tissues contain a substance or substances which cause rapid coagulation of the blood plasma, and that these substances are present in the tissues of the vessel wall. The formed constituents of the blood also contain these same or analogous substances. Calcium salts are necessary for the formation of fibrin. Experiments upon the vessels of animals whose blood had been made incoagulable by injections of hirudin or of peptone have shown that another process enters into the play, an agglutination of the blood plaques or platelets.

It is not necessary for us to decide between the theories concerning what happens first, or what happens further, as whether the action is a ferment action or whether it is not.

Let us think of the action of some of the factors in coagulation which I have mentioned. The suture, being inelastic, must offer a point where the current of the blood is more or less influenced; the sutures are the foreign bodies; the holes in the intima are rough; the tissue coagulins contained in the vessel wall have access to the blood through the needle holes; blood platelets are deposited in the wounds of the intima, even in incoagulable blood, and we know that a true coagulum can start from such a deposition of platelets. Further, if two factors are united in these biological phenomena, the result is usually much greater than the sum of the separate action of each factor.

That some coagulation occurs in every case seems to me to be proven by the statement to be found in every report of extensive work,—that slight hemorrhage is to be controlled by gentle digital compression. Such a method could only stop hemorrhage, it seems to me, by favoring the filling of the needle holes with a coagulum.

I therefore think that those who report uniformly successful results have succeeded not because they enjoy a monopoly of aseptic technique, but of mechanical technique. In other words, the man who will master the numberless details of asepsis in experimental work on animals, where matters are more complicated than in human surgery, is probably the man who will master the delicate mechanics of the operation. The vessels are brought together with the least possible stretching or narrowing of the lumen, thus affecting the blood stream as little as possible. The foreign body is made less active as a foreign body by impregnating the silk with vaseline. The silk is so chosen as to fill the holes made by the needles and thus prevent the admixture of tissue coagulins from the vessel wall. Having excluded these factors, the deposition of blood platelets, which, I believe, always fills the wound of the intima at least, may perhaps be insufficient to cause the formation of fibrin and thrombosis.

The exclusion of these factors brings me to the consideration of a mechanical aid to blood vessel anastomosis, which is

commonly called the method of Payr, but which, if my literary researches are correct, should be accredited to von Quirolo, his report appearing in 1895. The method consists in drawing the cut end of the vessel through a tube of glass, or ivory, or metal; the internal diameter of this tube is the same as the external diameter of the blood vessel. The vessel is then turned inside out, back over the tube, so that the intima is on the outside. This cuff is fastened in place by a ligature, and is then inserted into the other end of the blood vessel, which is fastened in its place by a second ligature. The ligatures are prevented from slipping off the little tube by placing them over grooves cut in the tubes, or back of a raised thread made on the outside of the tube. By this method broad surfaces of endothelium are placed in contact, and no wounds are made by the needles; the cut edges of the vessel, exuding coagulins, are entirely outside the vessel lumen. The method does not appear to have given especially good results except for temporary anastomoses, as in transfusion, where it seems to me to approach the ideal. It is not so easy to execute as it may seem. Crile has improved upon the original suggestions by attaching a handle to the tube, which greatly facilitates the eversion of the vessel.

The theories of the coagulation of the blood have carried me far out to sea; I was left there by the following facts concerning an operation little known, because of no practical importance. In 1876 a Russian army surgeon named Eck conceived the idea of making an artificial opening between the portal vein and the vena cava, in order to relieve the congestion in the portal system in cases of cirrhosis of the liver. He not only conceived this idea but executed it experimentally; and since that time the operation has been often performed, yet in no report do we find that thrombosis or embolism has resulted.

The operation has been done in several ways, none of which is calculated to prevent thrombosis. The vessels are brought together by interrupted sutures; wires or threads are then placed in position in the lumen of each vessel so that

when the small scissors, the blades of which are fastened to the wires, are drawn through, after a second row of sutures has been laid, each blade must cut a linear incision through the wall of its respective vessel, an incision limited by the points of entry and exit of the guiding wires; the line of this incision is then enclosed by a second row of interrupted sutures parallel with the first, and the scissors are pulled through between the two rows of sutures. In my own method the wire of an electro-cautery is substituted for the scissors. The portal vein is then tied off at the hilus of the liver, thus forcing all the blood through a torn or burned wound through all the walls of the veins. The interrupted sutures also pierce the intima.

We have then a beautifully torn, rough wound, sutures with no attempt to neutralize their action with vaseline, undoubted coagulation,—since we have no hemorrhage between the sutures, which are laid from one-sixteenth to one-eighth of an inch apart,—and yet no thrombosis. The explanation may be that the portal vein has no collateral branches to open and enlarge, and the blood is forced to pass through this artificial opening; but on the other hand the pressure cannot be so great as it is in an artery. It might be that the portal blood contains peptone-like bodies which inhibit coagulation, but this is hardly probable, for the portal blood coagulates outside the vessels as rapidly, if not more rapidly, than does blood from any other vessel. I have thought that the burned wound made by my cautery sealed the edges so that the tissue coagulins could not exude; yet equally good results have been obtained by using scissors; further, I have attempted to prove my idea by cutting the vessels of the neck with the cautery, and then joining them according to various methods; the results are possibly not so good as after the vessel wall had been severed by a sharp scalpel. In short, I am willing to admit that the processes governing thrombosis are not sufficiently clear to my own mind.

For the practical surgeon I feel that we may draw these conclusions: in any case where the anastomosis of a blood vessel is indicated, it should be tried; aneurisms and secondary

hemorrhages should not occur. If immediate thrombosis occurs we would be as well off as though the vessel had been ligated; if gradual thrombosis occurs, we might well hope that such a process would be more favorable to the formation of a collateral circulation than would immediate ligation; and if we should succeed, the literature of surgery would undoubtedly be enlarged and enriched.

IV. ENDO-ANEURYSMORRHAPHY (MATAS).

BY CHARLES H. FRAZIER, M.D.,

OF PHILADELPHIA.

ONE of the most fascinating chapters in the history of modern surgery concerns the application of the suture as applied to lesions of the vascular system. These revolutionary measures have attracted wide attention not only because of their applicability to the treatment of the everyday lesions of the vascular apparatus, but because in simplifying the technic of direct transfusion they open a field of speculation, the possibilities of which are just beginning to dawn upon us.

The history of the development of the suture in the surgery of the vascular system and its applicability to the treatment of aneurysm has been so graphically described by Matas that I will confine my remarks to my personal experience with his operation, adding such comments as may be suggested by the conditions which presented at or after the operation.

CASE I. B. T. (University Hospital, No. 1313, Series 2.)
Popliteal Aneurysm: (Sacciform) Endo-Aneuromorrhaphy (reconstructive): Recovery.

A colored man, 38 years of age, was referred to me by Dr C. S. Weeks in April, 1906. He was a waiter by occupation. He had had syphilis about eighteen years ago and was addicted to the free use of alcohol and tobacco. Eight months ago (September, 1905), the patient began to complain of a dull pain in the popliteal space. The knee joint felt stiff and the patient thought he had rheumatism. The pains and stiffness increased but it was not until two months later (December, 1905) that he noticed a small swelling, about the size of a chestnut, in the right popliteal space. The swelling gradually increased in size, until one month before his admission to the hospital, when it began to increase so rapidly that he was obliged to give up his work.

Upon examination there was found a pulsating tumor occu-

pying the lower portion of the popliteal space measuring 10 cm. in its longitudinal and 11 cm. in its transverse axis. The circumference of the limb over the tumor was $32\frac{1}{2}$ cm. as compared with 29 cm. on the unaffected limb. The leg below the aneurysm was somewhat swollen and the superficial veins quite prominent. There was a visible expansile pulsation and a marked bruit on auscultation. Pulsation could not be felt in the anterior tibial vessel. Operation. April 28, 1906. Under nitrous oxide-ether anæsthesia, an Esmarch tube having been applied to the thigh, a longitudinal incision was made directly over the tumor. Upon opening the sac a careful inspection proved that we were dealing with an aneurysm of the saccular or sacciform type, having but one communication with the parent artery. The operator then proceeded to remove the clot which partially filled the aneurysmal sac. This proved to be a rather slow process because the laminae, particularly the deeper ones, were well organized and quite adherent to one another. These were peeled off as one peels an onion. Microscopically these clots were found to be well organized, being composed of a stroma of young connective tissue within which were sprouting newly formed blood vessels. When the sac wall was finally stripped of its clots the single communication with the artery was closed with a continuous silk suture and the sac cavity obliterated by means of two layers of fine silk sutures. The cutaneous wound was closed with silk worm gut suture, the dressing applied, and fixation assured with a posterior splint. The post operative convalescence was devoid of interest. At no time was there any cause for apprehension as regards the vitality of the limb below the seat of operation. The temperature of the foot on the affected side was unaffected, the limb was not swollen so that I was quite sure neither the arterial nor venous circulation had been affected by the operative manipulations. The patient complained of numbness in the limb for a few days but this sensation soon passed off. There was some suppuration in the upper layers of the wound. While accidental infection may occur in any wound there are two factors, which in this particular operation may be regarded as predisposing causes, one traumatism, such as may be inflicted in removing the laminated clot, the other, impairment of circulation; Matas, in speaking of the chief points to be observed in closing the wound, says "too tight or too many sutures must be avoided in order not to compromise the circulation of the sutured tissues."

When the patient was discharged from the hospital there was no pulsation detected in the anterior tibial artery, a condition which was noted before the operation. The patient was examined in October, 1906, nine months later, when there was no signs of recurrence.¹

Comments.—In this case I was surprised with the comparative simplicity of the procedure from the technical standpoint. There was of course no difficulty in rendering the field of operation bloodless, the aneurysm was easy of access. At no time was there any danger or fear of injuring the popliteal vein, which there would have been had any attempt been made to remove the sac. Whatever difficulty there may have been was entailed in removing the laminated clot and in determining when the intima had been reached. The layers which composed the clot were firmly adherent one to the other, in fact there was, as proven by microscopic examination, absolute union between the layers. A good deal of force had to be applied to separate them from the sac wall, and on several occasions I thought the intima had been reached only to find one or more layers still adherent. With more experience and with greater familiarity with the gross appearance of the structures involved this step of the operation could have been conducted more expeditiously. The necessity of removing everything necessary to lay bare the intima is apparent; inasmuch as the success of the operation depends absolutely upon the apposition and union of the serous coat of the aneurysmal sac and arterial orifice. The single communication with the parent artery was situated at the bottom of the sac near its upper extremity and not in the middle. We are accustomed to see the communication with the artery, in cases of saccular aneurysm, diagrammatically represented about the middle of the sac. This was the position in which I expected to find it in this case; failing to find it there, it was some time before I discovered it near the upper pole.

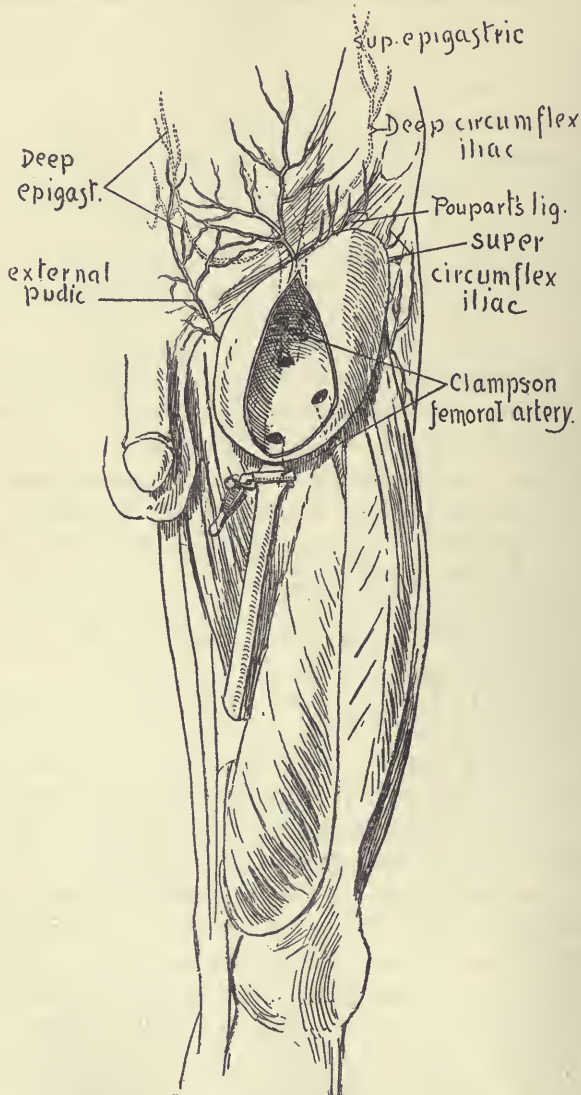
¹ The patient died January, 1907, of pneumonia, at which time it was reported that there was no recurrence.

CASE 2. T. S. (University Hospital No. 1785) *Femoral Aneurysm (Sacciform: two communications with parent artery) Endo-Aneurysmorrhaphy, (obliterative) Gangrene, Amputation, Recovery.*

A colored man, 34 years of age, presented himself for treatment at the University Hospital, October 8th, 1906. He had contracted syphilis eight years ago, he used alcohol very freely and his occupation, as a porter, required him to lift heavy objects. Although by occupation and habit he had paved the way for aneurysmal formation he attributed the lesion to an injury which he had received three months ago. He struck the groin against the corner of a table and two weeks later he noticed in the femoral region a small lump, which increased in size and soon began to pulsate. An examination revealed a powerful subject with numerous cicatrices on the cutaneous surface, the result of old syphilitic lesions. The arteries did not seem to be sclerotic. Extending from Poupart's ligament to the apex of Scarpa's triangle and some 12 cm. in width was the aneurysmal tumor. Pulsation was controlled by pressure upon the femoral artery just below Poupart's ligament. Below the knee the limb was swollen, the patient complained of a sense of numbness about the knee, and of so much pain that for the past two weeks he has been scarcely able to walk. The character of the operation and its risks were clearly explained to the patient.

Operation.—October 10, 1906. Owing to the situation of the aneurysm, close under Poupart's ligament, it was quite evident that it would not be feasible to use a tourniquet. I proceeded accordingly to close temporarily the external iliac artery: this was done through an oblique incision just above and parallel to Poupart's ligament; an arterial clamp was applied and as an additional precaution a heavy silk ligature was thrown around the vessel, but not tied. This accomplished, a vertical incision was made over the site of the tumor, the aneurysm exposed, the artery below the aneurysm isolated and an arterial clamp applied here. Having taken the precaution to close the artery on both the cardiac and distal side of the sac, I hoped to be able to proceed with the operation unembarrassed by hemorrhage. Upon opening the sac, however, a large column of blood spurted out a foot or more above the table. My first thought was that the blood which made its escape represented what was present in

the aneurysm under more or less tension, but it soon became apparent that active bleeding was going on in the aneurysmal sac.



Femoral aneurism:—showing openings in floor of sac.

The bleeding was so profuse as to give cause for alarm. I have never seen so free and apparently uncontrollable hemorrhage.

The cavity was packed firmly with gauze, and an attempt made with firm pressure to control hemorrhage, but this was only partially successful. The pulse soon rose to 160 then to 170; normal saline solution was given by hypodermoclysis and other appropriate remedies. It was quite evident that some more effective means must be adopted to save the patient's life. I proceeded as rapidly as possible to expose little by little the inner wall of the sac and found two openings, one on the floor and one on the lateral aspect of the sac, from both of which the blood was streaming. Direct pressure was made upon the openings with the tips of two fingers, and by this means only was bleeding finally arrested and an opportunity offered to inspect the sac. The latter was found to have three openings, two on the floor and one on the side. These were closed as rapidly as possible with fine catgut sutures. The laminated clot was then peeled off, as in the first case, and the cavity of the sac obliterated by taking up the lateral folds and bringing them together with a continuous mattress suture after the manner prescribed by Matas. Three layers of sac superimposed over the arterial orifices sufficed to obliterate most of the aneurysmal sac; there still remained a small pocket at the upper pole, so far distant from the artery itself, that there seemed to be no objection to leaving it undisturbed. A drainage tube was introduced, the wound closed with interrupted silk worm gut sutures. After the dressing was applied the limb was enveloped in cotton and elevated. The patient's condition when he left the table was better than it was earlier in the operation. On the following day the toes were exposed and found to be warm, but anæsthetic; there was no pulsation in the dorsalis pedis. On the fourth day the patient complained of pain in the calf of the leg, there was marked tenderness when pressure was exerted over the course of the posterior tibial vessels, the limb was evidently swollen, and the foot was cold. It was quite evident that the circulation was seriously impaired and that gangrene would follow. The line of demarcation soon formed and the limb was amputated. A careful dissection of the specimen made for me by Dr. B. A. Thomas revealed the cause of the gangrene in a thrombus which had formed in the popliteal vessel just above its bifurcation, and extending for a short distance into both tibial vessels.

This case has been presented in greater detail than would at first sight seem warranted, because of two more or less distinctive features; the tremendous hemorrhage and the gangrene. Of the 35 or 40 cases that are on record this is the first case in which gangrene followed an uncomplicated endo-aneurysmorrhaphy. This was a very unfortunate occurrence, inasmuch as one of the strongest arguments in favor of the Matas operation is its safety to the patient and to the parts involved, because of the non-interference with the collateral circulation and the avoidance of gangrene. The operation is founded upon such sound principles and the mode of procedure has been so carefully elaborated by Matas that I am quite willing, if not anxious, that in this case some error in technique may be discovered which will account for the thrombus formation and ultimate gangrene. From the subjective and objective symptoms it would seem that the thrombus had obliterated the vessel on the third or fourth day. The process may have originated at the site of the thrombus or it might have been due to the lodgment at that point of an embolus. There was an accidental infection of the wound, but there could be no relation of cause and effect between an infection above the seat of the aneurysm and the thrombus below the aneurysm, a segment of obliterated vessel intervening between the two. It seems much more reasonable to attribute the thrombus formation to an inadequate collateral circulation.

The second rather distinctive feature was the tremendous hemorrhage. One of the conditions which Matas considers essential for the success of the operation is provisional or temporary hemostasis. The aneurysm should be so situated that provisional hemostasis may be obtained by controlling the proximal arterial supply of the tumor on the cardiac side. "When circular constriction (as in my case) is impossible great care must be observed, writes Matas, in securing the distal as well as the cardiac side of the main trunk in order to obtain a comparatively bloodless field." Accordingly I closed temporarily with arterial clamps the vessel on the distal and proximal side with what results has already been told.

While the hemorrhage was most profuse, it was at the same time a most instructive demonstration, for it proved at once how utterly futile in this case it would have been to have practiced one of the older operations, particularly ligation, and illustrated beautifully the point upon which Matas has so frequently laid stress, namely, that the complete obliteration of the sac and the freedom from recurrence depends not only upon closure of the parent artery, but the collateral branches.

Had the reconstructive rather than the obliterative type of operation been carried out gangrene might not have occurred. There were two communications with the parent artery, but there was nothing left by which the course of the parent artery between the two openings could be recognized. It was blended with the aneurysmal sac throughout its circumference. Even had it seemed possible or desirable to reconstruct the artery the operation in this case could not have been carried out in the presence of so much free and uncontrollable bleeding.

Because of the evidence of so free a collateral circulation I was disposed to give a favorable prognosis as to the preservation of vitality and was much surprised when gangrene developed. While there is an erroneous impression that the Matas operation implies the reconstruction of the artery, "for all practical purposes the preservation of the continuity of the artery is not assential to success and is only indicated positively in the sacciform aneurysm with a single opening, when the parent artery already exists as a formed vessel." (Matas.) With this experience, however, I should be disposed in the future particularly in femoral aneurysms and under favorable conditions to attempt to reconstruct the artery, rather than depend entirely upon the collateral blood supply.

V. ENDO-ANEURYSMORRHAPHY (MATAS).

[BY JOHN H. GIBBON, M.D.,
OF PHILADELPHIA.

THE ideal operation for the cure of aneurism is one which arrests completely and permanently the circulation of blood in the sac, without interfering with the blood supply in the parts beyond the aneurism. These two objects have always been in the mind of the surgeon and numerous operations have been devised which have accomplished them in certain situations.

The Matas operation comes nearer the ideal than any other, and is more generally applicable. Certain aneurisms, like those of the thoracic aorta, are probably beyond the field of operative surgery, but in every accessible variety where the circulation can be temporarily controlled, the Matas operation can be employed. Accessibility and temporary control of the circulation are essentially necessary, and where impracticable the operation should not be attempted. These limitations, however, do not prevent endo-aneurismorrhaphy being more universally applicable than any other operation for the cure of aneurism. It is not, however, the general applicability of the operation which has caused it to take first rank as a radical cure, but especially the fact that it interferes less with the blood supply beyond the aneurism than any other.

The experimental work of Carrell, in this country, and of San Martin, Höpfner, Payr, Ullman, Jassinowski, Glück, and others abroad, together with the clinical and experimental work of Abbe, Murphy, Crile, Brewer, Hubbard and Matas, has shown with what readiness the blood vessels lend themselves to plastic operations. Suture, anastomosis, transplantation, substitution of vein for artery, arteriotomy for embolism, all of which have now been shown to be perfectly practicable, give some idea of the possibilities of vascular surgery.

The Matas operation has for its foundation this experi-

mental and clinical work. It having been shown that when intima is approximated to intima union occurs just as when two peritoneal surfaces are placed in contact, Matas conceived the idea of closing the openings of the blood vessels in the aneurismal sac and of obliterating the sac by approximating its walls. He first operated by this method in 1888,¹ and reported a case, but his paper attracted little attention. At the time of publication of his second paper, in 1903,² he had done this operation four times. He suggested two other possibilities; first, the repair of the artery in sacciform aneurism, and second, the reconstruction of the artery in fusiform aneurism when the openings of the vessel were on the same line and not too far apart. To show that these were good suggestions it is only necessary to point to the successful cases since reported.

Bickham,³ in an excellent paper, has shown that the principle of endo-aneurismorrhaphy is equally applicable to all accessible arteriovenous aneurisms, a variety in which ligation is especially dangerous, because of the likelihood of gangrene resulting from obstructed circulation.

Matas' own papers are so complete and comprehensive that it is unnecessary to go minutely into the technique. Briefly, the operation consists in controlling the flow of blood in the diseased vessel by compression; the free incision of the sac from end to end; the evacuation of its contents; the closure by suture of the arterial openings in it; and then the obliteration of the sac by plication and infolding of the skin. In the case of a sacciform aneurism but one opening requires closure, and when this is done the caliber of the vessel is, of course, reestablished. In the fusiform aneurism there are two courses open to the operator—one, of closure of the two openings of the artery into the sac, and of any collaterals which may originate within the sac, and then the entire obliteration of the sac by continuous rows of sutures; or, he may reconstruct the arterial caliber by suture over a catheter which is withdrawn before the last sutures are tied. Although I consider that the operation is no longer on trial, yet it is

important that all cases operated on should be reported in order to compare the results with those of the older operations. In Matas's last paper⁴ he classified 34 operations performed by twenty-one American surgeons, and referred to 6 foreign cases done by three operators, in which there was considerable variation of the technique—so much in fact that he is not inclined to combine them with the American cases. He believes that there has been a great misapprehension regarding the technique on the part of foreign surgeons, many of whom have on this account disapproved of the operation. In this series of 34 cases there have been but two deaths, neither attributable to the operation itself. One patient died fifteen days after operation from associated pyelitis and nephritic coma, the wound having healed completely. The other patient died on the seventeenth day after operation. This patient had an aneurismal diathesis and after operation developed multiple aneurisms. He was first operated on for a ruptured aneurism of the right popliteal, the sac was extirpated; he then developed a left femoral aneurism which was operated on by the Matas method. Twenty days later the vessel above the aneurism dilated and ruptured at a point where a traction loop had been applied for the temporary control of the circulation. Ligation of the femoral high up was then done but suppuration took place and later gangrene of the foot. Six days after this a secondary hemorrhage occurred and the external iliac was ligated, the gangrene extended, and the leg was amputated in the mid thigh. The patient died in about two weeks from exhaustion. It should be noted that in this case neither secondary hæmorrhage nor gangrene took place until the vessel was ligated.

In none of the other cases did either hemorrhage or gangrene occur as a complication.

In considering the question of permanent cure, Matas divides the operations into obliterative, those in which the arterial openings were closed and the sac obliterated; restorative, those in which the aneurisms were sacciform and the arterial opening was closed without interfering with the circulation in the artery; and reconstructive, those in which a new

vessel was constructed from the aneurismal sac. There were 22 of the obliterative cases with no relapses; there were 7 restorative cases with no relapses; there were 5 reconstructive cases with 2 relapses. In one of these an amputation was done at the patient's request. In the other case a second operation was done, the openings in the sac being occluded by suture, and a cure resulted.

I have been able to add to this collection of 34 cases 3 from recent literature, (McCord,⁵ Brown,⁶ and Yocum⁷); a second case of my own, and a second case of Frazier's⁸ making in all 5 additional cases. Two of these were reconstructive operations, both of which were followed by good recoveries without complications; one was a restorative operation with an equally good result; two were obliterative operations, in one gangrene occurring on the fourth or fifth day necessitating amputation, after which the patient recovered; and in the second, my own case, death occurred on the 59th day from uræmia, the patient having been in a bad condition from chronic Bright's disease at the time of operation. The wound in this case was practically healed and the œdema of the limb had disappeared. My first case was operated upon on October 26, 1904.⁹ I examined this man a few days ago and there was no evidence of any return of the aneurism, and after two years and a half it is unlikely that any recurrence will take place.

In this connection it is interesting to refer to a case of popliteal aneurism reported by J. Goyanes,¹⁰ of Madrid, in which he ligated the artery above and below the sac, and then transplanted a section of the popliteal vein to bridge the defect in the artery. The result was successful. This operation was suggested by San Martin in 1902, and this is the first clinical case. The anastomosis was made according to the technique of Carrell. It is impossible to say what the future of this operation will be, but it certainly is of limited applicability and requires the most expert handicraft. It is unlikely that one who has not done considerable experimentation with arterial suture would be justified in attempting it, especially

when the Matas operation is so much simpler and gives such remarkably good results.

In a ruptured aneurism with a large false sac, such as was found in my second case, it is difficult to carry out completely the Matas technique. The lining membrane has not yet taken on the characteristics of the intima of the vessel, nor is it sufficiently organized to stand the necessary traction by the sutures to permit of obliteration. Even in these cases, however, the openings of the vessels in the sac can be closed by suture and the principal benefit of the Matas operation gained, namely, the cure of the aneurism with the least possible interference with the circulation of the part.

The great disadvantage of the older operations is the extent to which they interfere with the circulation of the part beyond the aneurism, and the consequent frequency of gangrene. The ligation operation not only interferes with the circulation in the sac, but also cuts off a certain number of anastomotic branches which originate between the ligatures and the sac. The extirpation operation, although it allows the ligatures to be applied much nearer the sac, also greatly interferes with the establishment of anastomotic circulation by injury of the surrounding tissue, and gangrene frequently follows.

The Antyllian operation, although not cutting off as many anastomotic branches as the ligation or extirpation operations, at the same time does require considerable manipulation beyond the sac in order to apply the ligatures and consequently is objectionable. To my mind, the Matas operation is the simplest yet devised, and the least likely to be followed by gangrene. That it is curative the statistics show conclusively.

The following is an account of my second case :

Dr. F., aged 57 years, was operated upon at the Bryn Mawr Hospital, on November 24, 1906. I first saw the patient on October 30th with Dr. Walter Chrystie. At that time he had a small popliteal aneurism about the size of a hen's egg. He had been having some fever and was generally in very bad con-

dition. His urine contained albumin and casts and the secretion was scanty. His vessels were atheromatous and he had valvular heart disease. At this time he was put on increasing doses of iodide. I next saw him on November 13th with Drs. Earnshaw and Gamble. His general condition had not improved, excepting that the kidney secretion was greater. Two days before operation his pulse was 120 and of very high tension. The leg was very much swollen, which had developed since I first saw him. The pain had been so great since the increase in the size of the aneurism that morphia had to be used pretty continuously. On account of his general condition I was very loathe to operate upon him, but he suffered so much that there seemed to be nothing else to do. He had gotten up to 75 grains of iodide a day. Half an hour before operation he was given 1-6 of a grain of morphine and 1-100 of a grain of scopolamine. A tourniquet was applied until the pulsation ceased, and I then injected the line of incision with Schleich fluid. I made an incision, opened and evacuated the aneurismal sac without causing much pain. The aneurism had ruptured and a false sac had been formed in the surrounding tissues. The removal of the organized portion of the clot caused considerable pain, and as I was unable to detect with my finger the arterial openings in the sac, and if I had found them, would have been unable to suture them because any attempt to put the patient's leg straight gave him a great deal of pain, I was compelled to give him ether. I found both openings in the sac and closed them by suture. The sac was very friable and the sutures cut very easily, so that I had considerable difficulty in closing the openings, especially the proximal one. The sac wall was so friable that I could not reef it over, as is done in the Matas operation, and I therefore simply introduced a gauze pack and a few sutures in the muscular structures. The patient stood the operation, which occupied forty-five minutes, very well.

The next day he was passing a sufficient quantity of urine, his pulse had dropped to 104, and was of much lower tension. The swelling of the leg had greatly decreased, he had practically no pain, and his temperature was normal. The circulation in the foot was good, though no pulsation could be felt in the anterior tibial. This pulse could not be detected before the operation. This improvement in the patient's condition was only

temporary, however, as the kidney and heart lesions steadily progressed until January 22, 1907, when he died of uræmia. At the time of his death there was no œdema or other recurrence of the aneurism. The wound had gradually filled up with granulation, until there was only a superficial area unhealed.

The only advantage of the operation in this case was that the patient was completely relieved of his pain and was able for a while to get out of bed with comparative comfort.

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THE SUTURE OF BLOOD VESSELS. IMPLANTATION AND TRANSPLANTATION OF VESSELS AND ORGANS. AN HISTORICAL AND EXPERIMENTAL STUDY.*

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It is only in comparatively recent years that conservative methods have been employed in dealing with the larger blood vessels in the human body. This advance is in a large measure due to the results obtained by the application of modern surgical technic to animal experimentation.

The ligature, which during the middle ages waged a constant warfare with cauterization, compression and other methods of hæmostasis, was toward the end of the eighteenth century recognized as the best method for controlling hemorrhage from large and small blood vessels. Inasmuch as ligation of the large vessels not infrequently gave rise to gangrene and sometimes caused loss of life, this method was not an ideal one. Some years elapsed, however, before further progress was made; then surgeons began to apply the lateral ligature in partial wounds of veins where the continuity of the vessel was not interrupted. This method was first used successfully about the beginning of the nineteenth century, but, as was the case in other branches of surgery, first came into general use after the introduction of antiseptics. The lateral ligature has the disadvantage that it can be used in only a limited number of cases, for if the wound in the vessel is

* From the Hunterian Laboratory of Experimental Medicine, The Johns Hopkins University. This paper in full, with details of the experiment protocols and an exhaustive list of references to literature, was published in *The Johns Hopkins Hospital Bulletin*, May, 1907.

large the ligature will produce considerable narrowing of its lumen and there is danger of the ligature slipping. To meet these difficulties various clamps were devised for approximating the edges of venous wounds during the process of healing, but the great objection to this method, although it was a step in the right direction, was that it prevented primary healing of the cutaneous wound.

THE LATERAL SUTURE OF VEINS AND ARTERIES.

The problem was solved by the introduction of the venous suture, which was carried out for the first time successfully by Schede in 1882. This method was later employed in numerous cases and has now come into such general use that almost every surgeon of experience has had occasion to use it.

The beginning of a conservative treatment of arterial wounds antedates by more than a century the first experiments with the lateral suture of veins. In 1759 Hallowel, an English surgeon, at the suggestion of Lambert, who had observed the spontaneous healing of vessel wounds after venesection, sutured an artery in man for the first time. A small wound in the brachial artery was closed by placing a pin through the lips of the wound and passing a thread around it. The patient recovered and the radial pulse remained nearly as strong as that in the other arm.

In 1772 the question of arterial suture was tested experimentally by Asman, who closed wounds in the femoral arteries of four dogs by the same method which Hallowell had employed in man. None of these experiments were successful, and Asman therefore declared the method insecure and dangerous. It was not until 1881, after antiseptics had gained a firm foothold, that arterial suture was again tried in animals, but without the desired result. In 19 cases Gluck sutured longitudinal wounds in the common iliac arteries of large dogs and in the aorta of rabbits, but there was always hemorrhage from the stitch holes and in tying the sutures tears were often made in the vessel wall. To overcome these difficulties he later constructed small ivory clamps, with which the wound in

the artery was closed and which were allowed to remain in situ. In this manner he succeeded in closing a partial wound of an artery with preservation of its lumen. Several years later v. Horoch experimented with arterial suture, but, likewise, with little success.

To Jassinowsky, who published the results of his experiments in 1889 in his inaugural dissertation, belongs the credit of having proven conclusively that arterial wounds can be sutured with preservation of the lumen of the vessel. He avoided the femoral artery, which had been used by previous experimenters, and used the carotids of large dogs, horses, and calves, making longitudinal and transverse wounds in the vessels and then suturing them. The longitudinal wounds varied in length from 3 mm. to 2 cm. and the transverse wounds included $\frac{1}{3}$ to $\frac{1}{2}$ of the circumference of the vessel. Of 26 experiments, all were successful except four, and in none of the successful cases was there secondary hemorrhage, thrombosis or aneurysm formation, although some of the specimens were examined as late as a hundred days after the operation.

Jassinowsky attributed his good results to his technic and to the fact that he experimented upon vessels of large caliber. He used fine curved needles and fine silk, the interrupted sutures being placed about 1 mm. apart, including only the media and adventitia and avoiding the intima. As a result of his experiments he reached the following conclusions: (a) The arterial suture heals by first intention; (b) bleeding after operation can be surely and completely avoided; (c) secondary hemorrhage and thrombosis are not to be feared; (d) suture should be done in all recent, clean longitudinal, oblique, and flap wounds of large vessels and in transverse wounds not exceeding one-half the circumference of the vessel; (e) the strictest asepsis is necessary; (f) the suture is easily done.

MURPHY in 1897 published the results of numerous experiments with the partial suture of arteries along with other experiments with the resection of arteries.² He sutured 11 partial wounds in the abdominal aorta,

² Vid. infra.

carotid, femoral and iliac arteries of dogs and two wounds in the carotids of sheep. These were longitudinal and oblique wounds $\frac{1}{4}$ to $\frac{5}{8}$ inch in length and transverse wounds including $\frac{1}{3}$ of the circumference of the vessel. Of the 13 sutures 6 were entirely successful, the lumen of the vessels being preserved. In 10 cases a continuous suture of fine silk, including all the coats of the vessel, was used; in one, interrupted silk sutures were used, and in two, kangaroo tendon was the suture material. As the means of provisional hæmostasis Billroth clamps armed with rubber were usually used, sometimes a heavy silk thread twisted and held with the fingers.

As a result of his own and the experiments of others Murphy came to the following conclusions: (a) Besides the most careful asepsis, a good technic is necessary for the success of vessel suture; (b) the vessel must be exposed very carefully and a good means of provisional hæmostasis applied; (c) the edges of the wounds must be accurately approximated and bleeding completely stopped; (d) as suture material he recommends silk which should include only the outer coats of the vessel; (e) he recommends the suture of the vessel sheaths and surrounding tissues as a support to the vessel suture.

In 1897 and 1898 SILBERBERG experimented with the arterial suture in dogs. He applied 12 longitudinal and 6 transverse sutures, 10 in the femorals, 6 in the common carotids, and 2 in the abdominal aorta. Five of the longitudinal and 3 of the transverse sutures were quite successful. For a successful suture Silberberg emphasized the importance of an absolute asepsis. As suture materials he used the finest Hagedorn intestinal needles and the finest silk. With the exception of three cases in which he used interrupted sutures, he made use of the continuous suture, which can be applied more rapidly. He does not attach much importance to the question as to whether the suture should or should not penetrate the intima, but thinks that sutures exposed in the lumen may contribute to thrombus formation. He thought a method of provisional hæmostasis, which spares the vessel wall as much as possible, was very important and made use of heavy silk threads which were passed around the vessel and, after being twisted, were held thus by means of clamps. The slight bleeding from the stitch holes is easily stopped by a little compression. As an additional support he recommends the suture of the vessel sheath. Concerning the indications for vessel suture this author says: (a) The wound should be clean; (b) only large vessels, such as the aorta, the carotid, subclavian, axillary and femoral vessels, should be sutured; (c) longitudinal oblique, and transverse wounds, which do not exceed one-third of the circumference of the vessel are adapted to suture.

In 1899 DÖRFLER published a very interesting and instructive paper, describing the results of his experiments with the suture of arteries. Altogether there were 20 experiments, 16 being simple sutures of longitudinal, oblique and transverse arterial wounds with 12 successful results and 4 being sutures of completely divided arteries, which will be described later.* As the result of his experiments, Dörfler came to the following

* Vid. infra.

conclusions: (a) Arterial suture is only indicated in clean wounds; (b) for temporary hæmostasis the best means are compression with the fingers, strips of gauze twisted together, or clamps armed with rubber; (c) fine needles and a continuous suture of fine silk including all the coats of the vessel should be used; (d) slight pressure upon the suture for a few minutes after its completion will readily stop bleeding; (e) the vessel sheath should also be sutured.

JAKOBSTHAL, who examined Dörfler's specimens histologically, found that the process of healing of arterial wounds proceeds as follows: The incision becomes filled with blood and fibrin, there being only slight deposits within the lumen about the suture and upon the inner aspect of the vessel wound. These deposits are very early, even in the first few days, covered with endothelium. Soon there is an active formation of new connective tissue and blood vessels in the adventitia and to a lesser extent in the media. These make their way into the clot and in a certain measure organize it, thus forming an end-, mes-, and peri-arteritic growth rich in cells. Then there is a retrogressive process; the cells become fewer and less rich in protoplasm, while a fibrous substance appears between them. This substance in the media and adventitia is chiefly connective tissue with a few elastic elements, while in the intima there is an extraordinarily rich new formation of fine elastic lamellæ and fibers which may lead to the formation of a kind of secondary elastica, at least in the region of the scar.

In 1906 DORRANCE published a method of vessel suture, which he claimed to be original with him, but which is almost identical with that described by Clermont in 1901. Dorrance used a continuous mattress suture of fine Pagenstecher's thread with the dropping-back one-half a suture length every third suture, continuing the same suture as a whip-stitch over the everted edges of the artery after completing the mattress suture. With this method he experimented with the closure of wounds in arteries and the union of completely divided arteries.

There were 14 operations in all, nine on horses and five on dogs, and of the 14 wounds 12 suppurred. There were three complete circular and 11 partial transverse, oblique and longitudinal wounds. Ten of the vessels were examined from 2 to 14 days, and the other four from 21 to 42 days after the operation. In seven no thrombus was visible, in five a small mural thrombus was present and in two complete thrombosis. These are remarkably good results considering the number of suppurations. I am inclined to think that, had the specimens been examined at longer intervals after operation, more complete thromboses would have been present, especially when we consider the number of cases in which mural thrombi occurred.

While animal experimentation has shown conclusively that arterial wounds can be sutured successfully, numerous instances of successful suture of accidental wounds of arteries in man have demonstrated the practical value of this pro-

cedure. Such cases have been reported by Heidenhain, Israel, Ssabanejew, Orlow, Lindner, Garré, Seggel, Veau, Heinlein, Baum, Torrence, and others. Up to July, 1902, Schmitz was able to collect 21 cases of lateral sutures of arteries in man, the axillary artery having been sutured seven times, the femoral five times, the popliteal and brachial each three times, the common iliac, common carotid, and internal carotid each once. In 1903 Höpfner collected 30 such cases.

The results of the foregoing experiments on animals and the clinical experience show that for a successful suture the following things are necessary: (a) A very perfect aseptic technic; (b) clean cut wound edges which can be approximated without too much tension; (c) very careful handling of the vessel without stripping its sheath too much.

While there is considerable difference of opinion as to whether silk or catgut is the best suture material, there is little doubt that the former is preferable. It can be obtained in finer sizes, handled much more easily, and sterilized more surely. The needles should be as fine as possible, but whether straight or curved depends upon the location of the vessel to be sutured.

The question as to whether the interrupted or continuous suture should be used, seems to be settled in favor of the latter, which is simpler and can be applied more rapidly. The question as to whether the suture should penetrate all the coats of the vessel or avoid the intima, seems of more importance. While Jassinowsky and others recommend the avoidance of the intima, v. Horoch, Murphy, Dörfler, Dorrance, and others allow their sutures to penetrate the intima, in fact, in suturing veins it is almost impossible to avoid it. By including all the vessel coats the suture is not only simplified, but made more secure.

Various methods have been used for producing temporary hæmostasis, finger pressure, various clamps, strips of gauze, etc. The main desideratum is to injure the vessel wall as little as possible. The pressure of the fingers is the gentlest method and should be used in man, where possible.

If there is leakage at the site of suture a slight compression will generally cause it to cease in a few minutes.

THE CIRCULAR SUTURE OF ARTERIES AND VEINS.

Inasmuch as the lateral suture was not successful in large transverse wounds of vessels and in cases where the edges of the wound were crushed or otherwise injured, attempts were made in such cases after resection of the vessels, and in complete transverse wounds of vessels, to unite the ends of the vessels, by the simple circular suture, by protheses of various kinds or by invaginating one end into the other.

The circular suture of arteries.—The first experiments of this nature were those of Robert Abbe of New York, who published his results in 1894.

ABBE divided the femoral artery of a dog and united it again by tying the ends together over a small hourglass-shaped tube of thin glass. The immediate result of the operation was very favorable, for the circulation of the leg was re-established as soon as the clamps were removed and the dog recovered promptly. After some time the artery was removed and examined. The tube was found lying free in the lumen of the vessel which had become occluded a short distance below it. Abbe united the divided aorta of a cat in a similar manner and afterwards exhibited the animal, thinking that its survival demonstrated the patency of the aorta. This vessel, however, might have become gradually occluded without inconvenience to the animal.

In 1896 BRIAU and JABOULAY made ten experiments with the circular suture of carotid arteries in dogs, the ends of the vessels being united with U-shaped sutures, which everted the edges and approximated intima to intima. None of the experiments were successful, all of the vessels becoming thrombosed. They later tried the method on a larger vessel, namely the carotid of a donkey, with perfect success. This method was tried in 1900 by Salomoni, who claimed the honor of discovering it.

MURPHY in 1897 published a very interesting and important article in which he detailed his numerous experiments with the suture of arteries and described a new method for the union of completely divided vessels. This method, which is said to give a more solid union than the simple suture, consists in invaginating one end of the vessel a short distance into the other and is done in the following way: After applying Billroth clamps armed with rubber, the artery is divided and the proximal end is invaginated into the distal by means of three or four double-needled silk sutures which include only the adventitia and media of the proximal end, but are passed through the entire thickness of the distal end. When these

sutures are drawn up and tied the ends are easily invaginated and fastened in this position. After the invagination is completed, the free edge of the distal end is sutured to the proximal by several interrupted sutures which include only the adventitia and media of the proximal end, but the entire thickness of the distal. The invagination is sometimes facilitated by splitting the distal stump longitudinally for a short distance.

This method was tried on the carotids of dogs three times, on the carotids of calves four times and on the carotids of sheep four times, once on the femoral artery and abdominal aorta of dogs. Only three of these cases were successful, thrombosis occurring in the others. The unfavorable results were thought to be due in a large measure to the small caliber of the vessels which were used.

Murphy also made a few experiments with the simple suture of arteries, the carotids of sheep being sutured twice, the carotids of dogs and calves once each and the abdominal aorta of a dog once. The continuous suture was used four times and the interrupted suture once. Only one of the five experiments was successful.

The invagination method was tried by DÖRFLER four times, twice in the carotids and twice in the femorals of dogs. In three cases thrombosis occurred; in the other case the lumen was unobstructed when the animal died of a venous hæmorrhage only three days after the operation.

In discussing Murphy's paper at the International Medical Congress in Moscow in 1897 NITZE demonstrated some small ivory prostheses, resembling those later described by Payr. They consist of small ivory cylinders over which the ends of the vessel are slipped in such a way as to approximate intima to intima. A simple ligature holds them in this position.

In 1898 GLUCK, who had done pioneer work with the lateral suture of arteries, described a new method of circular suture. After exposing the artery and applying clamps armed with rubber, a small section of the artery was excised and slipped over one of the ends in the manner of a cuff; the ends of the vessel were sutured together with interrupted sutures which included only the adventitia and media, and then the resected portion was drawn over the line of suture and fastened thus with a few stitches. Instead of using a section of the artery to be sutured, rings of rubber and decalcified bone or a section of vessel from the same or another animal can be used.

PAYR, fearing that a simple circular suture could not withstand the pressure within large arteries devised a method, which he published in 1900, of uniting divided vessels by invaginating the ends over extra-vascular prostheses of magnesium, which is absorbable in the body. If the vessel is an artery, the central end is invaginated into the peripheral, if a vein, the peripheral end is invaginated into the central. The prostheses consist of hollow cylinders of magnesium, which have very thin walls and vary from .3 to 1 cm. in length. On the outer surface of the cylinder, near one end, there is a small groove, one-third to two-thirds of a millimeter deep, in which the ligature is placed. The method, as applied to arteries, is carried out as follows: After provisional closure and division of the artery, the

central end is drawn through the cylinder, which just fits over the vessel, by means of three sutures placed in the end of the vessel, which, after being drawn through the cylinder, is everted over it and fastened thus with a ligature of fine silk. The peripheral end is then drawn over the everted cuff and also fastened with a ligature, broad surfaces of endothelium being thus approximated. Payr thinks the fact that the prosthesis is absorbable is of great importance. This property of the prosthesis is probably of very little importance, for it requires from two to four weeks, or even longer, to be completely absorbed.

Payr, who tried the method on the carotids of dogs and pigs, says it can be done very easily and quickly and claims to have obtained very good results with it; however he does not state how many experiments he has made and makes no reference to any journal of experiments. The article is illustrated with schematic drawings, all of his preparations having been destroyed in a fire.

In an article published in 1904 Payr, on the strength of the experiments of others with it, notably those of Höpfner, champions his method and says the unsuccessful experiments of Salinari and Viridia, Jensen, and Reinsholm were due to the fact that they did not proceed according to his directions.

In 1901 BOUGLÉ performed a few experiments with circular suture of the carotids of dogs. He first used the method of Murphy, invaginating the ends by means of U-shaped sutures. The vessels, however, were so small that obliteration of the lumen always occurred. He then tried a new method, invaginating the ends only a few mm. and fastening them thus by interrupted sutures, which included only the media and adventitia. He mentions one case, in which both carotids were sutured, one by this method, the other by simple end to end union with interrupted sutures which did not include the intima. When examined 15 days after operation both vessels were patent, the intima was smooth and no clots were present.

In 1902 articles upon the circular suture of arteries by Salvia, Salinari and Viridia, Carrel, Thomaselli, and others appeared.

SALVIA made numerous experiments upon the femorals of dogs and the carotids of donkeys and sheep with special reference to the process of healing in wounds of arteries. He employed the end to end suture with fine silk, after resecting considerable lengths of the vessels. In none of the cases did the lumen remain patent. He examined the specimens histologically and found that, with the exception of the elastic fibers, there was a complete restitution of the vessel wall.

The object of the experiments of SALINARI and VIRIDIA was: (a) To test the methods most often tried in animals and man and from the results to determine which offers the best chance of restoring the function of the vessel; (b) to investigate the healing process microscopically and see whether the arterial walls will be sufficiently strong at the sutured point. The experiments, about 30 in number, were done on large dogs, the carotid and femoral arteries being generally used, the abdominal aorta being used twice. With the exception of a few partial transverse and

longitudinal sutures, the sutures were done on completely divided arteries. For provisional hæmostasis various clamps were used, but, finding these unsatisfactory, they constructed a special clamp with parallel blades, regulated by a thumb screw, which proved very satisfactory.

Of 16 sutures done according to Murphy's method, six became infected and the results were negative, six healed with mural or canalized thrombi; in two the lumen remained pervious, though considerably narrowed, and in two others the site of suture presented an almost normal appearance. The protheses of Payr were tried three times, two of the animals died of infection, the other of secondary hæmorrhage.

The authors conclude that suture is preferable to ligation in wounds of large size and that in cases of complete transverse wounds invagination is the best method, although their results would hardly justify these conclusions. In cases of *restitutio ad integrum* the vessel wall is richer in muscle cells and elastic fibers than under normal conditions.

THOMASELLI emphasized the importance of approximating intima to intima. In his experiments, which were done on the abdominal aorta, carotid and femoral arteries of 11 dogs and the femoral artery of one goat, the endothelial surfaces were held approximated by fine clamps, which were removed in turn as the suture proceeded. Interrupted sutures, passing through all the coats of the vessel were used and the suture materials were fine curved needles and silk thread. In seven cases there were positive results with or without narrowing of the lumen, in three the results were negative and in two others it was necessary to ligate on account of sclerosis of the vessel wall.

In an article published a year later Thomaselli says, that the best method of vessel suture is that previously recommended by Salomoni, which consists in approximating intima to intima by means of U-shaped sutures transfixing the entire wall of the vessel. He studied the process of healing in transverse wounds to determine whether there is a real *restitutio ad integrum* as Burci had already observed in the case of longitudinal wounds. Histological examination showed the following: (a) The muscular layer is completely regenerated; (b) the elastic fibers of this layer are regenerated and are more numerous at the edges of the scar and near the lumen where they do not form a real inner elastic membrane, but they replace this membrane and prevent the formation of an aneurysm; (c) neither the inner elastic membrane nor the elastic fibers of the adventitia are reformed, the latter being composed of fibrous connective tissue; (d) close up to the suture one can demonstrate the complete restoration of the three layers with hypertrophy of the muscle cells and elastic fibers.

In 1902 CARREL published a method of circular suture, which, while differing very little from certain methods previously employed, has greatly facilitated such sutures. The ends of the vessel to be sutured are first united by three tension sutures of fine silk, inserted at equidistant points on its circumference. Traction upon these sutures approximates the edges of the vessel and renders the application of a continuous suture comparatively easy. In his original communication Carrel recommended

avoiding the intima, where possible, but in his later experiments the sutures have included the entire thickness of the vessel wall. He has made no systematic study of the circular suture of divided arteries and veins but by applying his method to arterio-venous anastomoses and the transplantation of vessels and organs has obtained brilliant results.*

In 1903 an article by JENSEN on the circular suture of blood vessels, which was awarded a gold medal by the University of Copenhagen, was published. In this very complete and interesting article Jensen describes the various methods for uniting completely divided vessels which had been used up to that time and gives a critical review of the results obtained with them. Jensen's own experiments in which bone protheses, the magnesium protheses of Payr, and the various suture methods were tried on the vessels—mostly the internal jugular veins and carotid arteries—of horses and goats, were undertaken with a view to solving the following questions: (a) Why does thrombosis occur so often? (b) in how far does this or that method offer a better guarantee against thrombus formation.

Of three arteries united by Murphy's method two became completely thrombosed and one remained unobstructed; of three united by invagination over protheses of bone, in two the lumen was much narrowed and in the other almost obliterated; of twelve united by sutures seven were thrombosed, three were more or less constricted, and two were neither thrombosed nor constricted.

Ten veins were united by various protheses; of these eight became completely occluded and two remained patent but partly occluded. Seven veins were united by sutures; of these four were thrombosed, two more or less constricted and one neither thrombosed nor constricted.

From these results which are not very encouraging, Jensen rejects protheses and concludes that the best method of uniting completely divided vessels is to insert two or three simple interrupted or U-shaped sutures and join them by continuous sutures. He prefers silk to catgut and allows the suture to include the entire thickness of the vessel wall. He thinks thrombosis is due chiefly to infection with pathogenic organisms and says, "If we accept infection as the only cause of thrombus formation we have the best explanation of the capriciousness of the results of the experiments. This agrees also with the fact that sutures not involving the intima are more likely to succeed for infection of the lumen is more difficult if the suture does not enter it."

In an extensive article published in 1903 HÖPFNER gives statistics of the results of the ligation of large arteries and veins in man and thus points out the need of a practical method for uniting completely divided vessels. He then gives a history of the lateral and circular suture of vessels in animals and man. He experimented with the circular suture of vessels, vessel implantation and transplantation, and the replantation of amputated extremities, using the magnesium protheses of Payr.

Of six arteries united by this method, two became thrombosed and

*Vid. infra.

four remained unobstructed, three of these being examined eight days after operation and one four weeks after operation. The experiments with transplantation and implantation of vessels and the replantation of amputated extremities will be described later.

In 1903 AMBERG experimented with the circular suture of arteries in horses and large dogs, using the carotids, femorals, and abdominal aorta. After dividing the arteries, the ends were split longitudinally for a distance of 3 to 4 mm. so that the edges could be everted after the manner of flanges which were then sutured together intima to intima. His experiments were not very successful for in only three of the six cases was the lumen entirely preserved. In one there was a mural thrombus and in the remaining two complete thrombosis and secondary hemorrhage occurred.

In 1903 DE GAETANO tried on dogs a new method for the transverse suture of arteries. He placed a small spindle-shaped glass bobbin in the lumen of the vessel and applied the suture over the bobbin which was removed when the suture was nearly completed. This is said to greatly facilitate the suture. I have not been able to consult the original article and therefore cannot give the results of the individual experiments. According to De Gaetano histological examination of the specimens four months after suture showed a complete restitution of all of the elements of the vessel wall, including the elastic fibers.

In an article published in 1903 CHÉRIE-LIGNIÈRE reviews the various methods of arterial suture and concludes that the simple suture is only applicable to longitudinal wounds and not to transverse wounds. He describes the Payr method in detail and reports his own experiments with this method. Of six cases in which the arteries of dogs and donkeys were thus united, in four the results were good, in two there was secondary hemorrhage, once due to necrosis, once to infection. The magnesium cylinders were absorbed in 20 days. Secondary hemorrhage is prevented by strict asepsis and the isolation of only a short stretch of vessel.

In 1906 DORRANCE⁶ reported three cases of complete transverse suture of arteries in animals, in which he used a continuous mattress suture, whipping over the everted edges of the artery after the mattress suture was completed. In two cases the lumen remained unobstructed, in the other complete thrombosis occurred.

The circular suture of veins.—As compared with arteries very few experiments have been made with the circular suture of veins. This is probably due to the fact that the danger of gangrene following the ligation of large veins is, as a rule, less than that following the ligation of the corresponding arteries.

V. HIRSCH⁶ is said to have successfully sutured the completely divided

⁶ Vid. supra.

⁶ Cit. by Clermont.

femoral and jugular veins of dogs in 1881. Murphy in 1897 united the divided jugular vein of a sheep by means of a continuous suture of fine silk, the lumen of the vessel being considerably narrowed by the suture. The vein was examined 28 days later and found to be occluded by adhesion at the line of suture, but no thrombus was present.

In an article published in 1901 CLERMONT gives an historical review of venous suture and reports his experiments with the lateral and circular suture of veins. The latter were limited to two sutures of the divided inferior vena cava: In one case the ends of the vessel were united by a continuous mattress suture of fine silk, which everted the edges of the vessel and approximated intima to intima; the union was completed by suturing the everted edges together with a continuous whip-stitch of the same material. The vessel was examined a month later and its lumen found to be perfectly smooth and unobstructed. In the other case he invaginated the peripheral end a few mm. into the central and fastened them thus with fine silk sutures which were allowed to enter the lumen. When examined a month later the vein was found to be patent, but greatly contracted. From these experiments and those with the lateral suture of veins, Clermont concluded that the first method is the best for suturing veins.

PAYR claims to have obtained excellent results in the union of veins by means of his magnesium protheses, which are applied to veins just as to arteries, except that with veins the peripheral is invaginated into the central end. The method is said to be more easily applied to veins than to arteries, for their walls are thinner and therefore more readily stretched. Here again Payr fails to give the number of his experiments or any exact description thereof.

In 1903 JENSEN made 17 experiments with the union of completely divided veins, using the simple suture in seven cases and protheses of various kinds in ten. Of the seven simple sutures four remained patent; of the ten cases in which protheses were used, eight became completely thrombosed and two remained patent. In six of the sutures the following method was used: After inserting two or three tension sutures, a continuous suture including the entire thickness of the vessel wall was applied. In the other case mattress sutures were used. In only two cases was cat-gut employed and in both thrombosis occurred. Of the ten cases in which protheses were employed, the cylindrical rings recommended by Payr were used in seven, but in only three of these were the rings made of magnesium, the others being made of bone or decalcified bone.

The circular suture of arteries and veins in man.—Cases of suture of completely divided vessels in man have been reported by Murphy, Djemil Pascha, Krause, Kümmell, Payr, Brougham, and probably others.

In 1897 MURPHY reported the following case: On September 19, 1896, a young man received a bullet wound in Scarpa's triangle just below

Poupart's ligament. When he was first seen by Murphy on October 4, there was a marked thrill and loud bruit in this region and the pulsation in the popliteal and dorsalis pedis arteries was scarcely perceptible. At the operation on October 7, a penetrating wound was found in the femoral artery, which was almost divided, and also a small wound in the femoral vein. After closing the wound in the vein the artery was resected and united by the invagination method, the central end being invaginated into the distal for about one-third of an inch. On removing the clamps there was no leakage and pulsation immediately reappeared in the artery below the anastomosis. There was no disturbance of the circulation of the leg and the patient made a good recovery.

At the International Medical Congress in Moscow in 1897 DJEMIL PASCHA reported two cases of injury of the axillary artery treated successfully by Murphy's invagination method.

KRAUSE in 1900 reported this case in which he resected both the femoral artery and vein: In operating upon a woman, 55 years of age, for a carcinoma, the femoral vessels were found to be involved to such an extent that it was necessary to resect a portion of them. With the leg strongly flexed the ends of the vessels were then invaginated and fastened thus with sutures which did not involve the intima. Immediately after the operation pulsation could be felt in the artery distal to the suture; the leg had to be amputated later on account of gangrene.

In 1900 KÜMMELL reported two cases, in one of which he anastomosed the femoral artery, in the other the femoral vein. In removing a carcinoma of the glands of the groin the femoral artery was found to be involved to such an extent that it was necessary to resect 5 cm. of this vessel. This was done in the following manner: After freeing the vessel above and below and applying clamps armed with rubber, the diseased portion was removed and, with the leg flexed at the hip, the central end of the vessel was invaginated $\frac{1}{2}$ cm. into the distal and sutured with fine silk which did not include the intima. This suture was reinforced by a second layer of sutures which included only the adventitia. After a short time distinct pulsation could be felt in the popliteal artery. The carcinoma recurred in a few weeks and death followed in four months; at the autopsy, unfortunately, nothing could be seen of the suture, for the vessel was completely destroyed by the growth.

In the second case it was necessary to resect 2 cm. of the femoral vein, likewise on account of involvement in malignant growth. The ends of the vein were united by means of a continuous suture of fine silk which doubtless penetrated the intima. After removing the clamps the circulation in the leg was re-established, and the patient made a good recovery.

In 1901 PAYR had an opportunity to try his method in man: In extirpating carcinomatous glands of the groin 4.5 cm. of the femoral vein was removed on account of involvement in the growth. The ends of the vessel were united by invagination over a magnesium prosthesis after his method. The patient died three days later of pneumonia and examination showed that the lumen of the vein was fully preserved.

In 1906 BROUGHAM reported the following case: A man, 39 years

of age, received a stab wound which almost completely divided the axillary artery and vein. The vein was ligated, but the division of the artery was completed, and the ends united by invagination after Murphy's method. The patient made an uneventful recovery.

Remarks.—What has been said above, in discussing the lateral suture of vessels, regarding suture materials, the means of provisional hæmostasis, the question as to whether the suture should or should not penetrate the intima, the need of a perfect aseptic technic, etc., applies equally well to the circular suture.

The methods recommended for uniting completely severed vessels may in general be divided in two classes: (a) Those in which the simple suture is used; (b) those in which mechanical aids are employed.

The suture has been applied in various forms; some have used simple interrupted sutures and mattress sutures, others the continuous suture; some include all the coats of the vessel in the suture, others try to avoid the intima, which in veins is almost an impossibility. Murphy recommends uniting completely divided vessels by invaginating one end a short distance into the other and fixing them thus with sutures.

The mechanical aids may be divided into the extra-vasal and endo-vasal. Among the former may be mentioned various clamps, decalcified bone and ivory rings, sheaths made of sections of other arteries or veins, aluminum rings, magnesium rings, etc. The most important of these are the magnesium rings or protheses of Payr, by means of which the ends of the vessel are so invaginated that intima is approximated to intima. Among the endo-vasal aids we may mention the glass cylinders of Abbe and Gluck, the caramel cylinders of Carrel and the glass bobbins of De Gaetano. These are of no importance clinically, but are of historical interest.

Although the results of the application of the invagination methods of Murphy and Payr to vessels in man have proven very gratifying, I cannot but feel in the light of the animal experiments of Carrel, Jensen, myself, and others, that the simple suture is preferable to these more complicated pro-

cedures. The results obtained in animals by Carrel and myself have been, barring the cases in which infection occurred, almost ideal and seem to demonstrate conclusively that the sutures can penetrate the intima with impunity. The method is simple, easy, and requires no mechanical aid. It seems to me that, just as in intestinal suture we approximate endothelium to endothelium, so in blood vessel suture it is advisable to approximate intima to intima. With Carrel's method traction upon the three primary sutures, during the application of the continuous suture, approximates intima to intima more or less accurately, but the apposition might be improved by substituting U-shaped sutures for the single traction sutures and then applying the continuous suture to the everted edges, as has been suggested by Jensen. The advantages obtained by this method might, however, except with large vessels, be counterbalanced by the constriction produced.

ARTERIO-VENOUS ANASTOMOSES.

Circular or end-to-end arterio-venous anastomosis.—The first successful arterio-venous anastomosis was performed by GLUCK who united the carotid artery of a dog to the jugular vein by circular suture without thrombus formation. In 1902 BERARD and CARREL divided the femoral artery in Scarpa's triangle and sutured the central end of the artery to the peripheral end of the saphenous vein. The anastomosis withstood the arterial pressure and the vein became distended and pulsated actively, but no physiological results were observed, as the animal died of infection two days after the operation. In the same year these experiments were continued by CARREL and MOREL, who succeeded in anastomosing the central end of the carotid artery into the peripheral end of the external jugular vein without subsequent thrombus formation. Several weeks after the operation, when the animal was presented before the "Société nationale de médecine," the external jugular vein pulsated actively and a loud systolic murmur could be heard at the point of anastomosis. During the several months the animal was under observation the results remained satisfactory.

In 1902 SAN MARTIN Y SATRUSTEGUI also experimented with the circular arterio-venous anastomosis. He made a series of experiments on dogs, operating by preference in the groin, but also in the neck and other regions traversed by large blood-vessels. The femoral vessels were separated and the central portion of the femoral vein ligated. Forceps were then applied to the central portion of the artery and the distal portion of the vein and the vessels divided; there was no bleeding from the distal end of the artery, although it was not clamped or otherwise occluded. The central end of the artery was then united to the distal end of the

vein by invaginating the artery into the vein and suturing them with catgut. On removing the clamps the arterial blood flowed into the vein and the distal portion of the artery, which had remained bloodless during the operation, in 30 to 60 seconds after the current was turned on, began to carry fluid which looked like a mixture of arterial and venous blood as though the current had been reversed. This end of the artery was then ligated, the wound closed, and the animal allowed to live. In later cases St. Martin saw the saphenous vein fill and change color as soon as the arterial blood was turned into the femoral vein.

All of the animals stood the operation well, except those whose peritoneum was invaded. One of the more vigorous dogs lived eight days with anastomosis of the carotid artery and jugular vein on both sides, death being due to hemorrhage, or asphyxiation from enormous œdema of the neck. Few of the dogs had œdema, but in many there was a hemorrhage on the eighth day, which was often fatal. As to the cutaneous wound, it healed usually by first intention, sometimes there was a little suppuration, and in two or three cases a real phlegmon. The specimens were examined at periods varying from 48 hours to 20 days after the operation. The vessels were found completely obliterated by extensive thrombi, which, in the late examinations, were already organized. In one case the vessel remained pervious for two days, but in some instances coagulation took place even before the current was turned on.

In 1903 EXNER undertook certain experiments with the intention of studying the changes which veins undergo, under arterial blood pressure. In four dogs he united the central end of the carotid artery to the peripheral end of the external jugular vein by means of the magnesium protheses of Payr. The wounds healed without reaction, but when examined two to six weeks after the operation, the vessels were found to be completely thrombosed. HÖPFNER in 1903 also experimented with arterio-venous anastomoses, using the protheses of Payr. In all of his cases there was thrombus formation which he attributed to degeneration of the thin vein wall, produced by the high arterial tension.

In 1905 the experiments begun in France by Carrel and Morel were continued in this country by CARREL and GUTHRIE, and, with improved technic, various arterio-venous anastomoses were done with very successful and interesting results. The technic is thus described by Carrel: "The threads and needles were the finest and strongest obtainable. The threads were sterilized in vaseline and applied when heavily coated with the same. The vessels were handled very gently and the endothelium was protected from drying by isotonic sodium chloride solution or by sterilized vaseline. No dangerous metallic forceps were used. The greatest care was exercised to obtain accurate and smooth approximation of the endothelium of the vessels. Finally, we developed a technic which is equally well adapted for arterio-arterial, veno-venous or arterio-venous anastomoses, and which yields uniformly successful results."

Circular or end-to-end arterio-venous anastomoses may be divided in two classes; viz., (a) uniterminal, and (b) biter-

minal arterio-venous anastomoses. The former will be discussed now, but the latter will be considered when we describe the implantation and transplantation of arteries and veins.

Concerning uniterminal anastomoses Carrel and Guthrie write as follows: "The termino-terminal anastomosis may be performed in nearly all cases even when the size of the vessels differs greatly. An artery may be easily united to a vein of twice its caliber. On the contrary, it is more difficult to unite a small vein to a large artery, for the venous wall is easily folded, while the artery on account of its thick walls is not. The more nearly similar the diameter of the vessels, the more easily successful anastomosis may be performed. When the vein is much larger than the artery and the consequent foldings of the vein in making the anastomosis are irregular, as may happen if the operation is performed without sufficient care, hæmorrhage occurs at the line of union. Fibrin may be deposited in the bottom of the foldings and in the miniature gaps occurring between the endothelial coats of the artery and vein. Therefore, when the difference in size of the artery and vein is too great, instead of end-to-end anastomosis, it is better to perform lateral implantation of the end of the vein into the wall of the artery.

"This termino-lateral arterio-venous anastomosis is more difficult than the former. It should be used only when the end-to-end anastomosis seems inadvisable, owing to the difference in size of the vessels or when the experimental result sought for indicates it. For instance, when a segment of intestine is transplanted into the neck for the purpose of establishing communication between the cut ends of the œsophagus, the end-to-end anastomosis of the intestinal vein to the jugular vein is impracticable, owing to the enormous difference in the size of the vessels. It then becomes necessary to make a lateral implantation of the end of the small vessel on the wall of the jugular vein. Or this lateral implantation is performed in order to obtain certain modifications of circulation, as, for example, lateral implantation of the central end of the external jugular vein on the common carotid artery, in order to diminish the amount of blood in the peripheral portion of the artery.

"Although the termino-lateral anastomosis is somewhat more difficult than the end-to-end anastomosis, it is by no means impracticable on this account. By making a triangular opening larger than the lumen of the vein, through the wall of the artery, and taking care to have an accurate approximation of the endothelial surfaces of the vessels, the anastomosis is very satisfactory, as absolutely no blood escapes and no stenosis of the vein is produced.

"A third kind of anastomosis, more rarely used than the kinds above described, may also be mentioned. When the vein is exceedingly small, so small that a direct anastomosis is impossible, it is dissected a far as its junction with a larger vein. The wall of this vein around the mouth of the small vessel is then resected and grafted onto the wall of the artery.

"As previously stated this paper will deal mainly with the transplantation of veins onto arteries.

“There are six possible varieties of this operation, as the central end or the peripheral end of the vein may be united to the central end, the peripheral end or the wall of the artery. But as the anastomosis of the central end of the artery to the central end of the vein is practically the same in result as lateral implantation of the artery onto a vein, and as anastomosis of the peripheral end of the vein to the wall of the artery produces practically the same results as the anastomosis of the peripheral end of the vein to the central end of the artery, they do not deserve special mention. Four varieties only will therefore be described.

“1. *Union of the central end of the vein to the peripheral end of the artery.*—Anastomosis of the central end of the external jugular vein to the peripheral end of the common carotid artery is an example of this kind of operation. It produces a vessel composed in its upper portion of the carotid artery and in its lower portion of the external jugular vein. The pressure in this portion of the artery becomes lower than the normal blood pressure and the direction of the blood stream is reversed. The jugular carries toward the heart red, instead of dark blood. As a result, functionally, the carotid artery becomes a vein filled with red blood, being comparable in this respect to the pulmonary vein. It is probable that the wall of the artery undergoes marked anatomical changes. Owing to the lowering of the blood pressure, its wall may become thinner and the elastic and muscular layers modified, but at the present time we cannot go further into the point. But, as we have a dog in good health upon which this operation was performed nearly seven months ago, we shall subsequently be enabled to discuss it further.

“2. *Union of the central end of the vein to the wall of the artery.*—It is evident that after this operation a large part of the red blood of the artery returns toward the heart through the veins. In several cases the central end of the external jugular vein was united to the wall of the carotid artery. An abundant portion of the red blood flowed into the vein through the anastomosis with a strong thrill. The vein retained its venous functions, *i.e.*, it conveyed blood toward the heart, but was filled with arterial blood. The artery also retained its normal functions, but its blood pressure was lowered. Tracings were taken, and they showed that after the establishment of the circulation through the anastomosis, the blood pressure in the artery is markedly diminished. This result is quite natural, for the lateral implantation of the central end of the jugular onto the wall of the carotid artery permits of a kind of continuous hemorrhage from the carotid into the vein. When this operation is made on the jugular and the carotid it does not apparently alter the character of the circulation in general.

“3. *Union of the peripheral end of the vein to the peripheral end of the artery.*—This operation was performed on arteries having no, or very small collaterals. The result was the reversal of the circulation through the vein. The artery becomes filled with dark blood, venous in character. If, for instance, the peripheral end of the right renal vein be united to the peripheral end of the left renal artery, the dark blood from the right renal vein would flow through the left renal artery, the left kidney, the left renal vein and thus into the vena cava.

"4. *Union of the peripheral end of a vein to the central end of an artery.*—It is evident that, from a functional point of view, the operation transforms the vein into an artery. Several series of experiments were performed. The external or internal jugular or the thyroid veins were united to the carotid artery; the femoral or long saphenous veins to the femoral artery; and the inferior vena cava to the aorta.

"*The transplantation of the peripheral end of the external jugular vein onto the central end of the common carotid artery.*—The right external jugular vein was exposed, thoroughly dissected and cut near the root of the neck. Its peripheral end was inserted between the sterno mastoideus and the sterno hyoideus muscles and united behind the trachea to the central end of the left carotid artery. On release of the hæmostatic clamps, the vein became filled with red blood and pulsated like an artery, it being transformed from a functional standpoint into an external carotid artery. The vein is able immediately to perform the more important arterial functions. Its wall adequately supports the increased blood pressure. Even when the carotid artery is anastomosed to a more delicate vein, such as the internal jugular or thyroid, the sudden increasing of the pressure apparently does not injure the wall. In size the vein always appears to be very much enlarged. Clinically, this operation does not produce general or local symptoms if it deals only with vessels like the carotid and the external jugular vein. Even when the central end of the carotid is anastomosed to the peripheral end of the internal jugular vein the dog manifests no abnormal symptoms. A dog on which the operation was performed three months ago is now living and appears absolutely normal in all respects."

CARREL and GUTHRIE claim to have produced an actual arteriosclerosis of an artery by suturing it into a relatively small vein. The macroscopic modifications of the artery are characterized by a slight retraction of its lumen and by a marked increase in the thickness and rigidity of its walls. The histological changes consist of an hypertrophy of the middle coat, which is due to an increase in the number and size of the muscle and elastic fibers and an hyperplasia of the interstitial connective tissue. The sclerosis of the adventitia may be regular or irregular. The same is true of the intimal sclerosis, which may present itself in the form of a regular thickening of the intima or may be much more marked in certain places than in others. The regions of greatest thickening of the intima and adventitia correspond to the places where the media is thinner. It seems that the arterial wall reacts first by an hypertrophy of the muscle layer and that the sclerosis of the intima and adventitia comes later. In a case observed three months and ten days after the operation the hypertrophy of the muscle was strongly marked, whereas, the intimal sclerosis was slight. In another case observed six months after operation the muscular hypertrophy was somewhat greater than in the preceding case, while the intimal sclerosis was much greater. No atheromatous lesions were observed.

When arterial tension is lowered by anastomosing an artery into a large vein the wall of the artery becomes thinner and its lumen larger. The muscular and elastic constituents of the medial coat diminish in number and volume.

Lateral arterio-venous anastomosis.—After his experiments with end-to-end arterio-venous anastomoses had failed, and arguing that arterio-venous aneurysms are well borne in man, San Martin y. Satrustegui in 1902 began to experiment with the lateral anastomosis of arteries and veins in goats. After opening the carotid artery and internal jugular vein in the neck, temporary hæmostasis was produced by small rubber tubing placed about the vessels at either end of the wound and openings 1 cm. long made in the vessels. The edges of the openings were then united by means of continuous sutures of fine silk, the posterior row of sutures apparently being placed from within the lumen. Two animals were thus operated upon and the result was said to be the same in both cases, though only one section was described. In this case which was examined three months after the operation, the carotid pulsated strongly and retained its original dimensions; the vein, however, was atrophied and almost empty of blood proximal to the anastomosis, but peripheral to the anastomosis was distended with dark blood and did not pulsate. The site of the anastomosis could hardly be determined by simple inspection, but seemed to correspond to the point where the vein suddenly became contracted. No opening could be demonstrated by injecting water into the vessels. Microscopic examination showed that a small opening persisted.

Arterio-venous anastomoses in man.—From these experiments, although they could scarcely be called successful, St. MARTIN concluded that such an operation might be of value in treating gangrene due to arterial sclerosis. He tried it clinically in two cases. The first case was a man, 52 years of age, with gangrene of the toes extending onto the metatarsus. No pulsation could be felt in the dorsalis pedis, posterior tibial or even in the popliteal artery. The femoral pulsated strongly in Scarpa's triangle. An incision was made in Scarpa's triangle and the artery easily isolated, but the vein was freed with difficulty, being rather adherent. Temporary hæmostasis was produced by rubber tubes held with clamps. Openings 8 mm. long were then made in the vessels and a fairly satisfactory anastomosis obtained. After removing the ligatures the arterial blood passed through the artery to the limb, but the vein did not change color, either because the anastomotic opening was too small or because the walls of the vein had lost the little elasticity which they normally possess. The wound was closed and the gangrenous portion of the foot removed. The immediate result of the operation was fairly satisfactory; the pains became less, either because the gangrenous portion was removed, because the nerves had been separated from the vessel sheath to which they were quite adherent, or because, thanks to the anastomosis, the leg was better nourished. Unfortunately, this condition did not continue long and symptoms appeared which required amputation of the leg through the calf. The arteries were greatly sclerosed; the vein, however, appeared normal with the exception of some atrophy, probably from disuse. St. Martin thought the veins might have assumed the function of arteries if the operation had been done earlier and been more successful. Sometime later amputation through the middle of the thigh resulted in death. The specimen showing the anastomosis was not examined, at least it is not described.

The other case was a man, 66 years old, who had gangrene of the toes. The same procedure was adopted as in the foregoing case. The artery and vein were so adherent to each other that, for hæmostasis, it was necessary to place the rubber bands about the two together. The nerve, however, was carefully separated. Very small openings were made in the artery and vein, which were united by continuous sutures. After removing the ligatures the vessels filled out, but the walls of the vein were so thick that one could not see whether arterial blood passed into the vein through the small wound. The wound in the groin was closed and the foot amputated. The patient made an uneventful recovery, but nothing is said of the subsequent behavior of the vessels.

In 1902 JABOULAY reported the following case: A man, aged 47, had senile gangrene of the right foot which required amputation, first of the foot and then of the thigh. Sometime later gangrene began in his left foot and Jaboulay performed a lateral anastomosis of the femoral vessels in Scarpa's triangle. Thrombosis, which was attributed to the presence of an arterio-sclerotic plaque, occurred at the site of suture, and it became necessary to amputate through the thigh.

In 1903 GALLOIS and PINATELLE, assistants of Jaboulay, reported this case and published the results of certain experiments, which they had made, to investigate the possibility of a reversal of the circulation in the head, arms, and legs. In order that such a reversal of circulation may take place they pointed out that the following obstacles must be overcome: (a) The valves; (b) the numerous venous anastomoses, which create short circuits and lower the blood pressure; (c) the resistance of the capillaries. Their experiments were done on the cadaver. A colored fluid was injected under pressure into the main vein of the member, but immediately returned by the other veins. After these were occluded it was impossible to force the fluid into the main vein, although considerable pressure was used. They concluded that, experimentally the circulation through the main vein of a limb, in a direction opposite to that of the normal current is prevented by the valves. They realized the fact, however, that, clinically, the valves can be forced and the current reversed in the veins, for they had observed cases of arterio-venous aneurysm, in which the veins of the limb, even at considerable distances from the aneurysm, were markedly dilated and pulsated actively.

Carrel and Guthrie, who attribute the failure of the experiments of Gallois and Pinatelle to the fact that they operated upon the cadaver and not upon living tissues, which have a great adaptive power, seem to have proven that a reversal of the circulation in a limb of a dog is possible by establishing an end-to-end arterio-venous anastomosis. An experiment on a dog showed that three hours after a *termino-terminal* anastomosis of the central end of the femoral artery to the peripheral end of the femoral vein, the veins of the thigh, the leg, and the foot were filled with red blood, and that the dark blood returned to the heart through the arteries. They found that: (a) The valves prevent, at first, the reversal of the circulation in the veins; (b) after a short time the valves gradually give way and the red blood flows through the veins as far as the capillaries; (c)

finally, it passes through the capillaries and the arteries are filled with dark blood. Probably the dark blood also returns from the capillaries toward the heart through some of the veins; (d) practically complete reversal of the circulation is established about three hours after the operation. However, when a *lateral* arterio-venous anastomosis has been done, the larger part of the arterial blood, instead of going toward the capillaries, returns to the heart through the central end of the vein and at the same time the arterial blood pressure is lowered. Experiments have shown that: (a) After a lateral arterio-venous anastomosis a very large portion of the red blood returns immediately toward the heart through the central end of the vein; (b) the peripheral portion of the vein and its branches are distended and pulsate, but the valves are not forced and the red blood does not circulate through them; (c) three hours after the operation all the valves are yet competent and no beginning of a reversal of the circulation can be detected.

If this be true very little can be expected from the treatment of senile gangrene by lateral arterio-venous anastomosis.

In 1906 HUBBARD reported the following case, in which he performed a crossed arterio-venous anastomosis of the femoral vessels for senile gangrene of the toes. The patient, a man 80 years old, was admitted to the hospital with dry gangrene of the middle toe of the right foot. There was a general arteriosclerosis and no pulsation could be felt in the *dorsalis pedis* of this foot. In spite of appropriate treatment the gangrene extended and involved the neighboring toes. Operation: The femoral vessels were exposed at the apex of Scarpa's triangle and a crossed arterio-venous anastomosis performed by invaginating the central end of the artery into the peripheral end of the vein and the peripheral end of the artery into the central end of the vein, and suturing them thus with fine Pagenstecher's thread. After the first anastomosis had been completed, and the means of provisional hæmostasis removed, the vein partially filled and pulsated slightly. During the manipulations the controlling tourniquet was pulled off the peripheral end of the artery and a considerable amount of dark, venous-looking blood escaped. It is hardly possible, however, that the circulation could have been reversed in such a short time. The cutaneous wound was closed with silk-worm gut and a plaster cast applied with the thigh flexed on the body to relieve tension on the vessels.

The patient made a good recovery, but the gangrene subsequently extended to the tarso-metatarsal joint, where a line of demarcation formed. At this time the author thought he was justified in making the following deductions: "Inasmuch as the circulation in the leg before operation was sufficiently poor to permit gangrene of the toes, and inasmuch as the femoral artery had been divided in Scarpa's triangle thus permitting collateral circulation only through the profunda, it was fair to suppose that very little blood would have reached the lower leg through the collateral circulation, and that the gangrene would have rapidly involved the leg unless as a result of the operation the veins were carrying arterial blood." The lower portion of the leg and foot were amputated some

time later. At this operation, which was performed without a tourniquet, the anterior and posterior tibial arteries were found to contain arterial blood, which spurted from the cut ends with fairly good force, and the veins did not appear to contain any arterial blood. These findings probably vitiate the previous deductions.

IMPLANTATION AND TRANSPLANTATION OF ARTERIES AND VEINS.

In 1896 BRIAU and JABOULAY experimenting upon animals, after having removed small sections of arteries reimplanted them by circular sutures. The vessels were examined three or four days after the operation, and in all the cases occluding thrombi were present. In an article published in 1898 GLUCK mentions having transplanted a portion of the jugular vein into the carotid artery of a dog. The section of vein healed in and there was no secondary hemorrhage, but thrombosis occurred.

In 1903 EXNER experimented with the transplantation of blood vessels using the magnesium prostheses of Payr. In six animals he transplanted portions of the external jugular vein into the carotid artery, but in all the cases thrombosis took place. In two dogs pieces of jugular vein, 4 cm. long, were transplanted into the opposite jugular vein, and in two other animals the same was done with the carotid arteries. In these cases also thrombosis was always present when the specimens were examined. Exner thought the failure of the latter experiments was due to the poor nourishment of the transplanted vessel, resulting from disturbance of the *vasa vasorum*.

In the same year HÖPFNER performed some experiments with the implantation and transplantation of vessels, and obtained more or less successful results. He likewise employed the magnesium prostheses of Payr. Of two cases, in which sections of the carotid were removed and reimplanted, one was successful when examined four weeks after the operation. In one dog a section of the carotid 3 cm. long was transplanted into the femoral artery and a section of the femoral of the same length into the carotid; when examined eight weeks later there was no thrombosis, almost no constriction of the vessels, and their intima was smooth. In another experiment a portion of the carotid of one animal was transplanted into the femoral of another animal, and a portion of the femoral of the latter into the carotid of the former. The second experiment was successful, and the first was not, probably due to the fact that the wound in the neck healed *per primam*, whereas the wound in the groin healed by granulation. In 10 experiments, in which sections of veins were transplanted into arteries, although the technic was the same as in the other experiments and care was taken to have the valves of the veins point in the right direction, thrombosis always occurred. Höpfner concluded that such transplantations offer little prospect of being successful, for, when the current is turned on, there is a marked dilatation of the vein, and more or less stagnation of the blood, which leads to thrombus formation. In three experiments sections of vessels were transplanted from one animal species to another, but the result in all cases was negative.

Carrel and Guthrie, who, in this branch of vascular surgery also, have obtained the most remarkable results, speak of an autoplasmic transplantation, when the section of vessel is taken from one vessel and transplanted into another vessel of the same animal, a homoplasmic transplantation, when the section of vessel is taken from another animal of the same species, and a heteroplasmic transplantation when it is taken from an animal of a different species. As a matter of fact, clinically it would be unnecessary to perform any but an autoplasmic transplantation, for we can easily extirpate a short section of vein without interfering with the general circulation.

Transplantations may be (a) complete or (b) incomplete. In complete transplantations the segment of vessel is completely excised and then sutured between the cut ends of the other vessel. In incomplete transplantations the middle portion of the segment of vessel is allowed to remain attached to the surrounding tissues and to its branches; for example, a section of femoral vein can easily be isolated without disturbing its connection with the surrounding tissues and sutured between the cut ends of the accompanying femoral artery.

On removing the hæmostatic clamps, after transplanting a segment of vein into an artery, the segment of vein becomes distended with red blood until it is usually considerably larger than the artery, but, although they may be quite thin, its walls adequately support the arterial blood pressure. The pulsation in the vein is less marked than in the artery, for the vein is usually so distended that there is little excursion of the pulse wave. When the transplantation is incomplete and the segment of vein has branches, these branches do not immediately transmit arterial blood. At first they are filled with venous blood, which becomes displaced by the arterial blood as the valves are gradually forced. The branches then virtually become arteries.

REPLANTATION AND TRANSPLANTATION OF ORGANS AND LIMBS.

The replantation of an organ or limb consists in removing it, replacing it, and re-establishing its circulation by vascular anastomoses. The transplantation of an organ or limb consists in its removal and transplantation into another animal

or a different portion of the same animal, its circulation being re-established by vascular anastomoses.

In 1902 ULLMANN removed a dog's kidney and transplanted it into his neck, the renal artery being united to the carotid artery and the renal vein to the external jugular vein by means of Payr's protheses. The experiment was said to be successful, the kidney secreting normally after the operation. He does not state, however, how long this condition continued. Three months after this report, Ullmann reported having transplanted the kidney of one dog into another and the kidney of a dog into a goat. He exhibited the latter animal, and demonstrated the functioning kidney. When asked concerning the fate of the dog into whose neck the kidney had been transplanted, he did not say how long the animal had lived or how long the kidney had functioned. He said, however, that the kidney had been removed and on macroscopic examination several necrotic areas were seen; otherwise the kidney seemed normally nourished and had grown to the surrounding tissues.

In 1902 DECASTELLO also reported experiments with the transplantation of kidneys. He extirpated the kidney of a large dog and transplanted a kidney from another dog into its place uniting the vessels by means of protheses. The animal lived 40 hours during which time 1200 cc. of urine was secreted. Death was due to hæmorrhage resulting from separation of the venous anastomosis.

In 1905 FLORESCO reported certain experiments with the transplantation of kidneys. After several unsuccessful attempts he succeeded in extirpating the kidney of one dog and transplanting the kidney of another dog into its place the vessels being united by sutures. The end of the ureter was sutured into the skin incision. He does not give the ultimate results of the operation.

Since 1905 Carrel and Guthrie have made numerous experiments with the replantation and transplantation of organs and have obtained some very interesting results. One of their first experiments along these lines was the extirpation and replantation of the thyroid gland with reversal of its circulation. The right thyroid gland of a dog was dissected out and all its vessels ligated except the superior thyroid artery and vein. These vessels were divided, the gland removed and then replaced, the circulation being reversed by suturing the artery to vein and vein to artery. Eleven days after the operation the wound was opened and the gland found to be somewhat enlarged, but its hue and consistency were normal. Twenty-five days after operation the condition seemed practically the same. No histological examination was made, however. By reversing the circulation of goitres in dogs they claim to have produced a diminution in the size of the lobe operated upon and in one dog the goitre not only became smaller, but the general symptoms, referable to a hypothyroidism, largely disappeared. They think these phenomena were due to an augmentation of the circulation resulting from the reversal.

CARREL and GUTHRIE have used two methods of transplanting organs, *transplantation simple* and *transplantation en masse*.

The *transplantation simple* is the method which has been generally employed, but the objections to this method are that the nerves and their sympathetic ganglia are cut off from the organ and the veins are unduly exposed to injury, so that it is impossible to transplant such organs as the testicle and ovary by this method. To obviate these difficulties they developed the technic of *transplantation en masse*, which consists in extirpating the organ together with its surrounding connective tissues, its nerves and ganglia and its vessels with the corresponding segments of the large vessels from which they originate.

Making use of the simple method of transplantation Carrel and Guthrie have transplanted a heart, a loop of intestine, a kidney, and other organs into the neck. While the immediate result was, in most cases, satisfactory the ultimate result was usually disappointing. A kidney which was thus transplanted continued to function for some days.

The *transplantation en masse* has been used by Carrel and Guthrie in the transplantation of kidneys and ovaries. The technic of these operations is thus described by them.

Both kidneys and the upper portion of the ureters were removed from a small dog, along with their vessels, nerves, nervous ganglia, the surrounding connective tissue, the supra-renal glands the peritoneum, and the corresponding segments of the aorta and vena cava. The mass was placed in isotonic sodium chloride solution and later transplanted between the cut ends of the abdominal aorta and the inferior vena cava of a bitch. The circulation was re-established after having been interrupted one hour and a half. Clear urine flowed abundantly from the transplanted ureters which were anastomosed to the normal ones. Both normal kidneys were then removed. The dog recovered rapidly from the operation and remained in good health for eight days, during which time she secreted large quantities of clear urine, which contained no blood and was about normal in composition, the only abnormal constituent being a small amount of coagulable proteid. The dog died on the tenth day as a result of intestinal obstruction, due to a localized peritonitis on the right side of the abdomen. The circulation of both kidneys was perfect, but there was an enormous hydronephrosis on one side.

Ovaries were transplanted as follows: The specimen, consisting of ovary and a part of the Fallopian tube, united to the segments of the aorta and vena cava by a cellulose-peritoneal ribbon and the ovarian vessels, was taken from one cat and transplanted into another cat from which the corresponding tissues had been removed. The operation is said to have been successful.

Their experiments with *heteroplastic transplantations of organs* were unsuccessful, and they think that, on account of cytolysis, such transplantations are not likely to be successful.

The replantation of amputated limbs.—In 1903 HÖPFNER experimented with the amputation and replantation of the legs of dogs, uniting the femoral vessels in Scarpa's triangle by means of Payr's protheses. This was done in three animals. In the first case thrombosis occurred on the first day and gangrene followed; in the second case the circulation re-

mained intact 11 days, when death occurred under chloroform, while the dressings were being changed; in the third case thrombosis occurred on the sixth day and gangrene resulted.

CARREL and GUTHRIE have also made several experiments with the replantation of amputated legs of dogs, but none of these can be said to have been absolutely successful, for, although the circulation remained good for some days, obliteration of the vessels ultimately occurred.

AUTHOR'S EXPERIMENTS.

These experiments were begun with attempts to transplant the thyroid gland, making use of vascular anastomoses by Carrel's method. The attempts proved unsuccessful, so it was decided to apply this method to a series of arterial, venous, and arterio-venous sutures, with a view to determining in what percentage of cases we may expect a successful result.

The experiments were done on dogs of various sizes. When they could be obtained, large animals were used, but often it was necessary to make use of very small ones. The anæsthetic was ether, usually administered after a previous injection of one grain of morphine. The following technic was employed. After shaving a large area, the skin was cleaned with soap and water, permanganate of potash, oxalic acid and bichloride of mercury. The field of operation was then isolated with sterile towels and, after making the skin incision, sterile towels were clamped to the edges of the incision. The vessels were exposed, well freed and provisional hæmostasis produced by small spring clamps whose blades were armed with rubber. The vessels were then divided and prepared for suture by carefully removing the loose connective-tissue sheath about the ends of the vessel. This can be done very nicely by grasping the sheath with forceps, drawing it over the end of the vessel and clipping it off with scissors. The greatest care was exercised in handling the vessels, in order that they be injured as little as possible, and especial care was taken not to apply metallic forceps to the intima. Very fine (No. 16) straight needles and fine China bead silk were the suture materials employed, the thread being greased with or boiled in vaseline as suggested by Carrel. During the operation the

drying of the vessels was prevented by the application of normal salt solution or sterile vaseline.

The vessel sutures were done according to Carrel's method. The vessel ends were first united by three interrupted sutures equidistant from each other on the circumference of the vessel, the sutures penetrating all the coats of the vessel. By traction upon these sutures the edges of the vessels were nicely approximated and a continuous suture easily applied. It is convenient to leave the needles attached to the long ends of the primary sutures and to use these ends for the continuous suture. On turning on the current there was seldom any leakage, and when it did occur a slight compression usually caused it to cease in a few minutes. The tissues over the vessel were approximated with fine silk sutures and the skin wound was closed with a subcuticular suture of the same material. The wounds were dressed with silver foil and when the operation was on the neck a crinoline bandage was applied. When the wound was in the groin, it was usually dressed with collodion; sometimes a crinoline bandage was applied, which was usually torn off by the animal within 24 hours. Thanks are due Dr. R. R. Norris, of Washington, D. C., for assistance in many of these experiments.

Results.—The common carotid artery was sutured thirteen times. All of the sutures were perfectly successful and in no case was there the slightest evidence of thrombus formation. The femoral artery was sutured twice, thrombosis occurring both times as a result of wound infection. The external jugular vein was also sutured thirteen times, ten of the sutures being successful. (See figures appended.)

Microscopic examination of the arterial sutures at periods varying from twenty-eight to eighty-two days after the operation shows that there is a gradual restoration of the artery at the site of suture and that with the exception of the inner elastic membrane, all the elements of the vessel wall are probably regenerated. The sections of the thin-walled veins which were obtained were so distorted by the presence of the silk sutures that they were of little value for microscopic study.

The common carotid artery was sutured to the external jugular vein four times, all being successful. After the suture the veins became distended and pulsated vigorously; a marked thrill could be felt in the veins and a loud murmur heard over them. Examination of the veins one to three months after the operation showed a marked dilatation of these vessels, a thickening of their walls, and in some there were interesting plaques in the intima, suggesting the changes seen in arterio-sclerosis. Microscopic examination of the walls of the veins revealed changes very analogous to those found in the walls of arterio-sclerotic arteries. In the vein of experiment 13 (see Fig. 12) the following condition was found: While all the coats of the vessel were greatly thickened, the thickening of the intima, especially in the regions corresponding to the white plaques seen in the gross specimen, was very marked. The endothelial cells lining the intima were short and thick. The intimal thickening was composed of fibrous tissue fairly rich in cells. In certain places this tissue contained fewer nuclei and stained more poorly, but no atheroma was present. The thickening of the media was due to an increase in the interstitial connective tissue as well as to an increase in the size and number of its muscle cells. Where the intima was thicker the muscle cells seemed to be fewer and were separated by a considerable amount of connective tissue. The thickening of the adventitia was also well marked. There seemed to be a considerable increase in the elastic fibers of the intima, especially in the deeper portions near the inner elastic membrane, where a net-work of fine fibers was seen. In general, the elastic fibers seemed somewhat less abundant in the thicker plaques, but at their edges and in their deeper layers numerous fine elastic fibers were seen, apparently invading them. The elastic fibers of the media and adventitia were diminished, but the diminution was more marked in the former.

The central end of the divided femoral artery was sutured to the distal end of the divided femoral vein four times. One case was successful; in the others thrombosis occurred. In the

successful case the leg became very much swollen after the operation and in two days was twice as large as the opposite one. The swelling gradually subsided but never entirely disappeared. The femoral vein became much dilated and marked pulsation could be felt in the saphenous vein near the foot. Examination three months after the operation showed a marked dilatation and thickening of the wall of the vein. The distal portion of the femoral artery was small, atrophic, and did not seem to be performing the functions of a vein.

In four animals a lateral anastomosis of the femoral artery and vein was made. In all the cases the immediate result was quite satisfactory; on turning on the blood stream there was no leakage, the vein became considerably distended, a thrill could be felt in it near the point of anastomosis and a humming-top murmur could be heard at some distance from the animal. The red arterial stream could be seen through the thin-walled vein, rushing into the vein and for the most part returning immediately to the heart. In only one of the animals, however, did the anastomosis remain patent, a marked thrill and loud murmur being present five weeks after the operation when the animal escaped from the paddock and was lost. In the second animal the murmur and thrill persisted for four weeks and then disappeared, examination a few weeks later showing that the anastomotic opening had healed, but that the vessels had remained patent. In the third animal, whose wound became infected, the thrill and murmur lasted only four days; examination two months later showed a thrombosis of the artery, the vein remaining unobstructed. In the fourth case the thrill and murmur persisted five or six days, death occurring on the eighth day after operation from secondary hæmorrhage.

Excision and replantation of a section of the femoral artery was done once, but thrombosis occurred. Transplantation of a section of vein into an artery was tried twice. In one instance a section of the external jugular vein was transplanted into the common carotid artery with perfect success. Examination of the specimen (see Fig. 15) twenty-six days after

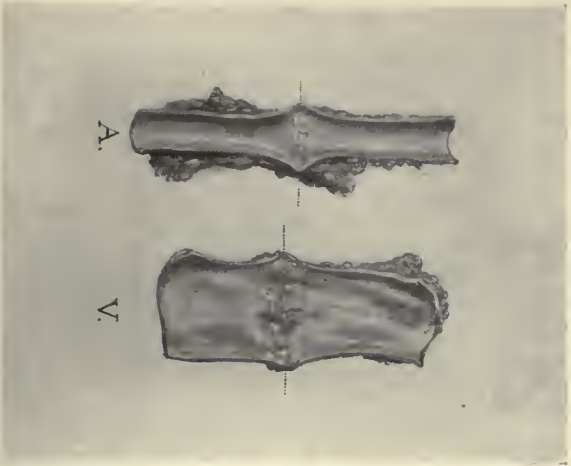
the operation showed considerable dilatation and thickening of the transplanted vein and the microscopic study of the vein revealed a condition very similar to that described above, resulting from the end to end anastomosis of the carotid artery and jugular vein. In the other case a section of the external jugular vein was transplanted into the femoral artery, but thrombosis resulted in a few days.

Transplantation of the thyroid gland was done six times, but none of these were successful. The failure of these experiments may be attributed to the small size of the inferior thyroid vein, whose diameter rarely exceeded two or three millimeters, and to the fact that the transplantations were undertaken before we had made any experiments with simple vascular sutures.

In reviewing our experiments we find that of thirty-one experiments upon the vessels of the neck twenty-eight were successful, whereas of twelve experiments upon the femoral vessels only two were entirely successful. This discrepancy is not difficult to explain. Wounds in the neck are inaccessible to the dog's teeth, and can be readily bandaged, the wounds being thus kept clean and dead space obliterated. In the groin, however, it is very difficult to apply a bandage which will remain in place, obliterating the large dead space which is so apt to be present and preventing movements of the leg which interfere materially with a successful vessel suture.

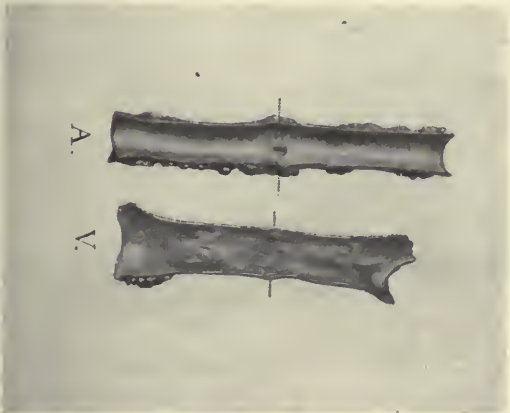
The results show conclusively that completely divided vessels can be sutured with almost uniform success, when the aseptic technic is good. The intima can be included in the suture with impunity, the application of the suture being thus greatly facilitated. Nearly all experimenters with the suture of blood-vessels have called attention to the need of a very perfect technic. I wish also to emphasize this point, for I consider infection by far the most important factor in producing thrombosis after vascular sutures. I think, as Carrel does, that there may be minor grades of infection, which, although allowing per primam healing of the wound, may be sufficient to produce thrombosis of the sutured vessels.

FIG. 1.



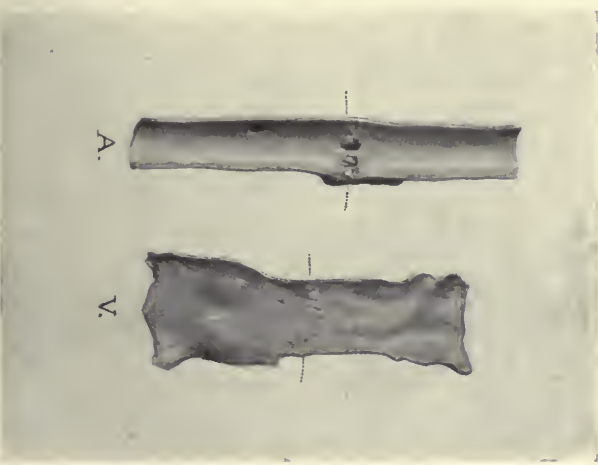
Circular suture of carotid artery and jugular vein,
28 days after operation.

FIG. 2.



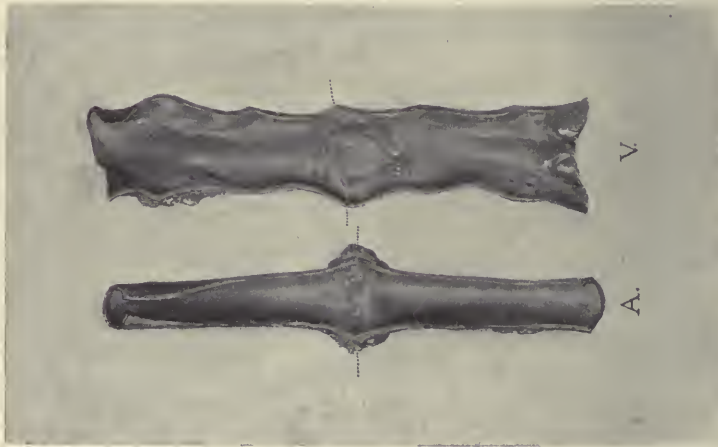
Circular suture of carotid artery and jugular vein,
42 days after operation.

FIG. 3.



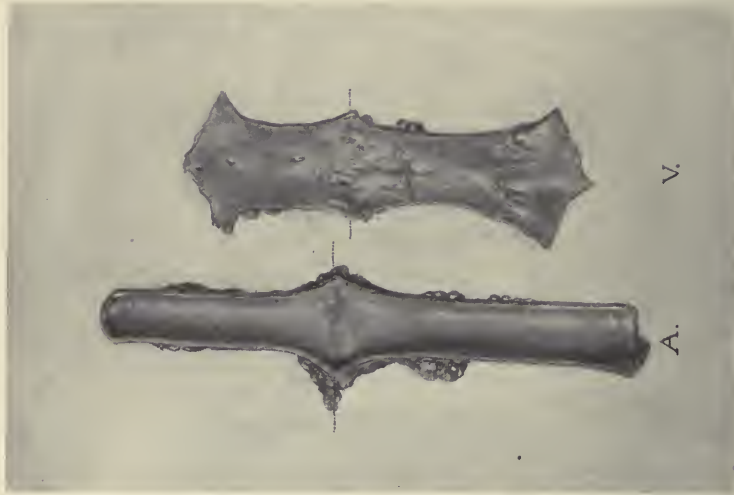
Circular suture of carotid artery and jugular vein,
35 days after operation.

FIG. 4.



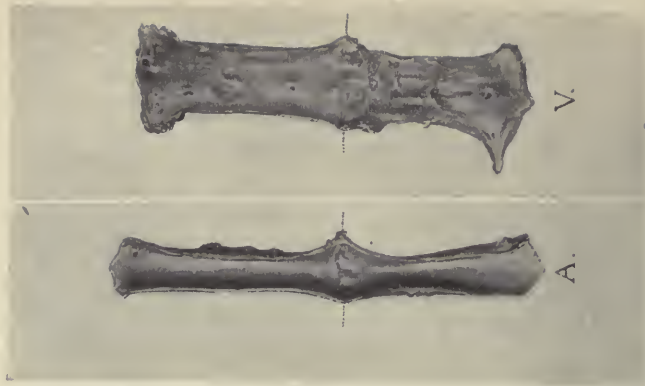
Circular suture of carotid artery and jugular vein.
82 days after operation.

FIG. 5.



Circular suture of carotid artery and jugular vein.
48 days after operation.

FIG. 7.



Circular suture of carotid artery and jugular vein.
32 days after operation.

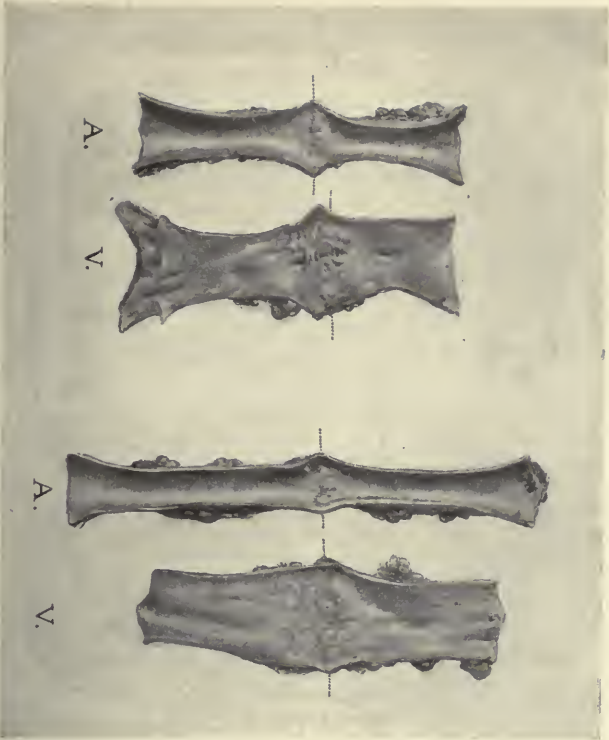


FIG. 6.

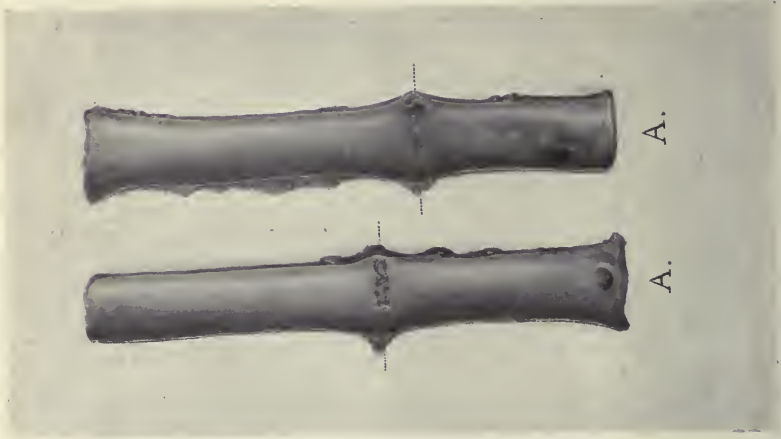
Circular suture of both carotid arteries and both jugular veins, 41 days after operation.



FIG. 8.

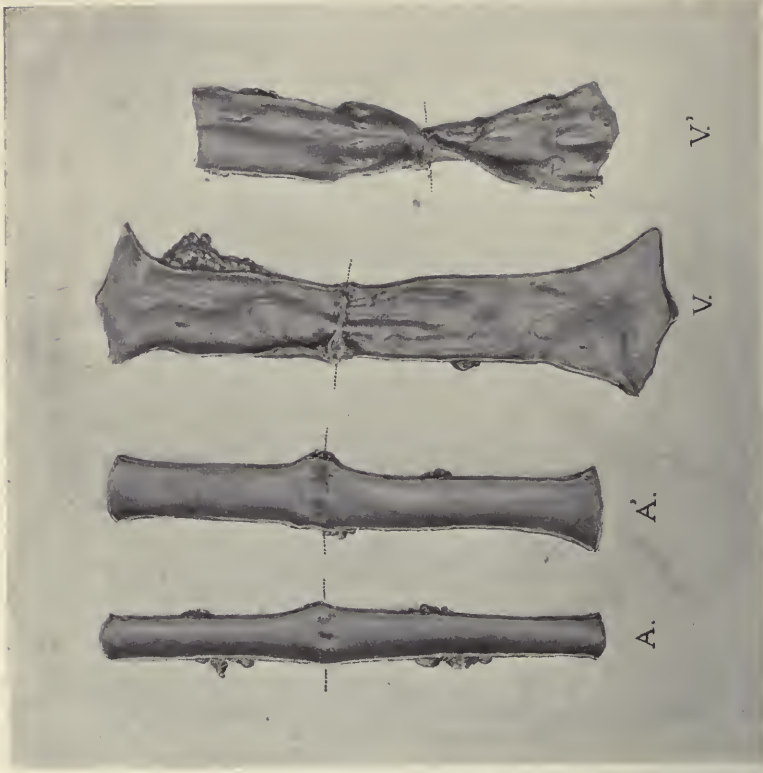
Circular suture of carotid artery and jugular vein, 26 days after operation.

FIG. 9.

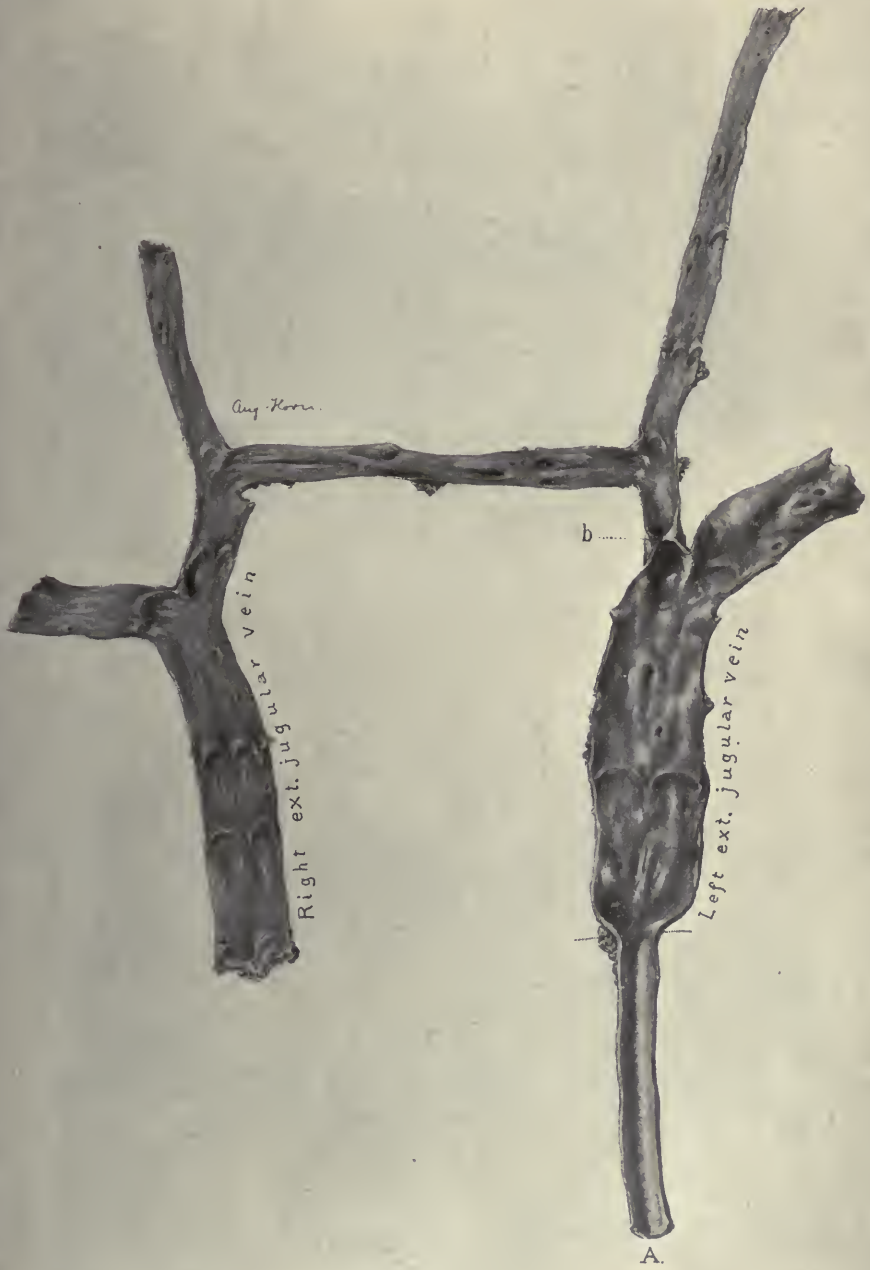


Circular suture of both carotid arteries, 18 days after operation.

FIG. 10.



Circular suture of both carotid arteries and both jugular veins, 17 days after operation.



Circular anastomosis of the left common carotid artery and left external jugular vein, 4 months after operation. As a result of arterial pressure this vein is much thickened and dilated. Small branch of vein occluded (b), probably due to valves being forced together and becoming adherent

FIG. 12.



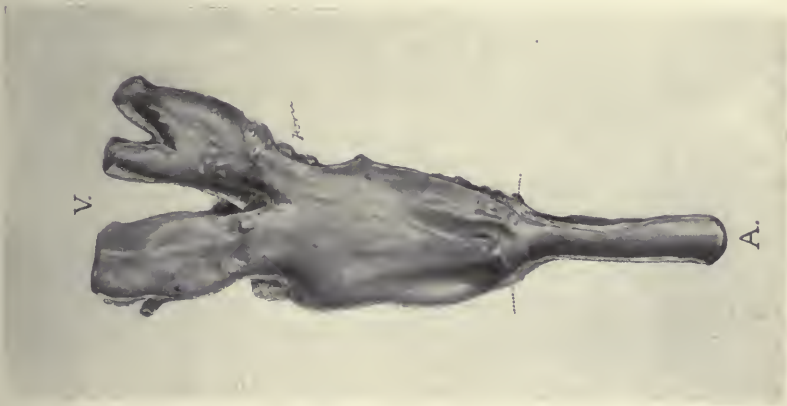
Circular anastomosis of carotid artery and jugular vein 3 months after operation. Marked sclerosis of vein.

FIG. 13.



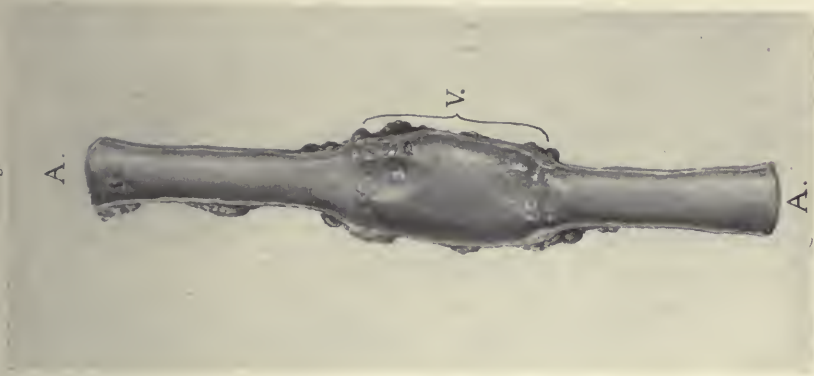
Circular anastomosis of femoral artery and vein, 3 months after operation. Marked thickening and dilatation of vein.

FIG. 14.



Circular anastomosis of carotid artery and jugular vein, 40 days after operation. Note thickening and dilatation of vein.

FIG. 15.



Transplantation of section of jugular vein into the carotid artery, 26 days after operation.

THE OPERATIVE TREATMENT OF ACUTE ABSCESS OF THE LUNG.*

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THE operative treatment of abscess of the lung, while it goes back to Hippocrates, was not put upon a sound basis until the latter part of the last century. Hippocrates recognized that abscesses of the lung not unfrequently ruptured into a bronchus and could thus be healed spontaneously, and in other cases broke into the pleura and then justified incision or opening with a cautery. In the eighteenth century De Barry and, later, Sharpe recommended operative procedures for abscess and other cavities. In 1845 Stokes attempted the opening of pulmonary cavities with the trocar. In 1873 Mosler, an internist, inaugurated the present period of lung surgery. Since then Quincke, Tuffier, Gluck, Karewski, and Garré have been important contributors to this branch of surgery. Progress became more rapid after it had been learned that the dangers of pneumothorax could be avoided, that the lung tissue stood well the invasion of the knife and cautery, and that hemorrhage need not be dreaded.

It is only of late years that an accurate differentiation of the suppurative lesions suitable to surgical treatment has been made, and definite indications and limitations have been laid down for the guidance of those contemplating operative interference. It is still true that lung abscess may present great difficulties of diagnosis, and this is likely to be the case at a stage of the disease when the prospect for a cure by operation is the most hopeful, *i.e.*, in fresh cases with the patient in a good general condition, slight extent of the suppurative process and no complications. In spite of greater accuracy in physical

* Read before the New York Surgical Society, April 24, 1907.

signs, and sputum examinations, and the added information from radiography, the diagnosis of suppurative lesions within the lung is still far from satisfactory. Discrepancies between the findings of the medical men and the revelations of the surgeon and pathologist are still of common occurrence.

Not only are the various acute and chronic suppurative lesions within the lung itself frequently mistaken for each other, but various conditions outside the lung are often wrongly claimed as intrapulmonic in origin. One has only to read carefully the histories of reported cases of abscess of the lung to find among them many of probable interlobar empyema or an empyema sacculated or general that has broken secondarily into the lung and bronchus. The best observers have been at times unable to distinguish correctly between an encapsulated intraparenchymatous and encapsulated pleuritic collection. It is equally true that many cases of abscess of the lung break into the pleural cavity, causing an empyema, which is drained and the existence of a primary lung abscess never suspected. Many of the instances of the slowly healing empyemas can doubtless be explained on the ground of persistence of a suppurating focus within the lung, which continues to discharge into the pleural cavity. For these reasons the frequency of acute abscess of the lung is stated very differently by different observers. Some of our medical confrères claim that it is a comparatively frequent condition following pneumonia, and point to numerous cases of spontaneous cure from evacuation into a bronchus. It should be borne in mind that a localized empyema may easily give the same physical signs as abscess of the lung, and very commonly perforates like an abscess into the bronchus. Other medical men recognize the infrequency of lung abscess following pneumonia, which is its most common antecedent, and place it among the rarest complications of that disease. Fraenkel, for example, found that in 860 cases of pneumonia under his observation, abscess of the lung occurred only in 1.5 per cent. of the cases.

Within the lung itself the various forms of suppuration are often not differentiated in the lists of reported cases, and

are classified together in symptomatology, prognosis, and treatment. While it is true that these different forms may have a resemblance to each other as regards symptoms, they should be strictly differentiated as regards indications *for* and results that may be expected *from* operative treatment. I think from a surgical standpoint we should carefully distinguish: First, acute abscess, simple and gangrenous; second, chronic abscess; third, bronchiectasis. Tuberculosis and actinomycosis belong in a still different category.

Acute abscess has been shown to follow most frequently lobar pneumonia. Tuffier found this to be the case in 23 out of 49 cases. Other causes are septic embolism and extension of suppuration from adjacent parts. The aspiration of foreign bodies usually results in an abscess of the chronic type that may eventually go on to bronchiectasis. The prognosis from the operative treatment of the chronic suppuration is so distinctly in another class from that of the acute that I have preferred to limit myself in this paper to the treatment of the acute. It is by directing our attention to the acute form of suppuration that we shall be able to prevent a certain percentage of the chronic cases which offer such a poor outlook for surgical interference. We cannot trust to Nature for a spontaneous cure by evacuation of the pus through a bronchus. If we could, there would be fewer cases of the chronic form come to our attention. We should interfere at an early stage before the abscess walls and surrounding tissue become hard and indurated, and the adjoining pleura thickened and unyielding, favoring a continuation of the suppuration and preventing a collapse of the abscess walls. The operative treatment of chronic abscess includes so much more than is necessary in acute abscess, and the conditions for healing are so unfavorable, that the two forms of abscess have little in common. To bring a chronic abscess to healing implies usually an extensive resection of ribs, removal, perhaps, of thickened pleura, and even then a sinus is likely to persist. On the other hand, the operative treatment of acute non-gangrenous abscess is in itself simple, and recovery should be the rule. The great difficulty

lies in an early recognition of the disease and in an accurate localization of the focus.

As regards the justification for operative interference in abscess of the lung, we must recognize the fact that spontaneous recovery is possible. Many abscesses of pneumococcus origin have undoubtedly healed after evacuation of the pus into a bronchus. In the absence of a gangrenous element, the abscess may not enlarge rapidly nor cause marked septic symptoms. Its walls not having become indurated coalesce after discharge of the pus, and cicatrization may be prompt and complete. On the other hand, we cannot be at all sure that this favorable result will follow. As these abscesses are often near the pleural surface they can easily give rise to empyema, which in such cases runs a severe and protracted course. Furthermore, if they persist as such their walls become thickened and unyielding, and later resist even extensive operative procedures. Spontaneous cures should be looked upon as a fortunate accident, and not waited for to the risk of the patient's life or future condition of health. The continued presence of an abscess within the lung should be regarded as a serious condition. Instead of rupturing into a bronchus it may at any moment break into the pleural cavity, give rise to multiple abscesses in the lung, or cause dangerous septic manifestations. When, however, the abscess has already broken into a bronchus and is discharging freely, it would seem proper to wait a time for nature to finish her cure. Should the discharge of pus per mouth not diminish rapidly, and the septic symptoms continue, we should not delay long. Evidences, however, of a gangrenous nature on the part of the abscess indicate very strongly early operation. The danger here is greater of infecting other parts of the lung and causing general sepsis.

Other reasons justifying some delay in operating are the persistence of the acute pneumonic process and the desirability of having firm adhesions of the two pleural surfaces. These should not, however, be allowed to weigh against early evacuation of the pus when there are well-marked indications for the same. Quincke claims that the duration of the disease has no

influence upon the presence of adhesions. Their existence is probable if there is a previous history of sharp pain on that side and other evidences of inflammation of the pleura.

In spite of the fact that the operative technique of pneumotomy is comparatively simple, this operation is often unsatisfactory and disappointments are not uncommon. In the first place the abscess, though present, may not be found. This may be due to the fact that its location has not been accurately made out beforehand. It is one thing to diagnose the existence of an abscess and quite another to locate it exactly. Mistakes can be made as to its height and depth. The experience of the past will help us here. The great majority of abscesses following pneumonia occur in the lower lobe and near the pleural surface. Furthermore, the location of the adhesions between the pleural surfaces is usually an important guide to the situation of the pus cavity. After the exposure of the adherent pleura the aspiration syringe should ordinarily locate the pus if introduced a number of times in different directions and to various depths. If there are no adhesions found at the point where the pleura has been exposed, the proper procedure, it seems to me, is to make a small opening in the parietal pleura large enough to admit a finger, and in this way a search can be made for adhesions. This "exploratory pleurotomy" done in this way, as first recommended by Bazy, may give valuable information, not only as to the location of adhesions, but the focus itself may be made out by feeling a firmer consistency of the lung at one point, a bulging of the surface, or a thickened pleura. The danger of making such a small opening in the pleura which is at once filled with the finger is very slight. The resulting pneumothorax is only partial, particularly if adhesions are present at one or more points, and even without adhesions the collapse of the lung is not complete, and the patient suffers no alarming symptoms. Bazy found in this way a gangrenous focus in the upper lobe of the right lung in a young man of twenty, in spite of the fact that the physical signs pointed to a localization of the cavity in the lower lobe. After resection of the eighth and ninth ribs the pleura was found to be healthy.

Upon inserting the finger he felt higher up an induration of the lung and adhesions. Thereupon he resected the fourth rib and opened an abscess cavity in the subjacent portion of the lung. Such a favorable result cannot, of course, be expected in every case that this method is used, but it seems advisable in cases where no adhesions are found at the point of resection of ribs. By uniting the non-adherent pleural surfaces without this exploration, we lose a valuable diagnostic method. The absence of adhesions carries with it considerable doubt as to whether the abscess will be found directly beneath the exposed pleural surface inasmuch as adhesions are the rule.

The more extensive exploratory operations in which the pleural cavity is opened widely and the lung palpated over its entire surface has no place in suppurative lesions in the lung. The same is true of the extrapleural method of Tuffier, in which the parietal pleura is dissected up for some distance from the subjacent fascia, thus making it possible to palpate the lung without opening the pleural cavity. The first operation is very dangerous on account of the complete pneumothorax and the probable infection of the pleural cavity, provided the abscess is found and opened in the same sitting.

The second operation is very difficult, prolonged and in the end unsatisfactory. Should, in spite of the Bazy procedure, no adhesions at all be found, and the existence of an abscess still be thought probable, the formation of adhesions by means of suture should be the next step before the introduction of an aspirating needle. In this way alone can we be sure that the needle when withdrawn after finding pus does not infect the healthy pleural surfaces. In case a pus focus is not discovered by means of a needle plunged in different directions through adherent pleura into the lung tissue, we should not hesitate to go further in case other signs point to the existence of an abscess. An incision can without danger be made into the lung tissue with the knife or thermocautery, or the finger or blunt instrument can be bored in until a cavity is reached or the hæmorrhage has become too free. By inserting gauze into a canal thus made the breaking through of pus is favored, and

eventually the abscess may be evacuated. A number of cases have been recorded in which this favorable result has occurred. The danger of serious hemorrhage is not great in the superficial portion of the lung, and it is not until the larger vessels of the deeper parts are reached that the bleeding becomes profuse. Had this direct exploration of the lung been more often practised, fewer cases would be on record where the abscess cavity had been left unopened and discovered only at autopsy. Besides, in not finding the abscess the operation may result in a fatal pneumothorax or infection of the healthy pleura. Should a complete pneumothorax and resulting collapse symptoms occur in spite of the precautionary measures already spoken of, the patient may be saved by prompt measures. The lung may be seized with tenaculum forceps and drawn forcibly against the wound in the pleura and retained there by sutures. Furthermore, the lung may be expanded by means of the O'Dwyer intubation tube or some similar apparatus. Should the pus be opened into the healthy pleura there is very great danger of a fatal empyema, especially in a person already septic and weakened. An attempt should be made, however, to provide for proper drainage at the most dependent part of the thoracic cavity. For this purpose resection of a portion of the ninth rib should be done.

Most of the other bad results from operation for acute meta-pneumonic abscess of the lung may be put down to non-recognition of the abscess and consequent delay in operating until the patient's condition has become too poor from sepsis to expect anything but a fatal outcome, or to the existence of multiple abscesses secondary to the original one or to some other complicating process. These bad results seem, therefore, nearly all avoidable, provided that the case comes under the physician's observation from the beginning. Better results from operation will follow from more prompt recognition on the part of the internist of the existence of an abscess, a more accurate diagnosis of the location of the same, and from earlier operative intervention. The mortality at the present time is far higher than it should be, and in reality should approach

that of empyema. The mortality as given in statistics, such as Tuffier (23.8 per cent.), which are computed from published cases, seems lower than it really is, as shown in unpublished records taken from one or more hospitals. Here will be found the successful and unsuccessful cases recorded together. I have made such a compilation of hospital cases which have been operated on during the last ten years. This shows a mortality of 50 per cent.

As regards operative technique, certain points seem of special importance. In the first place, the incision is preferably curved with convexity downward, and should correspond to the lower level of the abscess. This will insure the best drainage, and will permit of added resections of ribs at a higher level. One or preferably two ribs are resected for a sufficient distance and, later, if necessary, further resections may be added. The parietal pleura should be then carefully inspected to detect any thickening, adhesions, or other abnormality. The existence of adhesions is of great practical importance, as we have already seen, and fortunately are the rule in abscess cases. Tuffier found that they were present in 87 per cent. of the cases. In some instances there is a localized exudate, sero-purulent in character, between the two pleural surfaces. The method used for the production of adhesions has changed considerably in the evolution of lung surgery. Quincke, an acknowledged authority on abscess of the lung, still uses his cauterization method. Applications of chlorid of zinc paste are made repeatedly for several days, and at the end of two weeks adhesions are usually present. Other observers claim that they have had no results from this method. It is certainly unsurgical, and does not appeal to the aseptic operator. Suture of the two surfaces seems to be the method of choice. Inclusion of lung tissue by the stitches has the advantage of greater security of the line of suture. The additional use of gauze packing is highly recommended by some and certainly helps in the production of broad adhesions. It is desirable to form a sufficiently large area of adhesions, as the movements of the lung find in this way greater resistance, and the sutures are less

likely to tear out. Furthermore, a larger area of the lung lies attached in the wound, and any slight error in the diagnosis of the location of the abscess will be of less consequence. Round needles are preferable, and Garré recommends inserting them during expiration and covering the pleura with the finger during inspiration.

If the suturing has been done satisfactorily, the incision of the pleura can be done at once without putting it off to a second sitting. If, however, the patient's condition is good the delay of a couple of days will doubtless ensure stronger adhesions without lessening the patient's chances.

If the strength of existing adhesions is in doubt, sutures should be used for reinforcement, so that the introduction of the scalpel or trocar will not cause the adhesions to give away, followed by pneumothorax and separation of the lung from the field of operation. This experience happened to me in operating upon an abscess of embolic origin. The pus had been located by means of the aspirating needle passed through an adherent portion of the pleura. Upon inserting a sharp-pointed knife along the needle, the weak adhesion gave away, air entered, and the lung receded out of reach. A strip of gauze was hastily packed into the pleural cavity so as to come in contact with the area of the lung that had been adherent. The patient suffered no ill effects from the pneumothorax and a few days later the abscess perforated into the gauze packing. Within a short time the pus ceased to discharge, the fistula closed, and the patient made a perfect recovery.

As regards the method of dividing the lung tissue before reaching the abscess, surgeons hold various opinions. The general rule seems to be that the thermocautery (at a red heat) is preferable when the lung tissue is soft and vascular, as the oozing is undoubtedly checked and infection is less likely to penetrate the line of incision. The knife, however, is more suited to indurated tissues and does not obscure the tissues as does the cautery. The tip of the forefinger is an effective instrument in boring into lung tissue, and has been recommended by many operators expert in this branch of surgery.

The cavity having been opened, the treatment is similar to that of most abscess cavities, with the exception that irrigation should not, as a rule, be employed. The danger of spreading the infection into the adjacent tissues and, particularly when there is a communication with a bronchus, into other parts of the lung, is a real one, and fatal results have undoubtedly been caused in this way. In exceptional cases of gangrenous abscesses, with very foul contents and no communication with a bronchus, it may be desirable to run some risk on account of the detriment of the patient from the continued absorption from the septic contents. In one extensive abscess, with a large amount of secretion, I obtained the best drainage by means of a long tube connected with a bottle at the side of the bed. The dressings remained comparatively dry and thus their frequent change, which would have been necessary in case a short tube had been used, was done away with, which is no small consideration in the cases of these weakened individuals. Tube drainage seems to me preferable to any other in large abscesses. The danger of erosion of vessels from pressure is not present here as in chronic abscesses and bronchiectases, and hence the precaution of covering the tube with gauze is not essential. I have tried in all cases to keep these patients out of doors as much as possible on the roof or fire-escape. Their general condition is immensely improved thereby; they sleep better, their appetite improves and recovery seems hastened. The average time for healing seems about eight to ten weeks. This depends a good deal upon the length of time that the abscess has existed before operation. In the long standing cases the fistula may remain open for many months. Subsequent examination of the lung fails to show anything abnormal left behind by the abscess, and it is only very exceptionally that an inflammatory process is started up afresh.

If we turn to abscesses of origin other than lobar pneumonia we find the results from operative treatment are, generally speaking, far less favorable.

Embolie abscesses are frequently multiple, and in that case are not adapted to surgical treatment. Furthermore, the

cases in which the abscess in the lung is single, are frequently associated with purulent foci elsewhere in the body, and thus offer a poor outlook for recovery, even though the pulmonary focus is found and drained. Operation, however, should be attempted in suitable cases and the abscess opened and drained, just as in the meta-pneumonic abscess. Williams reported an abscess of the lower lobe following septic miscarriage in which adhesions were present, and the recovery followed incision and drainage. I had recently a successful case of embolic abscess in which there were three other pus foci in the body. The small single abscess in the lung was successfully opened and drained.

Abscesses following influenza-pneumonia are frequently multiple on account of the breaking down of disseminated areas of consolidation. They do not usually communicate with a bronchus, and run a more chronic course. The prognosis is hence distinctly worse than in the single abscesses of lobar pneumonia. Should the purulent foci be close to each other it may be possible to drain them by opening up one abscess and breaking down the intervening tissue. In general, however, operative treatment should not be extended to this multiple form of suppuration. Abscesses due to the aspiration of foreign bodies also show an unfavorable prognosis. These abscesses usually belong to the chronic type, often become multiple and develop into bronchiectasis. It is seldom possible to find the foreign body after opening the abscess, and unless the body is coughed up or removed by means of a bronchoscope, the abscess does not heal. Out of 14 cases the foreign body could be found and removed through the wound in only two instances. Such patients usually succumb to prolonged suppuration or to pyæmia.

The following statistics based on 20 cases of acute abscess have been taken chiefly from the records of several of the large hospitals in this city. They are all cases that have been operated upon within the last ten years. All cases in which an abscess was not actually found within the substance of the lung at the operation or subsequent autopsy have been excluded

from the list. Many cases were found tabulated in the records as "Abscesses of the lung," which seemed from careful perusal to be cases of sacculated empyema or empyema that had ruptured into the lung and bronchus. These were naturally excluded as well as all cases in which there were insufficient data as to the duration, nature of the abscess, etc. I have selected the acute cases of abscess for the reasons given at the outset of this paper. I have been impressed with the rarity of the condition, as shown by the surgical records. As regards the sex, the relative frequency in males is rather striking—17 males and 3 females. Etiology shows a decided preponderance of pneumonia as the underlying—15 cases.

The duration of pulmonary symptoms and the nature of the abscess have seemed of special importance as bearing upon the results of operative treatment. Abscesses of long duration and those with gangrenous contents show a bad prognosis. The two cases of multiple abscess died. With one exception all the cases of simple abscess of less than eight weeks' history and with non-gangrenous contents recovered. This case might, it seems to me, have recovered had not irrigation been used. All the gangrenous abscesses died; in one of them, however, the abscess was not found at the operation, but the autopsy showed that it was only an inch from the surface.

The operative result in the 20 cases shows a mortality of 50 per cent. This seems high, but when we consider that cases are here included of four and five months' duration before operation, and those of a gangrenous character, we realize that we are dealing with severe lesions. Without operation all such cases must necessarily be fatal. Our hope of good results seems to lie in the simple abscesses which are discovered early, before they have become extensive, multiple, or complicated by empyema, and before the patient has grown septic. Cases of lobar pneumonia which run an irregular course suggesting secondary empyema and in which pus is not obtained by trial puncture of the pleural cavity, should be regarded with suspicion. They should not be permitted to drag along in the medical wards until the favorable time for operating has

passed. It is far safer to explore such cases by resection of one or more ribs, palpation and inspection of the pleura, search for an adherent area, and trial punctures of the lung through the adherent portion. If pus is present within the lung it should be found in this way at the time, or may be evacuated later spontaneously through the wound. If pus is not present, no harm has been done by the simple operative procedure at a time when the patient's general condition is good.

SYNOPSIS OF TWENTY CASES OF ABSCESS OF LUNG.

Case No.	Sex.	Age.	Etiology.	Duration of Pulmonary Symptoms.	Condition of Pleura.	Nature of Abscess.	Result.	Remarks.
1	M.	26	Secondary to abscess of liver.	3 months.	Adherent.	Simple.	Death.	
2	M.	50	Pneumonia.	3 weeks.	Adherent.	Gangrenous	Death.	
3	M.	42	Pneumonia.	8 weeks.	Adherent.	Simple.	Recovery.	Abscess cavity not found but ruptured subsequently into wound
4	M.	23	Embolic.	5 weeks.	Slightly adherent.	Simple.	Recovery.	Secondary abscesses in joints.
5	M.	43	Pneumonia.	4 weeks.	Adherent.	Multiple.	Death.	
6	M.	5	Pneumonia.	3½ wks.	Adherent.	Simple.	Recovery.	
7	M.	11	Metastatic (appendic.)	5 weeks.	Adherent.	Multiple.	Death.	
8	F.	23	Pneumonia.	4 weeks.	Adherent.	Gangrenous	Death.	Autopsy. Abscess not located at operation.
9	M.	25	Pneumonia.	3 weeks.	Adherent.	Gangrenous	Death.	Lived 6 weeks.
10	M.	40	Pneumonia.	4 weeks.	Adherent.	Simple.	Death.	Irrigation.
11	F.	22	Pneumonia.	5 months.	Associated empyema.	Simple.	Death.	Lived 3 months.
12	M.	21	Pneumonia.	4 months.	Adherent.	Simple.	Recovery.	
13	M.	53	Pneumonia.	4 weeks.	Adherent.	Simple.	Recovery.	
14	M.	38	Pneumonia.	3 weeks.	Adherent.	Simple.	Recovery.	
15	M.	28	Pneumonia.	4 months.	Sero-purulent exudation.	Gangrenous	Death.	Lived 5 weeks. Whole lower lobe involved.
16	M.	10	Pneumonia.	2 months.	Adherent.	Simple.	Recovery.	Previously broke into bronchus.
17	M.	40	Pneumonia.	4 weeks.	Adherent.	Simple.	Recovery.	
18	M.	25	Embolic.	3 weeks.	Adherent.	Simple.	Recovery.	
19	F.	55	Pneumonia.	3 weeks.	Adherent.	Simple.	Recovery.	
20	M.	17	Influenza.	4 weeks.	Adherent.	Gangrenous	Death.	

CONCERNING A DISTINCT TYPE OF HYPERNEPH-
ROMA OF THE KIDNEY, WHICH SIMULATES
VARIOUS CYSTIC CONDITIONS OF THAT
ORGAN.

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THE pathological diagnosis of tumors of the kidney has made notable and permanent advances within recent years. In addition to the old and well recognized types of sarcoma and carcinoma among the malignant neoplasms which affect that organ, the so-called teratomata, which often assume many of the clinical characters of malignancy, have come to be definitely established. Of these, at least three types are known—the embryomata, or “Wilms’ tumors,” containing glandular tissue, striated muscle, and occasionally other elements; the adeno-sarcomata of Birch-Hirschfeld, grouped by many authors as tumors of the Wolffian duct, ^{2, 5} by others as a species of the Wilms’ tumors; ^{1 2} and the Grawitz tumors, or hypernephromata. These various types of new growths possess certain characteristics of their own, both in their clinical course and in their prognosis, which renders their recognition an extremely important object in diagnosis; and yet it cannot be gainsaid that this recognition still remains in very many of the cases little less than a diagnostic impossibility. The cause of this difficulty is not very far to seek, for, as pointed out by Thorndike, in almost all the recent publications which deal with these growths, their histological features have been made the subject of elaborate study and description, almost to the complete exclusion of their clinical characteristics. It would seem, however, that the time had arrived when a more careful study and definition of the latter aspect of the problem might be fruitful in practical results. It is quite evident that tumors

which differ so markedly in their course, their prognosis and, under certain conditions, in the indications for treatment cannot be profitably thrown together in the nondescript category of malignant neoplasms of the kidney.

In the following paper, an attempt has been made to define a certain group of hypernephromata, which offer many difficulties in the way of diagnosis, and yet which seem, upon closer analysis, to present certain peculiar characteristics, which are sufficiently individual to render their recognition possible.

An example of this group is offered by a very typical case which was recently observed in the German Hospital in New York City. The patient, E. W., a man 56 years of age, was admitted to the hospital in June, 1904. For the following details I am largely indebted to Dr. Kammerer, in whose ward he lay, and also to Dr. H. Klein,⁶ who had previously presented him at a meeting of the German Medical Society for diagnosis. His family history is irrelevant. His personal history up to the age of 16 makes mention only of the diseases of childhood. At the age of 16 or 17, he had an attack of hæmaturia, which lasted for almost two weeks. At this time he had no pain, and no other evidences of disease. From that time until 1899, a period of thirty-five years, the patient remained in every respect perfectly healthy, so far as he knew. In November, 1899, he again observed the presence of blood in the urine, which persisted for several weeks, and led him to seek the German Hospital in December. His only complaint at that time was weakness and occasional vertigo, due probably to the loss of blood. He had no pain either during or after urination. His urine at that time contained red cells, epithelia, leucocytes, and a few hyaline casts, and measured 1300-1500 cc. per day. He remained in the hospital for about five weeks, during which time the urine gradually cleared up, and in January, 1900, he left, apparently cured. He had presented no œdema and no uræmic symptoms of any kind. No clinical diagnosis was noted. About a year later he had an exactly similar attack, which lasted four to six weeks, and since then three more attacks, at intervals of several months. In general, these attacks were all of similar nature, and each one left him weaker and more anemic than before, so that for a year

previous to his admission to the hospital he had been unable to follow any occupation. In March, 1903, he first noticed an increase in the size of his abdomen, which steadily progressed. This went hand in hand with a sense of fulness and of oppression in the epigastrium after eating, and with a gradual diminution of appetite. During this period the patient thinks that he lost about ten pounds in weight. He has suffered from constantly increasing weakness, vertigo, and other anemic symptoms, which have always been aggravated just prior to the onset of his hematurias. He has never passed a stone or gravel, and has never had any form of colic.

Physical examination.—Man of medium height, with poor skeletal and muscular development. Considerable emaciation. Pallor of skin and visible mucous membranes marked. No œdema over malleoli or sacrum. Examination of the thorax reveals nothing of note, except slight upward displacement of the apex beat, and a few rales at the bases, especially marked on the left side. The abdomen is markedly distended, especially on the left side, and there are large and torturous veins in the skin of that side of the abdomen. By palpation, a tumor mass is found to occupy practically the entire left side of the abdomen, extending well beyond the middle line, including the entire umbilical and upper part of the pubic regions, and left lateral portions of the abdomen. In the midsternal line, it can be felt as high as three fingers' breadth below the ensiform, and as low as four fingers' breadth below the umbilicus. It appears to be smooth, rounded, tense, but slightly fluctuating, and exhibits no respiratory mobility. It is not tender. The liver and spleen are not palpable. The percussion note over the mass is uniformly flat, except for a tympanitic band, presumably ascending colon, towards the left flank. It is separated by a narrow tympanitic zone from the area of liver flatness. No evidence of free fluid in the abdomen. The urine is dark red, opaque, and contains coagula; albumen is present in varying amounts. Microscopically, numerous red blood cells, leucocytes, and epithelia; also hematin, and triple phosphate crystals. Cystoscopic examination revealed normal urine issuing from the right ureter, a bloody fluid from the left. A blood examination made shortly after admission showed 60 per cent. of hemoglobin; less than 3,000,000 red cells; 7800 whites, of which 40 per cent. are mononuclears.

The red cells were not normal; there were some poikilocytosis, a few macro- and micro-cytes, but no nucleated reds. Examination of the fluid obtained by puncture of the mass revealed only red blood cells, leucocytes, and degenerated epithelia. Pulse ranged from 90 to 100, temperature from 99° to 101°.

On June 11 Dr. Kammerer removed the tumor by lumbar incision.

Macroscopically it presents * a large cystic mass, irregularly ovoidal in shape. The surface is smooth, glistening, and white in color, and covered with a network of injected veins. There are surface indications of lobulation. Upon section, the content is found to be a reddish brown, grumous fluid, which shows degenerated leucocytes, red cells, epithelia, numerous cholesterol crystals, and blood pigment. The wall, which seems to be composed of tough, dense, connective tissue, measures from 4 to 16 millimeters in thickness. Incomplete septa partially divide up the cavity of the cyst. The inner surface is smooth and covered with adherent fibrinous masses. Coursing in the wall of the cyst is found the thickened but patent ureter. To all appearances, the tumor is a large monolocular cystlike distension of the kidney, containing much altered blood. Closer examination reveals the presence of two inconspicuous strands of a different tissue, one of which lies in the capsule, the other in one of the septa. Both of these strands are enclosed in a distinct fibrous capsule. Their tissue is firm, their color yellow. On microscopic examination, they are found to be composed of adrenal tumor tissue, presenting the characters of this tissue as it appears after it has undergone malignant degeneration. In some places it is with difficulty distinguishable from cancer, while in others it unmistakably displays the characteristics of the adrenals. The wall proper of the cyst is found to contain the remains of kidney tissue—Malpighian bodies and tubules in a fairly intact condition, imbedded in a large amount of interstitial connective tissue.

The tumor falls, therefore, in the group of hypernephromata. It is differentiated, however, from the great majority of tumors of this class by its remarkable cystic char-

* The tumor, with sections, was shown before the Pathological Society of New York in January, 1905, and is reported in Volume IV of the Proceedings, p. 156.¹⁴

acter. As is well known, all hypernephromata tend, from a variety of causes, to break down and form cysts. Almost invariably, however, there results a predominantly solid tumor, containing numerous larger or smaller, irregular, cyst-like, cavities; very rarely does the process give rise to the formation of single very large cysts, with hardly discoverable remnants of the tumor tissue in its walls. Nevertheless, a number of other cystic tumors have been described, presenting exactly similar characteristics and with similar hypernephromatous remnants in their walls, so that this—the cyst hypernephroma—must be recognized as one of the pathological varieties of that class of tumors.

The pathogenesis of these cysts seems to me to be a matter of some interest. The occurrence of adrenal tissue in the walls of the cysts seems to indicate with certainty their origin from adrenal "rests," and it might not at first sight seem unreasonable to suppose that their cystic character may simply represent a further extension of the tendency, so common in hypernephromata, towards cystic degeneration.

On the other hand, they differ very markedly from the typical cystic hypernephromata in the fact that the latter never break down to form single large cystic tumors, but simply contain cystic cavities in the mass of the growth. Indeed, it is difficult to conceive of the complete destruction of the tissue of a hypernephroma, and its substitution by a cyst corresponding to the condition in the cases described. On the other hand, it is easy to see the analogy between these cysts and certain other structures described by W. C. Bosanquet¹ as "cystic adenoma of the adrenal." This author described the following condition: "A round mass lying in front of the left kidney, with the descending colon passing down on the outer side. On removal this proved to be a nearly spherical body, three inches to three and a half inches in diameter, slightly longer in a vertical than in a transverse direction. The left suprarenal was attached to the upper and back part of the tumor, and looked normal." The tumor was found to be a cyst. The cyst wall showed adrenal tissue, and its contents were of the consistency of jelly and

orange colored. There is little doubt, as pointed out by Bosanquet, that the case described by Lockwood⁸ is an example of the same condition; he also cites several other cases. It is probable, therefore, that the adrenal rests incorporated in the kidney have gone on, in the cases described in this paper, to the formation of "cystic adenomata" and not of hypernephromata, and have then eventually burst into the pelvis, and induced dilation of the entire organ. All the stages of this process may be traced in the cases which have been reported, starting with that of Leopold (Case VII), and ending with Case I.

With the purpose of establishing the clinical type which characterizes this group of hypernephromata, I have collected all the cases which I could discover in the literature. In all, five cases were found, which closely resembled the present case in their essential pathological features, and in the identification of adrenal tissue in the wall of the cysts. All of these cases, of course, have been reported since the publication of Grawitz's original paper in 1883.

CASE I (GRAWITZ⁴).—The patient, a well nourished man, was observed for ten years. The first symptoms of disease referable to the genito-urinary tract occurred at the age of 40. At this time there were vague urinary symptoms, diagnosed as pyelitis. Seven years later there was hematuria, which lasted a few days, and frequently recurred. The urine showed not only blood, but peculiar papilliferous masses, of which the cells were large and ovoidal, so that the diagnosis of carcinoma of the bladder was made. The patient, however, became better again, and only two years later observed a swelling in the left side of abdomen. This tumor continued to grow, and finally after two more years produced pressure symptoms. The latter were relieved on three successive occasions by puncture, the last of which set up a suppuration. The puncture fluid was chocolate-brown in color, cloudy, and contained many cholesterin crystals.

The autopsy, by Grawitz, disclosed a tumor mass in the left side of the abdomen, measuring 25 x 20 cm. The tumor proved to be a degenerated left kidney, transformed into an enormous monocular cyst. The wall of the cyst showed remnants of kidney tissue, and remains of a whitish, crumbly tissue, which represented all that remained of the hypernephroma. There were three adrenal tumors in the opposite kidney.

CASE II (STRÜBING¹⁰).—In a patient, male, aged 67, a tumor of the abdomen was accidentally discovered. Tumor was clinically diagnosed to be cystic, derived from right kidney. General condition very good. Pres-

sure symptoms involved the gastric and respiratory functions; and there was œdema of legs. The cyst was observed for four years to gradually increase in size. Hematuria never occurred. Remarkable is the absence of hematuria, in spite of patency of connection between cyst and ureter. Finally puncture was indicated to relieve the pressure symptoms, and evacuated 3 liters of a chocolate-brown fluid, mixed with fat and cholesterin. After a brief period of improvement, the cyst again began to grow rapidly, owing, as the autopsy showed, to hemorrhage, and the patient died from asthenia.

Autopsy.—A cystic tumor in right side of abdomen, measuring 22 x 24 x 26 cm. Contained 5 to 6 liters of dark, chocolate-brown, fluid; cholesterin crystals present. Cyst is composed of right kidney. Wall shows remnants of kidney tissue; pelvis and calices dilated; ureter enters cyst. Wall of cyst 4-5 mm. thick. The inner surface presents numerous nodules, ranging in size from pea to twice that of a walnut, whitish yellow in section. Wall microscopically composed of dense connective tissue. The small tumors consist of polygonal, epithelioid cells, with much fat contents. The diagnosis of hypernephroma was made from sections of these tumors. The left adrenal was normal.

CASE III (STRÜBING²⁰).—A woman, aged 64, who had always been strong and healthy, had a sudden attack of pain in the left side. The pain lasted only a few days, but was followed by a period of irregular fever (37.2-38.8) and digestive disturbances. Examination disclosed a tumor of the size of a fist in the left hypochondrium. It was rounded, soft, not tender. It did not move with respiration. Tympany over the anterior surface. Urine normal. During the following three weeks, the tumor became larger and fluctuating; it reached the navel, and extended two fingers below the anterior spine. Fever persisted. Right pleurisy.

The case was diagnosed as a paranephritic abscess.

Lateral incision, for the purpose of drainage. Incision evacuated 1 liter of dark, bloody, fluid, containing large shreds of softened tissue. The tumor proved to be a large cyst. Suppuration followed, with pulmonary involvement, and death. The cyst was removed post-mortem and sent to Dr. Grawitz, who made the diagnosis of hypernephroma. The microscopic appearance was practically the same as that in the preceding case.

CASE IV (VILLARET²¹).—The clinical data are very inadequate. It is stated only that there were pressure symptoms from the tumor, but nothing referable to the urinary tract. The kidney was removed at operation, and came to the hands of Prof. Grawitz. The mass consisted of a sac, about as large as a man's head, the walls of which present soft tumor masses. At one point, kidney tissue is recognizable. The contents consist of a blood-stained fluid, containing masses of tissue in fatty degeneration, and much cholesterin. The wall shows remnants of kidney tissue, and adrenal tissue.

CASE V (PIRONE⁹).—A man of 40, previously healthy, began in January to have pains in the left side. At the same time a tumor made its appearance, and gradually increased in size. Three or four months later,

the patient observed blood and clots in the urine. The clinical diagnosis was sarcoma of the left kidney. Extraperitoneal nephrectomy was done in June, 1902. At operation the mass was found to be fluctuating, and an exploratory puncture yielded about 100 cc. of a thick reddish brown liquid, containing granular material. Incision over the site of puncture yielded 150 cc. of detritus.

In addition to the five cases above detailed, in which ad-renal tissue was identified in the wall of the cyst, the literature contains mention of a large number of other cases in which there is little doubt that the origin of the cysts was due to an unidentified hypernephroma of this type. These cases are not specifically referred to in the bibliography. A considerable number of them may be found in the article by Strübing who is, however, certainly somewhat too liberal in his interpretation of the pathology of certain of these doubtful cases. Two of these cases are of sufficient interest to demand detailed presentation.

CASE VI (SCHETELIG¹¹).—Patient is said to have had an enlarged abdomen from birth. This gradually increased in size up to the seventh year, when she had a severe fall. This was followed by a severe abdominal pain, and the passage of considerable quantities of bloody urine. This polyuria continued for three months and was associated with gradual decrease in the size of the abdominal tumor. The latter then gradually resumed its former size. At the age of ten the same thing recurred—a fall, hematuria, polyuria, decrease in size of tumor, and subsequent growth. Status praesens: a healthy looking young woman (age not given). Urine normal. Abdomen measures 122 cm. in its greatest diameter. A smooth, tense, movable tumor can be felt, apparently occupying the entire left half of the abdomen, and extending beyond the middle line to the right anterior superior spine. At operation, a median incision was made. The cyst was punctured, and 30 “pounds” of fluid evacuated. The fluid was rather dark in color, of a specific gravity of 1018, and contained large amounts of cholesterin. The patient recovered, but returned after three months with the abdomen again much swollen. A diagnosis was made of ovarian cyst, and the cyst was now extirpated by Esmarch.

The cyst was examined by Cohnheim. It measured more than one foot in diameter. The wall was composed of thick, leathery, whitish yellow membrane, almost $\frac{1}{2}$ cm. in thickness. Here and there, it was studded with numerous smooth, whitish elevations, some of which were calcified in parts. The ureter was found running in the wall of the sac. There was no obstruction.

CASE VII (LEOPOLD¹).—Woman, age 33. Has observed a swelling of the abdomen for five years. The objective signs were those of an enormous ovarian cystoma. An operation was done to extirpate this, and, upon removal, the following condition was found. The cyst was “the size of a man’s head” and was found to be attached to the lower pole of a somewhat compressed right kidney. The kidney pelvis was quite intact, and the cyst nowhere communicated with it. The capsule of the kidney was continuous with that of the cyst. The content was bloody and contained much hematoidin. The origin of the cyst is held by Leopold to be doubtful.

If the present case be compared in its clinical features with the great majority of hypernephromata, it will be found to present certain peculiar characters of its own. Briefly, the hypernephromata, as a group, occur in middle life, they grow slowly, rarely, however, running for more than three years; their course may be marked by repeated attacks of sharp hæmaturia of brief duration; in most of the cases, metastases are a marked feature. Peculiar to the cyst-hypernephromata, as seen both in the case above described and in the other cases collated from the literature, are the clinical signs of a cystic, instead of a solid tumor of the abdomen; the prolonged period of growth,—in the case herein reported, over 40 years, if the first hæmaturia be counted, and five years during the second stage of growth; the character of the hæmaturias, which were very largely *on the presence or absence of hæmaturia*. In the the absence or very late occurrence of metastases; and the presence of pressure symptoms from the stomach, or other abdominal viscera, due to the large size of the cystic growth. This group of symptoms, if at all constant, would seem to afford a sufficiently characteristic syndrome. As regards the character of the urine, this is entirely determined by the anatomical relations of the tumor. It is a matter of great clinical importance, whether the cysts breaks into the pelvis of the kidney and forms one large cavity with it, which constantly discharges its contents into the ureter; or whether it intermittently discharges its contents into the ureter, a phenomenon characterized by an intermittent hæmaturia, as in the present case; or whether it causes lateral compression of

the ureter, with retention of the cyst contents as in Case II; or whether it remains permanently separated, causing no urinary symptoms whatever as in Case VII.

If, now, the diagnosis of these tumors be considered, it is evident that they must be grouped, in the first place, among the intra-abdominal cysts. Further differentiation depends very largely *on the presence or absence of hæmaturia*. In the latter cases, the differential diagnosis from ovarian and other forms of cysts must be made largely from the location, the relation to the colon, and the other criteria upon which reliance is generally placed. Cases of this type have been confused with ovarian cyst and paranephritic abscess. If puncture of the cyst be made, a procedure of a very questionable character, the nature of the cyst fluid, which is uniformly rich in cholesterin and blood pigment, might be allowed to weigh heavily in favor of the diagnosis of cyst hypernephroma. In the former group of cases, the presence of hæmaturia, combined with the cystoscopic findings, make it a very simple matter to identify the renal origin of the tumor. In this case, therefore, the differential diagnosis must concern itself with all other forms of cysts, or cyst-like dilatations, of the kidney or pelvis associated with hæmaturia. If certain salient characters of the cyst hypernephromata—their prolonged course, their comparatively benign character, the absence of colic, their characteristic content of cholesterin and blood—be kept in mind, this diagnosis will rarely present great difficulties.

First to be considered is renal tuberculosis. Ordinarily, this produces only slight enlargement of the organ, perhaps to double its size; in another set of cases, it gives rise to large cyst-like dilatations, which may simulate an abdominal cystic tumor. The latter condition is due to intermittent or permanent obstruction of the ureter, either by stricture, or by caseous masses, resulting in a tuberculous pyonephrosis. At the same time, renal tuberculosis may produce recurrent hæmaturia, with emaciation, and anæmia, and so imitate in the most striking fashion the hypernephric cysts. There are generally marked vesical symptoms, such as frequent urination, and

cystoscopic examination may then reveal ulcerations or other tuberculous lesions of the bladder. The presence of tubercle bacilli in the urine, the finding of other tuberculous lesions, especially in the genito-urinary tract, the positive tuberculin reaction, are all diagnostic aids which should, of course, be sought for in all doubtful cases.

Cancer and sarcoma of the kidney may, likewise, if associated with obstruction of the ureter, give rise to a cystic tumor of the abdomen combined with hæmaturia. This is certainly a comparatively rare condition, but has been repeatedly described. The pathological differentiation between carcinoma, and even sarcoma, and the suprarenal tumors, is a matter of such recent date, and even now frequently so difficult, that it is not unfair to doubt the actual nature of certain of the tumors grouped in the former category. The combination of malignant tumor in the kidney with ureteral obstruction by means of its growth, or by metastases, does, however, occur, and its differentiation from the tumors under consideration might offer certain difficulties. With the former class of tumors, the period of growth is, however, rarely so prolonged, and the cachexia generally far greater.

Calculi with partial or complete obstruction of the ureter may also give rise to recurrent hæmorrhages, and to large cystic tumors of the abdomen. The character of the urine, and the history of colic ought in these cases to render the diagnosis a matter of no great difficulty.

Tuberculosis of the ureter, new growths of the bladder obstructing the ureteral orifice, and other conditions which might simulate the symptoms of cystic hypernephromata are rare, and as a rule easily identified.

The indications for treatment are quite evident from the recital of the cases on record. The tumor is not very malignant. It is a source of danger, in the first place, as a cause of hæmorrhages and anæmia, and, in the second place, on account of the pressure symptoms which it induces in the neighboring viscera. Metastases occur, if at all, only late in the disease. Its removal is generally a simple matter and offers a radical

cure. This course should, therefore, be followed in every case in which the operation is not contraindicated by the age or condition of the patient. Drainage, or repeated tapping of the cyst should never be resorted to, as these measures are not only ineffectual, but have precipitated a fatal outcome in every case in which they have been employed.

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THE EXTENSION OF THE FIELD OF TREATMENT
OF CERTAIN RENAL AND VESICAL CONDITIONS
THAT IS MADE AVAILABLE BY A NEW CON-
TRIVANCE FOR LONG CONTINUED OR
PERMANENT DRAINAGE OF THE KID-
NEYS THROUGH RENAL FISTULA
IN THE LOIN.*

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If life could be made not only tolerable but comfortable for persons with long standing or permanent renal fistula, in what respects would this fact modify or enlarge the field of treatment of cases of renal and vesical disease?

In the writer's belief the following advantages would be derived: 1. Primarily we should be enabled to save a good many kidneys which we are now accustomed to sacrifice in order to spare the patients the distress arising from the presence of a renal fistula. Thereby we should at the same time, of course, avoid the dangers, whatever they may be, attending the performance of nephrectomy and such subsequent ones as are involved in the fact of having but one kidney.

Further than this we should be enabled to carry out certain new plans of treatment which have hitherto not been available because of the fear of creating a permanent and distressing fistula. With this end in view, the writer proposes the simultaneous performance of bilateral nephrostomy, tying off of both ureters at the same time and establishing permanent renal fistulæ, thus wholly diverting the entrance of all urine into the bladder, for the following purposes:

1. *As a palliative measure.*—(a) In cases of inoperable vesical tumor. (b) In cases of vesical tuberculosis originat-

* Read at the meeting of the American Gynecological Society and American Association of Genito-Urinary Surgeons, May 9, 1907.

ing in descending infection, in which both kidneys are involved in the tuberculous process and when the tuberculous lesions of the bladder are causing suffering. In the latter condition also there might be expected to be better results obtained from the local treatment of the vesical tuberculous lesions.

2. *As a step preliminary to the total extirpation of the bladder in certain cases of vesical tumor.*—This proposal was made by the writer at the Montreal meeting of this Association in 1905 and published in the December number of the ANNALS OF SURGERY of the same year. It is referred to again now merely to reaffirm the writer's position with regard to it, which has been strengthened with respect to one of its features by the practical experience of three cases in which he has simultaneously performed bilateral nephrostomy and which have supported his contention that shock was not an element to be dreaded from the performance of the operation upon the two kidneys at the same time. The proposal was as follows:

That instead of doing ureteral implantation in connection with partial resections or total extirpations of the bladder in cases of tumor of that organ, the procedure be wholly abandoned, and that simultaneously performed bilateral lumbar nephrostomy be substituted for it, and that it be done as a step preliminary to the removal of the bladder, the latter intervention being carried out afterwards at periods which will vary according to the conditions existing in each case. That this course be pursued in cases of carcinoma of the bladder in which *any* radical operation is proper to do, and to recurrent tumors following the removal of benign neoplasms, if there is any reason to believe the recurrent growth to be of malignant nature.

The success of these measures must depend in large degree upon the possibility of arranging the drainage from the kidneys after the lumbar nephrostomies in such manner as to be comfortable, and thus to be secure of avoiding the creation of a condition as intolerable in its way as that for the relief of which it was undertaken.

This object the writer believes he has attained by a very

simple contrivance which he has devised, whereby that feature of renal fistula which is the one which causes it to be such an infirmity, is entirely overcome. The greatest trials of renal fistula are the constant soaking of the clothing and dressings with urine, and the unpleasant odor which emanates from them. The contrivance designed by the writer keeps the patient perfectly dry, and can be worn without attracting attention and with entire comfort. It is composed as follows:

1. A hard rubber cup-shaped shield through which the tube that enters and drains the kidney is passed (fig. 1).

2. A light metal receptacle into which the urine is conveyed (fig. 2).

3. A rubber tube attached to the bottom of the receptacle by means of which the latter is emptied (fig. 2a).

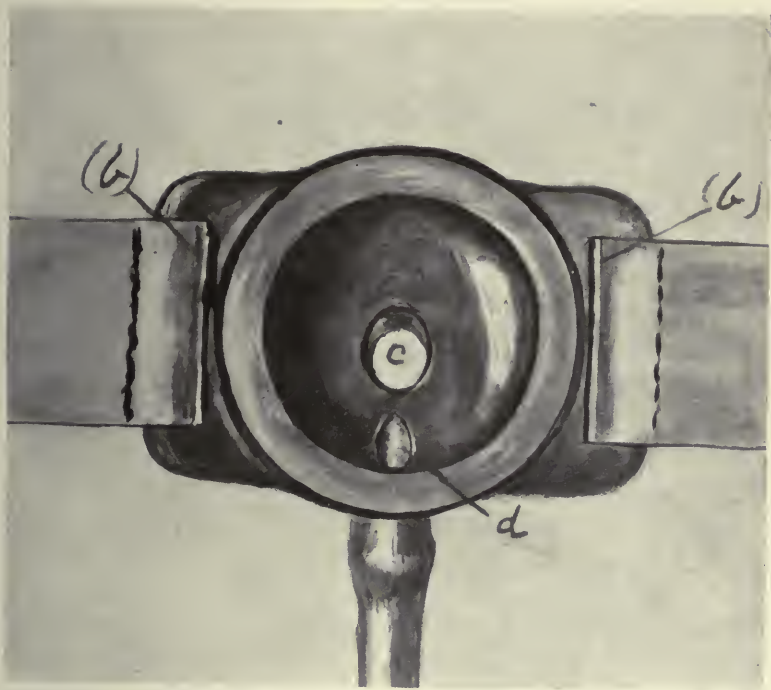
4. Two elastic bands or belts one inch in width which pass around the body and by which the shield and the receptacle for the urine are held in place (fig. 3, *a* and *b*).

1. *The Shield*.—The shield is made up of a circular, cup-shaped, central part, and two side wings. The former is perforated by two holes (fig. 1, *c* and *d*), one of them passing through its centre and having a downward slant in its course through the shield in order to avoid being obliged to give the kidney drainage tube a sharp bend and thus narrow it as it passes down to the receptacle. The second hole is just within the inner margin of the rim of the circular part of the shield and at the lowest point in the circumference when the shield is in place upon the surface of the back. The purpose of this hole is to drain the cup of the shield, which it does by the smaller of the two tubes which pass to the receptacle (fig. 4, *a*).

The cup of the shield catches whatever urine leaks around the outer sides of the kidney drainage tube, and this leakage is at once passed into the can in the manner already mentioned.

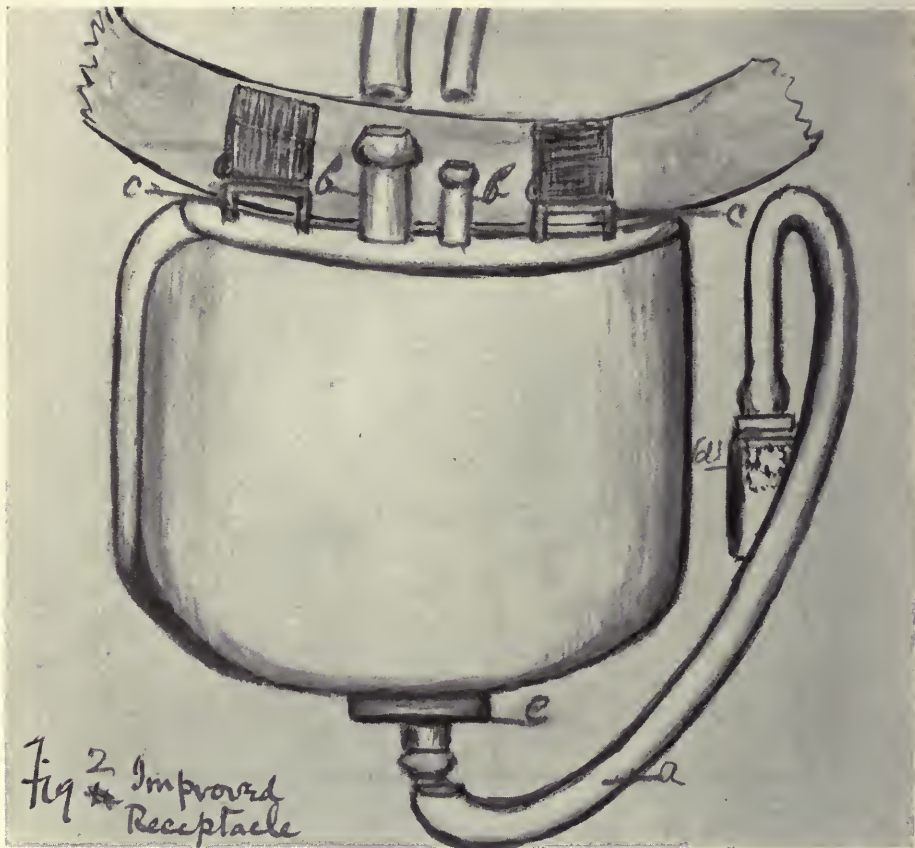
Elastic bands one inch in width are passed through the openings in the wings of the shield and are thus attached to it (fig. 1, *b* and *b*), and being passed around the body and buckled in front, form the belt by which the shield is constantly held close upon the surface of the loin.

FIG. 1.



The shield with the elastic bands attached and the tube which drains the shield.

FIG. 2.



Improved receptacle.

FIG. 3.



(a) and (b) are the elastic belts to keep shield and receptacle in place.

FIG. 4.



The shield-receptacle with their tubes and belts attached to them, and strapped to a board to show the individual parts of the apparatus. (a) tube which drains the cup of the shield.

The tube draining the kidney directly, and which passes through the hole in the centre of the shield, must be one or two sizes larger than the hole, in order that it shall bind firmly against the sides of it, and thus be prevented from changing its position to or fro, and pressing injuriously on the kidney on the one hand, or being withdrawn too far to efficiently drain it on the other.

The tube draining the cup is to be fitted over the end of the smaller of the two metal tubes which are placed in the middle of the upper surface of the receptacle, and in this way the junction between the cup of the shield and the receptacle is effected. The main drainage tube from the kidney is passed in the same way over the end of the larger metal tube of the receptacle, or if the drainage tube is too small to allow this to be done, it can be passed *into* the metal tube instead.

The calibre of the central hole in the shield is about 28 of the Charrière scale. If the kidney drainage tube is in any case so small that it will not bind in the hole, its calibre at that point can be sufficiently increased by passing over it a second bit of tubing just where it traverses the hole.

It is important to adjust the kidney drainage tube at the spot within the kidney at which its end drains the organ most effectively and at the same time causes the patient no discomfort. Once this has been determined, a mark should be made upon the catheter or drain just where it emerges from the outer side of the shield, in order that time shall not be wasted in re-adjusting the tube each time that it is introduced.

The tubes and all parts of the apparatus except the shield and the belts should be boiled in water once each day.

2. *The receptacle* (fig. 2).—The receptacle is a can made of German silver, curved to fit the upper part of the gluteal region and provided with the following things. Upon the middle of its upper end are two short metal tubes (fig. 2, *b* and *b*), upon the larger of which the main kidney drainage tube is attached. The smaller one receives the end of the tube which drains the cup of the shield. Two pieces of bent wire (fig. 2, *c* and *c*) set into the inner edge of the receptacle to

which the elastic belt is attached which keeps the can in place. A metal cap (fig. 2, *c*) in the middle of the bottom of the can which unscrews and allows it to be more readily cleaned.

3. *The tube for draining the receptacle* (fig. 2, *a*).—A tube, a foot and a half to two feet long, is attached to the screw cap in the bottom of the can and is led round to the front of the body, where it is tucked under the belt and its end brought over it and allowed to hang downward. The further end of this tube is provided with a hard rubber cap (fig. 4, *b*), one end of which has the form of a stem which slips into the rubber tube. In this stem is a hole (fig. 2, *d*). The hole is closed by the hard rubber cap when it is screwed home against the shoulder which is just behind the hole, while when the cap is screwed outward in the other direction, the hole is uncovered and allows the contents of the can to escape through it. The capacity of the can is about ten ounces, and consequently it does not require to be emptied more than two or three times daily. When it is desired to do this, the tube which drains the can is taken from beneath the belt in front and the hole just described at its end being opened, the can is evacuated of its contents. The hole is then closed and the tube replaced. By this contrivance the patient is spared the trouble of detaching any parts of the apparatus from each other during the entire day.

THE MANNER OF ARRANGING THE DRAINAGE AT NIGHT.

At night the can is detached and long tubes are substituted for the ones which drain the shield and the kidney. The two tubes are led to a bottle which is fastened to the side of the bed and the drainage is received by that during the night.

A semi-reclining position ensures better drainage than if the patient lies quite flat. The receptacle can be attached nearer or further away from the shield or can be carried slightly to one or the other side of it—corresponding changes being made in the length of the tubes—as the patient may find to be most convenient and comfortable. Fig 3 shows the apparatus in position with the tube which drains the can passed around the body to be placed under the belt in front. The

essentials of the receptacle are that it shall be light, fitted to the surface upon which it lies, its capacity sufficient to avoid the necessity of emptying it too often and of such a character that it can be readily cleaned. The shield is given a very slight curve in order that it may adapt itself more completely to the surface of the body, and thus insure the cup fitting tight and not leaking.

The object aimed at in this contrivance is to keep the patient dry, the failure to do this hitherto has been the one distressing feature of renal fistula. It is owing to this feature that individuals with renal fistula have been wholly disabled and practically isolated from their fellows because of the unpleasant odor arising from that source.

A receptacle is of course essential to the contrivance, but it may be varied almost indefinitely with respect to size, shape, and the place in which it is worn on the body and also as to the material of which it is made. The writer has one patient who wears for the receptacle, the usual form of rubber portable urinal bag attached to the thigh, and another who wears the metal can on the back. The advantage of the metal can is that it can be boiled as often and as long as one likes, has no odor; moreover it is easier to arrange the receiving and emptying tubes on a metal than on a rubber reservoir. The prime essential of the contrivance is the shield. It is that which keeps the patient dry and which keeps the tube in its proper place in the kidney where it will most efficiently drain the organ, and the essential features of the shield are its cup-shaped centre and the hole and tube which drain this cup. It is well to note the following things with regard to the shield:

In some cases there will be a furrow made by the cicatrizing of the wound through which the fistula passes and along the line of this furrow, the shield may fail to be held firmly against the surface and urine would then escape from the cup. The same may be true if the incision is made parallel with the lower border of the last rib, for the shield may then rest on one of its edges upon the surface over the rib and the other on the softer tissues. This fact together with the respiratory movements of the ribs might very likely displace it

enough to allow the urine to escape from the cup elsewhere than through the hole designed to drain it. Again some patients may find the pressure of the hard rubber rim of the cup uncomfortable. To obviate these difficulties, the rim of the cup may be made a little wider and a channel with overhanging edges cut in it, into which a ring or tube of soft rubber can be snapped and held by the undercut edges of the channel. The soft rubber will adapt itself to the irregularities of the surface, and may be advantageous in some instances. In case of the existence of a deep furrow in the line of the cicatrix which must be filled up to prevent the fluid from escaping from the cup, the rubber ring can be enlarged somewhat at that point in order to adapt itself to the surface. As a matter of fact, the skin of the immediately adjacent soft parts will usually bulge into such a depression when the shield is pressed hard against the surface and will fill it sufficiently to prevent leakage.

The writer has had this device in use with entire success in two instances. In one of them a little change in the adjustment and the size of the cup of the shield was required before it worked properly. The contrivance can be equally well applied, of course, to fistulous openings of transplanted ureters and other similar conditions connected with the different organs of the body, with which fistula is connected. This apparatus is made by Rodman and Shurtleff, 120 Boylston Street, Boston.

One word with regard to the advantages of nephrostomy as compared to ureteral implantation. The latter is open to the serious objection that it frequently invites renal infection because of contraction of the implanted orifice of the ureter or of the ureter itself at some point between the orifice and the renal pelvis, and, in case of intestinal implantation, because of its being a septic locality. The following tables show what the results of ureteral implantation were found to be in 94 cases. The operative mortality for the whole series was 41.4 per cent.; 23.4 per cent, was directly due to ureteral implantation. The conditions in which the implantations were done are as follows:

I

Vesical Tumors.	Cases.	Operative Deaths.	Causes of Death.	Later Deaths.
Suprapubicnot resections	11	0	.....	2. One to ureteral contraction I Not stated.
Partial resect.....	23	11	Ren. infect..... 3 Shock 4 Infilt. of urine.. 2 Peritonitis..... 2	
Total extirp.....	38	19	Ren. infect..... 10 Shock 9 Pneumonia 1	3. Ren. inf..... 2 Recurrence 1
Ureter cut in abdom. operations.....	22	9	Ren. infect..... 6	
	94	39		

Cases, 94 ; operative deaths, 39 or 41.4 per cent. Due to ureteral implantation, 22 or 23.4 per cent. mortality.

These cases in detail are as follows :

II

TOTAL EXTIRPATION OF THE BLADDER—38 CASES.

Treatment of Ureters.	Operative Recovered.	Operative Deaths.	Causes of Death.	Due to Ureteral Implantation.	Later Deaths and Causes of.
Abandoned in wound ...	2	2	Renal infect ... 1 Shock 1	1	
Sutured into intestine ...	5	10	Renal infect ... 5 Shock 4 No data 1	5	1 at 3½ months, renal infect. 1 at 14 months, no data.
Sutured to skin	3	1	Renal infect ... 1	1	1 at 13 months, renal infect. 1 at 6 months. Recurrence.
Sutured into vagina.....	3	2	Renal infect ... 1 Shock 1	1	
Sutured to urethra.....	1	4	Renal infect ... 2 Shock 2	2	
	14	19		19	10

Without data..... 5
 Total number 38
 Deaths due to ureteral implantation..... 10

OPERATORS REPORTING THE ABOVE CASES.

Bardenheuer.....	2	Viljaminow	1	Kayser	1
Pawlik	1	Berghem	1	Lund	1
Albarran	1	Mann	1	Mayo Robson	1
Modlinski.....	3	Verhoogen	1	Gopel	1
Kuster	1	Vaughan.....	1	Harris	1
Wassilief.....	1	Woolsey	1	Tuffier.....	1
McCosh	2	Schede	1	Lindner	1
Giordano	2	Turetta	1	Zeller	1
Chalot.....	1	Hogge	1	Garre	2
Kossinski.....	1	Krause	1	Wendel.....	1
Kummel.....	1				

III

PARTIAL RESECTIONS—23 CASES.

Treatment of Ureters.	Operative. Recoveries.	Operative. Deaths.	Causes of Death.	Due to Ureteral Implantation.
Implanted into bladder	12	9	Shock	4
			Renal infect.....	2
			Infiltration of urine.....	2
			Peritonitis	1
				9	4
Abandoned in the wound	0	2	Peritonitis.....	1
			Cellulitis	1
				2	5
	12	11		

Total, 23; deaths, 11. 47.8 per cent.

Deaths due to ureteral implantation, 5. 45.4 per cent. of deaths due to ureteral implantation.

	Cases.
Israel	2
Czerny	5
Albarran	2
Bardenheuer	2
Schuchard	1
Helferich	1
Giordano	1
Schilling	1
Verhoogen	1
Rafin	1
Rehn	1
Kuster	1
Mickulicz	2
Berg.....	1
Vincini.....	1
Total	23

Implantation into bladder, 21; abandoned in wound, 2.

III.

VESICAL TUMOR.

OPERATIONS OTHER THAN PARTIAL RESECTION OR
TOTAL EXTIRPATION.

Cases II. Deaths 0. Later 2.

Implantations into bladder 2. Later deaths 2. Due to ureteral implantation in one perhaps, not so in the other.

In 7 other cases there was an opportunity to test the patency of the ureter at various times subsequent to the operation. In one of these the ureter was apparently obliterated and the kidney was believed to have undergone atrophy. The patient was, however, in good health.

Operators in these cases were: Routier, Pernice, Krug (case observed 8 years after operation), Kalabin, Rafin, Wertheim, and Frantz (5 cases).

With direct drainage of the kidney through the loin, on the other hand, the objection which has been brought by the writer against ureteral implantation, does not hold good, provided the drainage is thorough and thoroughly maintained, if ordinarily good care be taken of it, and the fistula prevented from recontracting. There is moreover the further advantage that nephrostomy and free drainage of the kidney directly through the loin is by far the best treatment that can be applied to cases of infected kidneys with suppuration, and to many of hydronephrosis, for which ureteral implantation is ineffectual, and in some instances actually invites an increase sooner or later of the malady. Furthermore, in such conditions, ureteral implantation gives no opportunity to explore the interior of the kidney, remove calculi, or break down partitions separating abscess cavities and so on, which nephrostomy does afford. Finally the mortality attending incision and drainage of the kidney is, per se, very small. While the contrary as has been shown is true of ureteral implantation.

It will be remembered that in the series of cases given above in which that procedure was carried out, death was caused by it in 23.4 per cent.

It is difficult to get an exact idea of the mortality of nephrostomy as an operation and the same is true of ureteral implantation, because of the serious conditions under which or in connection with which the two procedures respectively are done. The nearest approach that can be made to determining the operative mortality of each is by a comparison of the results of Maydl's operation with those of nephrostomy when done in cases of non-infected kidneys. Of 42 cases of Maydl's procedure for ectopia, 9 ended fatally or 21.4 per cent. (3 of the deaths or 7.1 per cent. were directly due to ureteral implantation). In 143 cases of hydronephrosis there were but 5 deaths following nephrostomy or 3.4 per cent. In 77 nephrostomies reported by Albarran, done for various conditions, there were 3 deaths or 3.7 per cent. mortality.

UPON CERTAIN ASPECTS OF CALCULOUS ANURIA
WITH ESPECIAL REFERENCE TO THE PER-
FORMANCE OF BILATERAL NEPHROLITH-
OTOMY SIMULTANEOUSLY IN SOME
CASES OF THIS CONDITION.*

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IF in a case of calculous anuria one kidney is laid open and a stone is removed from it or from its ureter and it is then seen that that kidney's secreting substance has been wholly destroyed, it is clear that the operation will have merely added more or less shock to the already critical condition of the patient without having secured any compensating advantage whatsoever. Equally is it obvious that whatever there may have been of renal functional activity possessed by the individual before the occurrence of anuria, must have resided in the other kidney, and it is evident that the only hope of saving life under such circumstances lies in immediately cutting into that opposite kidney, since only by so doing can we set free its suppressed function, this suppression being the factor which will cause death if it is not overcome within a short time.

Now, if instead of being wholly destroyed, the kidney first operated upon was seen to be in greater or less degree diseased, the logical inference would be that in degree inverse to the extent of disease and functional incapability of this kidney, the other one would be found to be more or less free from disease and more or less functionally capable. In other words, the worse the condition of the first kidney, the better may we expect to find that of the other one, and vice versa.

It is as we all know, impossible to determine from the thickness or thinness of the layer of renal substance that such

* Read at the meeting of the American Gynecological Society and the American Association of Genito-Urinary Surgeons, May 9, 1907.

kidneys are seen to possess at the time of operation, just what amount of functional activity may be left to them, but we can give a pretty good guess at it, and if in our judgment, it is very doubtful if the first kidney opened has enough sound secreting substance to enable it alone to sustain life, we should, in the writer's belief, at once operate upon the other kidney. In so doing, we may, it is true, fail to save the patient's life, but we shall have given him his best and often his only chance of life by putting in commission again all the available functionally active renal substances that he possesses.

If on the contrary, the first kidney has a goodly amount of renal substance which is apparently free from disease, the indication *not* to operate upon the second kidney would be equally clear, since the better the condition of the first one, the less likely will it be that there is any functional value in the second one, and correspondingly the less the advantage to be gained from operating upon it.

The above propositions appear to be simple and logical, and so obviously true, that it would scarcely seem worth while to present them, were it not for the fact, so far as the writer can learn, that he is the only surgeon who has acted upon them.

The question which arises when considering these propositions is how often, if at all, are the conditions just stated likely to be encountered.

In calculous anuria, apart from those instances in which the condition is brought about by anomalies of the kidneys or ureters, one of the three following things is generally stated to be the causal factor: (1) The simultaneous blocking of both ureters by calculi of both sides. (2) The blocking of one ureter, the other kidney being absent. (3) The blocking of one ureter, the other kidney being so far diseased or destroyed as to be functionally useless.

The suppression of the function of a normal kidney with an unobstructed ureter, by reflex influence, originating in the blocking of the ureter of its fellow organ on the other side, is denied by many observers. In parenthesis it may be said that there are very few cases in which the occurrence of this phe-

OPERATIONS DONE IN CASES OF BILATERAL CALCULUS.

Operations.	Cases.	Nature of Operations.	Results.	Remarks
Chevalier	1	Unilateral nephrotomy	R	Anuria of 14 days preceded operation.
Championnier	1	Unilateral nephrolithotomy	R	Same for 13 days.
Deaver	1	Nephrolithotomy on one kidney. 18 days later nephrectomy on same kidney, 9 months later nephrolithotomy on other kidney.	R	
Deansley	3	(1) Nephrolithotomy on one kidney. 2 week later same on other kidney. (2) Unilateral nephrolithot. No operation on other kidney. (3) The same.	R R R	
Desnos	1	Unilateral nephrolithot.	R	Anuria 12 days preceding operation.
Duret	1	Unilateral nephrolithot.	R	Same 10 days.
Delbet	1	Unilateral nephrolithot. Second kidney same one year later.	R	Hydronephrosis of first—pyonephrosis of second.
Kummel	16	5 with anuria—Unilateral nephrolithotomy. 11 without anuria, same operation with second kidney done after an interval in each case.	3 D 2 R 9 R 4 D	
Grohe	1	Unilateral nephrolith on one kidney and same on other after 15 days.	R	
Mixter	1	Same—second kidney done six months later.	R	
Tuffier	1	Same and later, at two intervals, same on second kidney.	R	
Verdi	1	Same. Calculus passed. Spontaneously from other.	R	
Watson	2	Simultaneous bilateral nephrolithotomy in both.	1 D 1 R	Anuria in fatal case See illustrative cases.
Young	1	Unilateral nephrolithot.	1 D	See illustrative cases.

Total 32, Deaths 9=27.9 per cent.

nomenon has been demonstrated. Four cases at least are well authenticated however.

But comparatively little mention is made of the not very common, but still very important cases, in which the suppression of the function of the unobstructed kidney takes place because of the calculous obstruction of its fellow when the unobstructed organ is in varying degrees diseased or disabled in its functional capability, but not wholly destroyed, possessing a lessened but by no means unimportant functional power could it be set free.

With regard to the frequency of bilateral calculus, we have realized since the use of X-ray photography that these cases are much more frequent than had previously been supposed. They may be estimated at 30 per cent. of the total number of cases of renal calculus. This estimate is based upon the reports of 231 cases of renal calculus made by Albarran, Legueu, Morris, Kummel, and Kraft. The first two place the number as high as 50 per cent., Morris as low as 10 per cent., but the average in the 231 cases referred to was 30 per cent.

Now if we put together all the cases of bilateral calculus, those in which the unobstructed kidney when it is more or less diseased and has had its function suppressed by reflex influence, but in which it is by no means incapable, and the small contingent in which the surgeon may have operated by mistake upon the most damaged of the two organs instead of the least injured one, there is a considerable number in which, if the operator rests content with having laid open one kidney, he will not have liberated all the functionally capable renal substance which is possessed by the individual, all of which he assuredly needs. In such circumstances, the writer believes, the second kidney should at once be laid open if the patient's condition makes it proper to do so.

Before the operation, in cases of bilateral calculus with anuria, the surgeon can never be entirely confident which of the two organs is the more seriously damaged, unless he has had the aid of an X-ray picture taken by an expert in photography of renal calculi or unless the functional capability of each

kidney has been established by means of the ureteral catheter, before the advent of anuria, or after anuria has occurred by detecting by the same means a calculus in both ureters.

In practice we shall frequently be deprived of the aid of these procedures, for the condition is one of the most serious of surgical emergencies and when the surgeon is called in, no time can be lost in making such examinations, even if an expert X-ray photographer should be available, which is frequently not the case. The cases in which the ureteral catheter will render valuable service are also few.

In most instances we shall have to depend on the physical examination and the history of the case alone, and the chances of being misled, more particularly in cases of bilateral calculus, are considerable, because of the absence of characteristic evidence, which, were it present, would enable us to determine whether calculus exists on one or both sides, and if on both, which of the two kidneys has received the least damage.

In the unilateral cases also there will always be a certain number in which the operator must be in doubt whether the first kidney operated upon will alone be capable of sustaining life after having been freed of its obstruction. The ones in which the greatest uncertainty is likely to arise are the non-infected hydronephroses which have but a small amount of good secreting substance left in them, for we all know how long such apparently inadequate amounts of renal substance are nevertheless capable of doing enough work to keep patients alive and in reasonably good condition. With the infected renal retentions of calculus origin the operator will feel less doubt as to the functional incapability of the organ, for a well-marked infection will render unfit for service what appears to the eye to be a considerable amount of renal substance, while on the other hand what seems to be an entirely inadequate quantity will sometimes, if not infected, be capable of sustaining life. In the infected cases therefore there should be less hesitation, when the operator is in doubt, in cutting into the second kidney at once than in the non-infected ones.

A study of the cases of unilateral renal calculus with

anuria shows that in the larger number of them the organ of the opposite side is either absent or totally destroyed functionally. In the minority—but an important minority—there is more or less disease or destruction of the secreting substance of the unobstructed kidney, but enough of it is left intact to contribute importantly to the sum total of renal activity, if its function were reëstablished.

In a few instances the unobstructed kidney has been normal. There are at least four such cases authentically reported. The reflex suppression of a normal kidney has been denied by a number of observers and affirmed by others.

That the sudden obstruction of the ureter of one kidney produces total suppression of the function of its fellow organ when the latter is extensively injured or diseased, is an unquestioned fact, and though less well recognized it is also true when the disease in that kidney is but moderate or very little. That this should not happen more often in cases of calculous anuria is rather surprising when it is remembered that the same thing takes place in the remaining kidney after nephrectomy, if that kidney is more or less diseased, and that urinary suppression occurs as the result of operations upon other parts of the urinary tract or elsewhere in the body, even in some cases when the operations have been trivial in character.

Just what the number of cases may be in which the condition of the first kidney operated upon will be found to be so diseased as to make it proper to lay open the second one on the chance of freeing an additional amount of functionally active renal substance sufficient to contribute importantly to the chance of saving the patient, it is impossible to say. The point which the writer wishes to establish is merely that the probability of being able to do this by cutting into the second kidney should be judged largely by the amount and condition of the renal tissue found in the first one laid open, and whenever it is seen to be but very small in amount or if it is seriously infected and suppurating, even though it be somewhat more in actual quantity, that the surgeon should then give the patient whatever chance of benefit may be derived from

cutting into the second kidney at once, unless, of course, previous examinations with the ureteral catheter have already demonstrated the absence or total destruction of the kidney on the other side.

In conclusion the writer would also urge the performance of bilateral nephrostomy at one sitting in cases of bilateral renal calculus without anuria, as well as in those with it, except the patient's condition be such as to make the longer time required for opening the two kidneys an obviously improper danger to which to submit him.

So far as the writer is aware this procedure has been done only by himself. (The case is one of those described at the end of the communication. The patient made an uneventful recovery.) In Wagner's contribution to the *Handbuch der Urologie* of Frisch and Zuckerkandl, he says that the calculus should be removed from the second kidney always, then, underlining the words, he adds, *but never at one sitting*.

On what principle this advice is given and why this custom has invariably been followed with the one exception mentioned, the writer is at a loss to understand. It is not based upon actual experience of bad results obtained from having done the operations simultaneously upon the two kidneys, since the writer's case which has not been published is the only one, and as has been said, the patient made an uneventful recovery.

The only objection to the procedure that could reasonably be made is that shock might be too great if both the kidneys should be operated upon in one sitting. This objection has not been sustained in the three cases in which the writer has operated upon the two kidneys at one time for three somewhat dissimilar conditions, nor is it borne out by such experiences as we have of the bilateral simultaneously performed renal operations, such as nephropexy and decapsulation (sometimes with nephrotomy added to it.)

On the other hand in these bilateral cases without anuria there is *every reason for removing* the calculi from both kidneys at the same time, for why should suppuration—even in

cases in which there is but an insignificant amount of functionally capable renal substance present in one or another of the organs—be allowed to be perpetuated by the presence of a calculus, and why should either kidney, if functionally capable substance is present in it, be subjected to the destructive influence of a calculus any longer than need be. For which reasons the stones, unless of insignificant size in one of the kidneys should be removed at the same time from both organs in cases of bilateral calculus with or without anuria under the conditions named.

Appended is the report of some cases which have direct bearing upon the subject of this communication, and also a table of cases of bilateral calculus in which operations were performed—with two exceptions—upon the two kidneys at different times with an interval between the operations.

CASE I.—A multipara, aged thirty-five years. Hematuria and pyuria had been present for about three weeks before her entrance into the hospital, and were accompanied by marked vesical tenesmus and frequent micturition. There was also at that time a good deal of phosphatic sand in the urine. Up to that time she had never passed renal calculi nor had any kidney pain.

The general condition was good and there was little or no fever. The urine contained a nearly normal quantity of solids, the sediment was large. It consisted of pus, a moderate amount of blood, a good deal of thick stringy mucus, vesical epithelium, a large amount of crystals of triple phosphates and phosphatic sand. The urine was ammoniacal.

No tenderness or enlargement of either kidney. Appetite good; no constitutional disturbance.

Cystoscope showed what was believed to be a partly necrotic papilloma of the bladder, with long villi floating far out from the vesical wall.

The hematuria became much less after the patient had been in bed for a few days.

Operation.—*Suprapubic cystotomy.* A large mass was found occupying the interior of the bladder and attached to the lateral wall (a little external to the orifice of the right ureter) by a pedicle about as thick as the thumb.

The pedicle of the supposed tumor was divided with the writer's galvano cautery scissors, a margin of the surrounding tissue being included in so doing, and the mass was removed. On examination it proved to be the entire inner lining of the bladder which had undergone necrosis and had involved a part of the muscular structure of the organ, so that it was partly detached from the surrounding tissue and gave the impression of the pedicle of a new growth.

The bladder was drained and the incision healed slowly by granulation. The recovery was uneventful.

The patient remained well until about six months before her second entrance to the hospital. She then for the first time began to have more or less pain in both kidneys and hematuria reappeared. She also had oliguria occasionally.

For three days before entering the hospital very little urine was passed, and for the last twenty-four hours there was complete anuria. Uremic symptoms began to be manifested on the day before her admission and were progressive.

Temperature 102° to 103° F. Pulse rapid. Tongue coated. Bowels constipated. Occasional vomiting. Intellect clouded. Moderate distension of abdomen and slight spasm of the muscles of the right side. Some tenderness in both flanks. Twitching of muscles of hands and forearms. General condition critical.

Operation.—Third day of anuria, thirty-six hours after beginning of uremia. The patient was placed upon the abdomen across the inclined planes made by the Cunningham "Kidney operating table." The right kidney was first exposed in the loin; it was found to be buried in a mass of connective tissue and was universally adherent. In separating it from this mass at the upper part of the organ, a large perinephritic abscess, communicating with the interior of the pyonephrotic kidney, was opened. In the pus which escaped were several fragments of phosphatic stone. The kidney was laid open parallel with and a little posterior to its convex border.

The kidney was pyonephrotic and its secreting substance extensively destroyed. Enough of it, however, remained intact, it was thought, to be in some measure functionally capable. A perforation near the upper pole communicated with the perinephritic abscess. A large calculus lay in the pelvis and sent

branches into the dilated calyces. A part of the calculus only could be removed.

While the writer's colleague, Dr. Blake, cleansed the operative field, sutured the wound in part, and arranged drainage, the writer laid open the second kidney and removed broken bits of calculus from it. The conditions on this side were similar to those upon the other; there was, if anything, a little less secreting substance in the kidney, and the stone was smaller. The calculi occluded the outlet of the renal pelvis of each kidney. The wound and drainage were arranged as on the other side. The operations occupied twenty-five minutes altogether.

Both kidneys began to secrete within three hours after the operations, the first one operated upon, abundantly, the second one not so much. On the following morning the patient felt decidedly better and the uremic symptoms had almost entirely ceased. This improvement was maintained for twenty-four hours. Uremia was then once more noticeable, and she died on the third day.

Shock played no part in causing death. No autopsy.

CASE 2.—A man of thirty-five years of age, in good general condition, who had had for a good while more or less characteristic evidence of renal calculus on the right side, and for the past year suggestive signs of it on the left as well.

X-ray pictures showed clearly a calculus in the right kidney and gave a doubtful shadow in the left one.

Operation.—By mistake the first kidney operated upon was the one in which the doubtful shadow of the X-ray photograph had appeared. It was laid open after being exposed by the usual incision in the loin. Exploration of the interior of the kidney failed to discover a calculus. The renal and outer incisions were both closed tight by suture, without drainage. The other kidney was then laid open and a calculus about the size of a chestnut was removed from one of the calyces. The kidney was but slightly infected. The calculus had a smooth surface. A drainage tube was placed in the kidney and the renal incision was closed around it. The outer wound was closed except for a space sufficient to allow the passage of the tube. Drainage maintained for two days. Wound closed in a short time. The incision on the other side healed per primam. Recovery uneventful.

CASES 3, 4, and 5.—These were all of them cases of bilateral renal infection with extensive suppuration.

The surgical intervention in the first of them was a simultaneously performed bilateral nephrostomy. Drainage of both kidneys. This patient made a good recovery without persistence of fistula.

In the other two cases unilateral nephrotomy only was done. Both patients died. Both had abscess of the other kidney. One of them would probably have lived had the second kidney been opened.

A NEW COMBINED LITHOTRITE WITH CYSTOSCOPE.

BY GEORGE WALKER, M.D.,

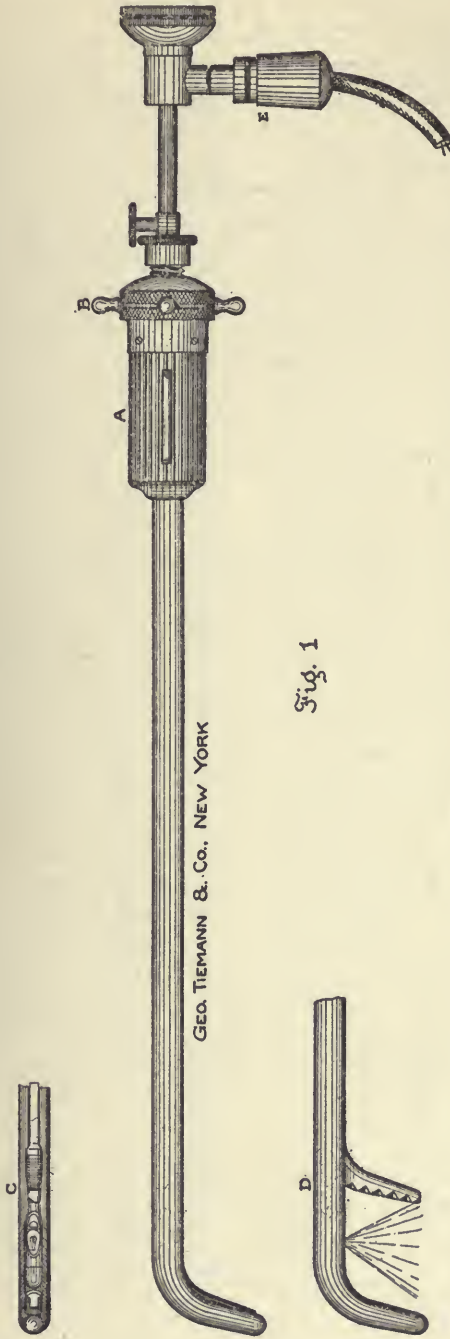
OF BALTIMORE,

Associate in Surgery, Johns Hopkins University.

THERE are three instruments of this kind on the market, those of Nitze, Bierhoff, and Casper, but all of them have the great disadvantage that one blade of the lithotrite is interposed between the prism and object to be seen. Moreover, owing to the mode of their mechanical construction, they are necessarily too weak to crush any stone that is not very soft and relatively quite small. These two disadvantages are so great that they render the instruments of very little practical value.

In the accompanying cuts I have shown an improved instrument so arranged that one looks directly between the jaws. It is constructed sufficiently strong to stand the strain of 175 pounds, which is amply sufficient to crush any stone except those of the hard oxalate type.

Description of the Instrument.—Figure 1 shows the complete instrument closed; (C) is a section looking directly between the open jaws on to the surface of the prism end of the cystoscope; (D) shows the jaws open (side view). The instrument (fig. 2) consists of a female blade (A) carrying a handle (ab); a male blade (B) carrying a screw (g); two attachments (e) for the cystoscope and (f) for the evacuator; a cystoscope (C) and a steel rod (D). The female blade, exclusive of the handle, is 9½ inches in length; in the straight portion it has a calibre of no. 25 French and in the curved of no. 26 French. It, as well as the other blade, is made of the very best quality of steel, highly tempered. The handle consists of two parts, a fixed (a) and a revolving part (b); (a) is firmly fixed to the blade, its surface is corrugated and it has two lateral flanges which prevent it turning in the hand; (b) the revolving cap is attached to the fixed portion by means of a ridge and a groove. It is provided



with four metal pins on its surface, so as to afford a better hold. This cap is adjusted, by means of a screw thread, to the end of the male blade (*g*), a device that readily provides for the opening and closing of the jaws. The female blade and handle, except the revolving cap, are provided with an open slot, into which the ridge on the male blade fits. The distal end of the female blade is perforated so as to allow the fragments to pass through and to permit the end of the cystoscope to project when necessary. The male blade is a steel tube reinforced on the under surface by a ridge which fits into the slot of the female blade and prevents it from turning. On the proximal end of the male blade there is a cylindrical screw (*g*) on which the outer portion of the handle (the revolving cap of the female blade) turns. On the end of this screw two attachments can be fitted: One (*e*), for holding the cystoscope in place, and the other (*f*) for connecting the evacuator. The cystoscope (fig. 2, C) has a calibre of no. 15 French; it is made with a small convex prism and the lamp is turned around so as to be placed very near the prism. The attachment for the cord at the outer end is placed on the same side as the prism and lamp and not on the opposite side, as has heretofore been the custom. The electric connection is made or broken by turning the guttapercha end of the cord (fig. 1, E). The cap for holding the cystoscope is of the usual type. The attachment for the evacuating apparatus is made after the pattern of the end of the ordinary evacuating tubes, but so modified that it screws on the end of the male blade. The steel rod (fig. 2, D) is the same calibre as the cystoscope; it is one-half an inch longer and has a small flat handle on the proximal end. This is intended to pass through the instrument and clear it of any fragments which might have become lodged in the tubal portion. The instrument with the evacuator attached is shown in fig. 3. This principle has been used for a number of years in the Chismore instrument. It is not, therefore, illustrated as anything new, but simply to show its adaptation to my instrument.

Mode of Using.—The bladder is thoroughly irrigated until the returning fluid is entirely clear, 150 cc. of clear sterile water being finally left in. The instrument, adjusted as shown in fig. 1, is then introduced; the jaws are opened by

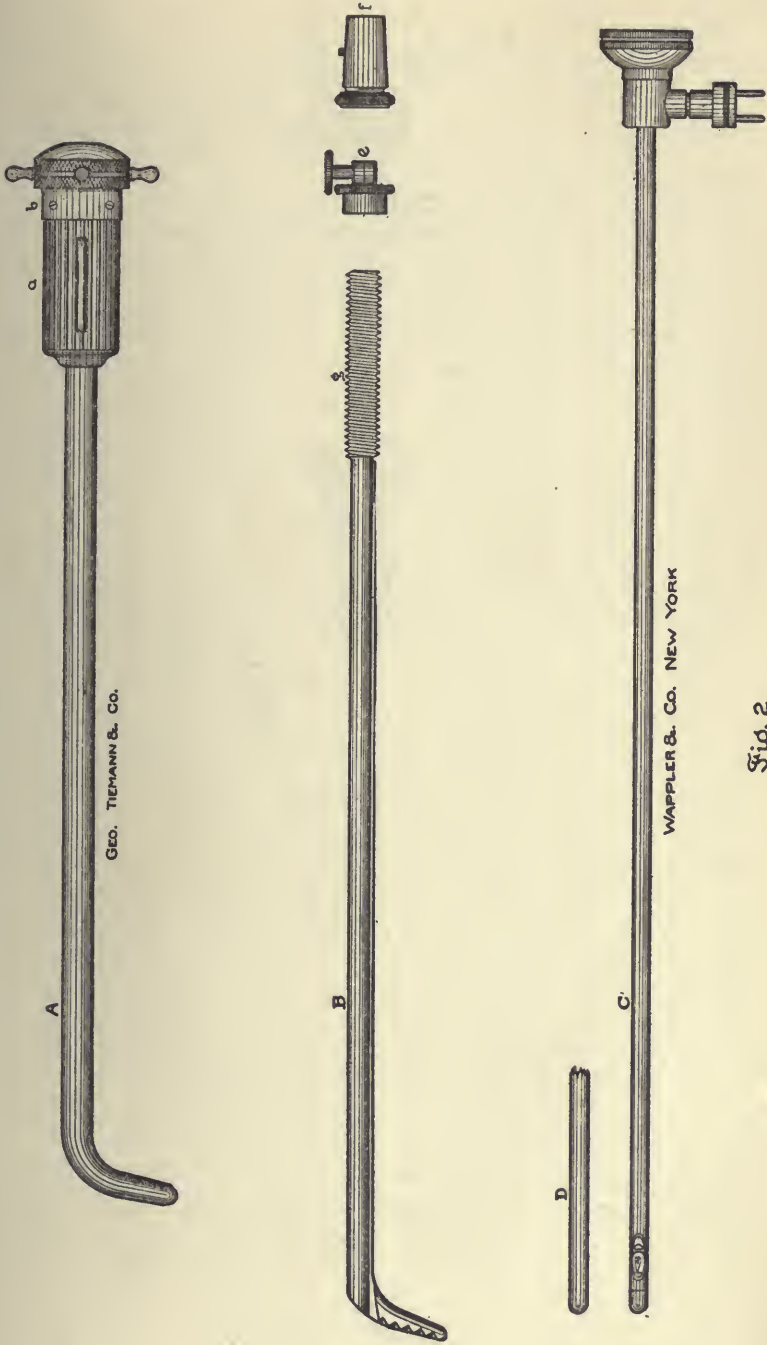


Fig. 2

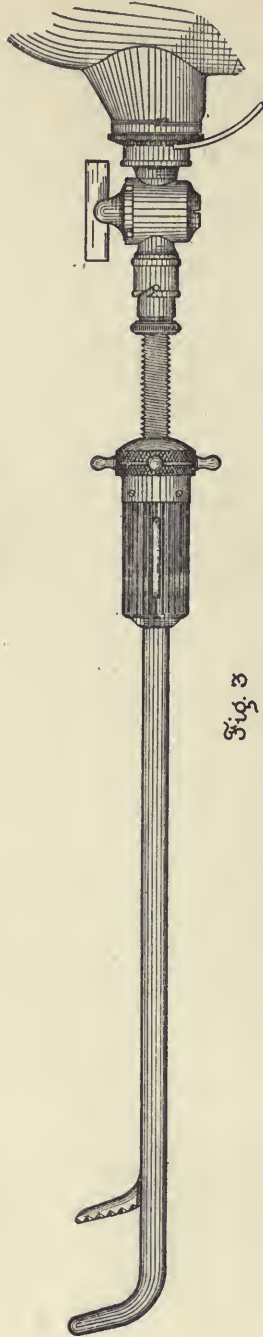


Fig. 3

turning the screw from right to left; the cystoscope is adjusted in such a way that the line of vision is between the open blades. The stone is then located and the male blade, which can be seen, is placed squarely in front of it, and the jaws are closed by turning the screw. Before the jaws are entirely closed the cystoscope is turned so that the prism surface will be protected. In some instances it is better to pull the cystoscope well back into the male blade so that it cannot be injured by the stone. After the primary crushing the larger fragments are sought for and broken. If during the crushing some fragments are forced into the tubal portion of the male or female blade, the cystoscope is removed and the steel rod passed through so as to clear the canal; after which the cystoscope is reintroduced. When the crushing is finished the cystoscope is removed and the evacuator attached (fig. 3). After this, the lithotrite is turned around so that the convex surface rests on the floor of the bladder and the beak projects upward into the cavity. The jaws are separated from $\frac{3}{4}$ to 1 inch, and the fragments are washed out in the usual manner. If there is any doubt as to the completeness of the operation the bladder is again filled with water and the cystoscope reintroduced. In filling the bladder it is better to raise the outer end of the instrument so that the water will not run out; if it, however, tends to do so, the end of the finger may be held over the opening. As the cystoscope is introduced, if there is much vesical contraction some fluid will escape, but the amount will be insignificant and the deficiency can be easily provided for beforehand by injecting a little more than is necessary for proper distention. If the operation is done under cocaine and the vesical contraction is violent some leaking will occur during the whole operation, but if the bladder is quiet the amount is reduced to a minimum and is not troublesome.

The object of this instrument is not to supplant suprapubic section or the use of the ordinary lithotrite, except in certain cases. It is intended to be used not for large or hard stones, but for small ones of the soft variety.

NOTE.—After having completed my instrument, I found in an old catalogue a cut of Casper's lithotrite, which formed a part of his operating set. It was impossible to get a very correct idea, but the instrument appeared to be constructed out of two tubes, one passing into the other and each carrying jaws on their distal ends. The cystoscope, which is straight, passes entirely through so that one blade is between the prism and the object. I have tried to find a better illustration and have applied to two of the largest instrument makers in New York, but they could tell me nothing about it.

I beg to thank Mr. R. Wappler for valuable suggestions in the adaptation of the cystoscope to the instrument and Mr. L. G. Pfarre for suggestions in the construction of the lithotrite.



Jacobson's Telephonic Searcher.

A TELEPHONIC SEARCHER FOR USE IN THE BLADDER.

BY ARTHUR C. JACOBSON, M.D.,

OF BROOKLYN.

The accompanying illustration shows a Thompson searcher attached to the front of a telephone transmitter through the medium of a plug joint. The transmission to the ear of sounds produced by contact of the end of the searcher with stones or other objects is actually microphonic. So delicate is this lithophone that the character of varying surfaces may be nicely differentiated by lightly rubbing the end of the searcher over them. The tapping of hard objects produces sounds so loud as to be almost unpleasant to the ear.

The searcher is introduced in the usual way, after which the transmitter is connected with it.

No stone, however small, will fail of detection if touched by the searcher, however lightly. Much may also be inferred regarding the constitution of a stone from its smoothness or roughness, hardness or softness, as determined by the sounds elicited.

In the diagnosis of stone probably no one will take issue with Agnew's dictum regarding the greater trustworthiness of the sense of hearing as compared with the sense of touch.

One dry cell operates the apparatus.

The midget receiver and watch-case transmitter made by the Schmidt-Wilckes Electric Company, of New York City, have been employed because of their small size.

NOTE.—This apparatus may, if desired, be used in conjunction with the lithotrite.

**"GAUZE-ETHER," OR A MODIFIED DROP METHOD,
WITH ITS EFFECT ON ACETONURIA.**

BY W. E. LADD, M.D., AND GEO. OSGOOD, M.D.,
OF BOSTON, MASS.,
House Surgeons in the Boston City Hospital.

OUR intention in this paper is to describe in some detail the method of etherization introduced by us into the Boston City Hospital, to point out its advantages, and to consider especially its effect on post-operative acetoneuria.

The method of etherization employed by us is as follows: A square pad of gauze twelve layers thick, and sufficiently large to cover the patient's mouth and nose, extending well down over his cheeks, is laid directly on the patient's face. Ether is then dropped on this gauze by means of a drop bottle consisting simply of an ordinary bottle with a small wick inserted through a slit in the cork. Ether having been dropped slowly for about one minute on this pad of gauze described above, another similar pad is laid on the first, and the rapidity of the drops is increased and continued until the patient becomes thoroughly anesthetized. It is very important that the ether should be gradually administered in this way, and not poured on in large quantities at a time, which not only hampers the etherizer in getting the patient narcotized, but also is inconvenient on account of the possibility of causing ether burns on the face, respiratory spasm, or at least coughing. When, however, the ether is administered as directed, the strength of the vapor is so gradually increased that the respiratory tract becomes accustomed to it without any sense of suffocation on the part of the patient. With this lack of sense of suffocation, and no incentive to struggle, we find that the stage of excitement referred to in all text-books on anesthesia, and seen usually with other methods, is as a rule not recognizable; and that there is no necessity of having an assistant to restrain the patient while he is taking the ether.

The question is now naturally asked, "How long does it take to produce complete surgical anæsthesia by this method?" In answer we would say that the average time is about five minutes. In our series of 102 cases, the average time was four minutes and twenty-nine seconds. The shortest time was one minute and a half, and the longest ten minutes.

Next, how much ether does it require? Of course, the amount of ether necessary to produce and maintain anæsthesia, with this as with other methods, varies according to the patient. In our series the average amount required to produce and maintain anæsthesia was seven ounces per hour. In one case on which a gastro-enterostomy and cholecystotomy was done, the duration of the operation being one hour, only one and one-half ounces of ether were used during the whole time. The above facts show conclusively that in this way complete narcosis can be quickly produced and maintained with a small amount of ether.

Now, let us consider the objections which have been raised to this method:

First, it has been suggested that the ether being dropped on gauze placed so close to the patient's face must chill the respiratory tract, and be a causative factor in producing bronchitis or pneumonia. At first thought it seems as though this idea might be well founded and true. But if anybody using this method properly, by which we mean using it as a drop method, and not pouring on large quantities of ether at a time, will take the trouble to place his finger between the patient's mouth and the gauze, he will find that it is not only not cold, but that it is far warmer than when placed inside any metal cone.

This observation led us to believe that for one reason at least, bronchitis was less apt to occur, and on investigating the subject we found this was in point of fact true. Dr. Ladd made three visits at different times to every patient on the service on which he worked. He found on the three visits, two cases with bronchitis, one of which had it before etherization, and with whom it persisted afterward and was of considerable

severity. The other was very slight, and cleared up in two or three days. Dr. Osgood, on the service on which he worked, found one case of ether pneumonia which had not been etherized by him, or by the gauze method, but by a house-officer of considerable experience in anæsthesia and with a Blake cone.

Now, with regard to etherizing alcoholics by this method. We have been fortunate in having some patients who had to be anæsthetized twice. The first time with the cone they were etherized with great difficulty, whereas on the second, with the gauze they were narcotized far more easily. This, with the fact that the alcoholic patients as a rule cause us less difficulty with the gauze than with the cone, leads us to the belief that the gauze method is particularly suited to that type of patient.

The other objections which have been raised are the likelihood of ether burns on the face, or ether conjunctivitis. To this we consider it sufficient to state that no patient etherized by the writers has ever had either of these sequelæ.

If we consider the ideal etherization that in which there is the greatest amount of fresh air with the minimum volume per cent. of ether necessary to produce anæsthesia, we must of necessity regard any closed, or semi-closed method as directly antagonistic to the first principles of etherization, for thus we do our utmost to exclude oxygen.

Having seen that the objections offered against the method do not exist when it is intelligently applied, let us consider whether it has advantages sufficient to recommend its more general adoption. First and foremost we believe that the comfort and the feelings of the patient should always be considered. We have been fortunate enough to have had several patients who had previously been etherized by the cone or other methods. Every one of them expressed a preference for the gauze method.

Next, with this method the usual absence of the stage of excitement and struggling must be beneficial to the patient's general welfare. The time required to produce anæsthesia in this way being less than by any other method of etherization with the exception of the gas-ether sequence, is of course of

value for the convenience of the operator and also beneficial for the patient.

The difference in the patient's recovery is very marked. So rapidly do they come out of ether that by the time the dressing is applied and the patient taken to the recovery ward, he is frequently able to assist himself from the truck to the bed, and even to answer questions rationally before being removed from the operating table.

With regard to vomiting: We were unfortunately not able to observe all the cases, but 52 out of 77 patients whom we did see, did not vomit at all, 19 vomited once or twice, and 6 presented the usual distressing degree of vomiting following etherization in other ways.

In other words, $67\frac{1}{2}$ per cent. of the patients did not vomit at all, and of the $32\frac{1}{2}$ per cent. who did, only 8 per cent. exhibited marked and distressing vomiting.

We have also compared the effect of the gauze method with that of the cone in producing post-operative acetoneuria, making observations in 222 cases in which there was no acetone before operation.

It has been generally considered that, barring organic disease or idiosyncrasy of the patient, ether alone does not produce any lasting unfavorable effect; Grevin, however, has shown that there is enough disturbance in metabolism in almost every case of anæsthesia to cause a marked acetone reaction in the urine.

Of the several tests for acetone, the following proved to be the most practical and satisfactory:

To one-quarter test tube of urine add a few drops of a saturated solution of sodium nitro-prussiate. Then add a few drops of glacial acetic acid and shake thoroughly. Now pour down the side of the tube 2 c.c. of ammonium hydrate. If acetone be present, there will appear at the line of contact, a crimson red zone which gradually changes to deeper red, and if much acetone be present, becomes diffused throughout the fluid, being at first more intense and fading later. Sometimes the colored zone does not appear for several minutes.

This test detects 8 mll. of acetone in the twenty-four hour amount of urine.

With this test we first examined the urines of 120 patients etherized with the cone or semi-open method, following a few of them as long as four days after the operation. All these patients were etherized with the Blake cone, no gas being used and the duration of the etherization varying from fifteen minutes to two hours and a half.

Of these 120 cases, 106 showed varying amounts of acetone, the intensity of the reaction in many cases being in direct proportion to the duration of the etherization. Out of the 14 cases not giving the reaction for acetone, there were but 5 where the administration of the anæsthetic exceeded twenty minutes, and only one where etherization was continued for one hour.

In every case here recorded the acetonuria developed before the eighteenth hour after operation. Of 10 cases where the first urine was voided within six hours after etherization, 9 showed acetone. The other case had acetone in the urine at the end of eighteen hours.

As to the time of the disappearance of acetone from the urine we can only say that we have found it in a number of cases up to the fifth day.

That acetone may be due to a restricted diet before or after operation is possible, and with this idea in view we examined the urine of four patients etherized on a full stomach with the cone. All 4 cases showed acetonuria. This, together with the definite relation between the length of etherization and the intensity of the reaction, shows that the sole cause of acetone in these post-operative urines, cannot be the restricted diet before and after operation,—furthermore, three of these patients had compound fractures and were on house diet twenty-four hours after operation, although acetone continued in the urine to the fourth and fifth day.

In these 120 post-operative urines examined, 106, or 88½ per cent. showed acetone.

These results, corresponding very closely with those of

other observers, would lead one to suppose that acetone appears in the urine after ether narcosis in about 90 per cent. of the cases. Now although acetone does occur in this large majority of cases, it is only in a very few that it is accompanied by the grave symptoms of acid intoxication, which are characterized by an odor of acetone in the breath, nausea, followed by vomiting, coming on 12 to 36 hours after operation. The vomiting increases, the pulse becomes very rapid and feeble, respirations increase and grow shallow, the patient may become delirious or comatose, and finally die at the end of twelve to forty-eight hours.

Now, though every case having acetone in the urine does not present serious symptoms, neither does every case of diabetes present serious symptoms. Still, we well know that acetone in quantities sufficiently large to be detected by any of the ordinary tests is a pathological constituent of the urine and indicates some metabolic change which may be more or less serious, occasionally serious enough to cause death and to show fatty degeneration of the liver and kidney post mortem, as has been demonstrated by Bevan, but more frequently this is not severe enough to produce any easily noticeable symptoms.

Whether or not acetone is the cause of the disease which presents the above symptoms is not yet settled, but we do know that the patients showing the symptoms have invariably had acetone in the urine in the cases in which it has been tested, we therefore believe that it should be regarded as a danger signal following anæsthesia and that every effort should be made to avoid its occurrence or to diminish its quantity in the urine.

The question which naturally arises is "How can this be done?" We have already stated that 88½ per cent. of the patients etherized by the semi-open or cone method showed acetone in the urine, while the employment of the simpler, cleaner, and more rational method of anæsthesia which we have described, reduced the percentage of post-operative acetonuria from 88½ to 26 per cent.

In conclusion, we may summarize the advantages that we claim for the gauze method of etherization, thus—

1. It is less disagreeable to the patient.
2. Post-operative vomiting is reduced from nearly 100 to 32½ per cent.
3. Quicker recovery of consciousness.
4. Reduction of post-operative acetonuria from 88½ to 26 per cent.

In closing, we wish to express our thanks to Drs. Burrell, Watson, and Blake, through whose courtesy we have had the opportunity to carry out this work, and especially to thank the latter, at whose suggestion the work on acetone was undertaken, for his valuable advice and encouragement.

TRANSACTIONS
OF THE
NEW YORK SURGICAL SOCIETY.

Stated Meeting, April 24, 1907.

The President, DR. GEORGE WOOLSEY, in the Chair.

SARCOMA OF THE HUMERUS.

DR. HOWARD LILIENTHAL presented a man about 30 years old, who, six months ago, after the healing of a fracture of the right humerus, noted peculiar sensations and pain in the callus. The pain finally became so marked that he visited the Mt. Sinai Dispensary, where he was seen by Dr. Walter M. Brickner, who, partly on account of the crackling sensation that could be elicited, became suspicious that the condition was malignant and had an X-ray photograph taken. This corroborated his suspicions, and the patient was admitted to the hospital about two months ago.

Upon exposing the humerus and opening it, the medullary canal was found to be filled with a soft, pultaceous material, which was removed and submitted to the pathologist, who pronounced it small, round-celled sarcoma. As the patient absolutely declined amputation, the diseased bone was removed as completely as possible, comprising a section about seven inches long. Even above this, and extending up into the shoulder, the bone was so extremely thin and brittle that it could be broken between the fingers.

In order to give the patient a fairly useful arm, at least temporarily, a prosthesis was determined on. This was accomplished by the insertion of an aluminum intra-medullary splint, as first suggested by Dr. Charles A. Elsberg, which was introduced into the medullary canal of the lower and upper fragments; is fitted snugly below, but not so well above, on account of the thinness of the bone. The wound was closed with drainage, and

the patient made a rapid recovery. Since then he had been treated by injections of Coley's fluid, and he now wears an apparatus, which, while not entirely satisfactory, is fairly so, and enables him to use the affected arm.

The future of this case, Dr. Lilienthal said, presented an interesting problem. If he remained free from a recurrence, which was scarcely to be expected, the aluminum splint would have to be replaced by some other material, as the aluminum would in the course of time be dissolved by the alkalinity of the blood, and become absorbed.

DR. FRANK W. MURRAY asked whether the absorption of the aluminum might not perhaps be prevented by gold-plating the aluminum rod? As to a future operation in this case he would suggest reopening the upper part of the wound and fitting the upper end of the aluminum rod more firmly into the canal of the upper fragment of the humerus.

DR. LILIENTHAL said he believed aluminum could not be gold-plated. Instead of aluminum, a splint of silver or of silver plated with gold might be tried, although it was questionable whether such a splint would remain in situ.

DR. CHARLES A. ELSBERG said that when he suggested the use of the aluminum splint, he did not have in mind cases like the one shown by Dr. Lilienthal. On the contrary, the absorbability of the aluminum splint in the cases in which he desired to use it was of distinct advantage, as it would disappear after it had served its purpose. It was intended simply to hold the divided fragments of bone in place temporarily, especially in cases where there was a slight gap between them. In a case of advanced tuberculosis of the knee joint which recently came under his observation, it was necessary to remove a considerable section of bone, leaving a gap of about two inches. An aluminum cylinder was then introduced into this gap, forcing it into the tibia below and the femur above. This wound was still unhealed, owing to the prolonged drainage that was necessary, but fully two-thirds of the gap between the femur and tibia had already been covered by a new growth of bone.

EXTRA-DURAL HÆMORRHAGE.

DR. CHARLES ELSBERG presented a young man of 20 who was admitted to Mt. Sinai Hospital on March 19, 1907, with the

following history: Two days before he had spent the day drinking with some friends, and in a fight he was said to have been struck on the left side of the head. He returned home in the evening in a dazed condition, but was able to go to bed without assistance. In the morning he got up and sat around the house, but toward evening he became more drowsy. At nine o'clock that evening he was brought to the hospital by his brother. He was able to walk, the distance being about ten blocks. Upon admission, he was in a semi-conscious condition; when aroused, he was able to answer questions. His pulse ranged between 50 and 60 per minute; respirations, 20; the pupils reacted to light, but the left was slightly larger than the right. There was distinct weakness, almost amounting to palsy, of the entire right side of the body. The reflexes on that side were exaggerated. Over the left temporal region there were numerous contusions, and cracked-pot sound could be elicited on percussion over the lower part of the temporal region. There was slight congestion of the retinal vessels. It was determined to delay operative interference for a few hours, in the meantime having the patient carefully watched.

The following morning his condition was about the same, excepting that the pulse and respirations had fallen slightly, and drowsiness was perhaps more marked. Further delay was considered inadvisable. Under anæsthesia, Dr. Elsberg made the usual incision in the left temporal region. When the bone was exposed, a fracture was seen running forward and downward. Part of the bone in this region was removed with gouges and rongeur. As soon as the dura was exposed, a large blood-clot was expelled under considerable pressure. The opening in the skull was then rapidly enlarged, and a very large amount of clotted blood was removed with the fingers and by irrigation. The anterior branch of the middle meningeal artery was then found to be bleeding, and it was secured by ligatures. The original blood clot extended from the frontal to the occipital region, and from the median line to the base of the brain, and in the temporal region the dura was separated fully an inch and a half from the inner surface of the bone. Within a few minutes after all the clots had been washed away, the dura resumed its natural position. The skin flap was then sewn back into place, a small drain being inserted to the region of the ligated artery.

The patient's convalescence was rapid and uneventful. By the evening of the day of operation the right-sided paralysis had entirely disappeared, and the boy was partly conscious. The pulse and respirations, however, remained slow for twenty-four hours longer. The respirations gradually rose to normal, and after that the pulse rate. The wound healed by primary union, and the boy was up eight days after the operation. Blood-pressure observations were made before and during the operation, and they showed in a characteristic way that there was no change when the dura remained unopened. The large area of dura compressed by the clot without marked pupillary changes was also of interest.

DR. BENJAMIN T. TILTON said that in the cases of extradural hæmorrhage he had seen there was no free hæmorrhage after removal of the clot, and he had seldom found it necessary to ligate the artery.

ABSCESS OF THE LUNG.

DR. FRANK W. MURRAY presented a boy 16 years of age, who was admitted on January 12 to the medical service of the New York Hospital. Some six weeks previous he had a severe attack of tonsillitis which lasted a week. Since then he has complained of headache and cough with mucoid expectoration. Two days before admission he was suddenly taken with severe pain below the right costal margin. The pain was increased by coughing and on deep inspiration. Examination of the chest on admission revealed dulness on percussion and bronchial breathing accompanied by many large râles over the lower lobe of the right lung. Temperature 101.6°, pulse 114. During the following week the area of dulness extended upward to the angle of the scapula and outward towards the axilla, and as fluid was suspected, the pleura was aspirated in two places, but with negative results. The temperature still continued elevated, averaging about 102° every afternoon, the pulse averaged 116, and the general condition did not improve. On January 25 there was noted an area about six inches from the spine and corresponding to the lower third of the scapula and extending an inch below the angle where percussion was hyper-resonant, the breathing caverno-amphoric, fremitus, increased whispered pectoriloquy present with an occasional râle. Dulness on percussion now

extended into the axilla as far forward as the anterior axillary line. The patient was much weaker, perspired profusely at night, and was steadily losing ground. The evening temperature at this time averaged about 103.5° and the pulse about 130, respiration up to 40. During the following four days the evening temperature was over 104° and the pulse averaged about 150. Examination of sputum revealed diplococci, staphylococci and streptococci; no tubercle bacilli found. On February 1 a needle inserted into the right chest at the angle of the scapula withdrew two ounces of pus. No improvement followed the aspiration except some lowering of temperature, but the local symptoms remained the same. On February 4, the temperature having risen to 105° and the pulse to 168, the patient was transferred to the surgical service of the hospital for operation.

Operation.—Light ether anæsthesia, patient in semiprone position, his right arm hanging over the edge of the table. The needle, inserted in the ninth interspace behind, withdrew pure blood. Inserting the needle in seventh right intercostal space at about the location of the spine of the scapula, and pushing the needle upward and forward for about an inch and a half, pus was withdrawn. An incision at this point was made down to the seventh rib, one and a half inches of which was removed, and on opening the pleura, a cavity about three-quarters of an inch in diameter and walled off by adhesions, was found. The needle was then inserted upward and forward through the floor of the cavity and pus again withdrawn. On palpating the floor of this cavity with the index finger, the tissues were found to be very soft and friable, and on pressure the finger broke through into an abscess cavity about the size of a hen's egg. Then followed an escape of gas, together with a discharge of light-colored, odorless, viscid pus. After carefully cleansing the abscess cavity, it was found to be in the lung tissue proper, and it was not an interlobular empyema. A drainage tube was inserted into the pus cavity and the wound partially sutured and covered with a large sterile gauze dressing. The operation was followed by rapid improvement, and on the following day the temperature had dropped to 99° and the pulse to 104, with a corresponding improvement in the boy's general condition. The discharge from the wound was profuse for several days, requiring frequent change of dressings. But it steadily decreased, and on February

16 the tube was removed. The patient was discharged early in March with a small granulating area, which has since healed.

Bacteriological examination of the pus removed at operation showed streptococci, apparently in pure culture.

The etiology of the abscess is somewhat uncertain, but while on the medical side of the hospital, the patient was treated for pneumonia, it should be remarked that during the entire course of the disease there was no cough with the characteristic pneumonia expectoration. The pus which was removed on February 1 by aspiration was thought to have come from a localized empyema, possibly from a lung abscess. Whether there was any connection between the lung abscess and the attack of tonsillitis in the previous December, it is difficult to say, but as the bacteriological examination showed pure streptococcus infection, and as the tonsillitis was presumably a streptococcic sore throat, the connection is somewhat suggestive. The speaker's experience with abscess of the lung was very limited, as he had only operated on two cases.

The patient is now entirely well, has good color, is able to work, and has no cough or expectoration. Over the lower lobe of the right lung there is still some dulness on percussion and a few râles are to be heard. The wound has entirely healed and the use of the shoulder and scapula muscles is unimpaired. He has gained fifty pounds in weight since operation and now weighs 115 pounds.

THE OPERATIVE TREATMENT OF ACUTE ABSCESS OF THE LUNG.

DR. BENJAMIN T. TILTON read a paper with the above title, for which see page 243.

DR. MURRAY said that while he agreed essentially with Dr. Tilton concerning the treatment of acute abscess of the lung, there was one point on which he slightly differed, and that is whether or not aspiration of the lungs should be resorted to in cases where there are no adhesions presenting for fear of contaminating the pleura. In his opinion the danger of contamination was more apparent than real, and in any given case where no adhesions were present, the question of immediate evacuation of the abscess depended on the patient's general condition. If it was possible to wait with safety for twenty-four or thirty-six hours to allow

adhesions to form, such a course would be advisable. In case, however, the patient was very septic and in a critical condition, immediate evacuation of the pus is indicated, and the danger of contamination of the pleura can be materially lessened by gauze packing around the line of incision. In the opinion of the speaker success in operation would depend to a great extent on the establishment of a diagnosis at the earliest possible moment. In order to establish the diagnosis definitely, aspiration is necessary, and in resorting to that the physician is not always certain whether adhesions are present or not. If the danger of contaminating the pleura were as great as expressed by the reader of the paper, it would be reasonable to suppose that septic infection would follow more frequently than it does in the hands of our medical confrères, who resort so often to it.

DR. HOWARD LILIENTHAL said that if aspiration was done in a case of abscess of the lung in which there were no adhesions, the withdrawal of the infected needle would in all probability contaminate the pleura, and an empyema would result, usually with fatal consequences. The speaker said he had operated on two cases of abscess of the lung. In one the abscess was found at the time of operating and in the other at the autopsy. Both cases died of pneumothorax.

Dr. Lilienthal said that after listening to Dr. Tilton's paper, he felt more inclined to operate on these cases than heretofore, and in any suspected case he would be willing to try Dr. Tilton's procedure of incising the pleura and resecting the rib, and then going in through a second opening at the site of the adhesions, if any were found. In the case shown by Dr. Murray, such adhesions were evidently present, and Dr. Murray was fortunate in entering the lung through the right spot and effecting such a brilliant cure. The speaker said he had on two occasions attempted to suture the two layers of pleura together, but the sutures would not hold.

As to the danger of creating a pneumothorax in cases where there was not an inflammatory condition of the lung, Dr. Lilienthal said he did not think it was as great as had been feared. He recalled a case where some years ago he removed a sarcomatous growth involving two ribs, which were excised, together with a large section of pleura. Some pneumothorax resulted, but the patient made an excellent recovery, and was still in good health.

DR. JOHN B. WALKER said he had seen two cases of abscess of the lung. In one case, where it followed pneumonia, he excised a portion of the rib, exposing an area of adherent pleura through which the abscess was opened. Death occurred in about two weeks. In the other case, where the abscess of the lung was not interfered with, the patient recovered.

DR. L. W. HOTCHKISS referred to one case of direct operation for abscess of the lung which had been recognized beforehand. The patient was a child, and the abscess was situated in the upper portion of the chest and was easily reached. It was found to be gangrenous, and the child died in the course of a few days.

DR. LILIENTHAL asked Dr. Tilton what his ideas were in regard to draining a tuberculous cavity of the lung, and whether the tactics he had outlined, either the same or properly modified, could be followed there?

DR. GEORGE WOOLSEY said that while the danger of infecting the pleura from the introduction of a needle into a lung abscess was evidently a real one, it was not absolutely fatal in the speaker's experience. He recalled two cases of abscess of the lung, both seen within the past three years, and both fatal. One of them was diagnosed as aspiration pneumonia, and was associated with a very powerful odor. There was some improvement after operation, but the patient succumbed in the course of two or three weeks. In both of these cases there were adhesions, so that the pleural cavity was not opened.

DR. TILTON, in closing, said that he had operated on five cases of abscess of the lung, with one death, and thought that these good results were due to early operation. The mortality of abscess of the lung in hospitals is very high, and the most plausible explanation for this is that most of the cases are referred to the surgeon in a bad condition; otherwise, the operative statistics would doubtless be more satisfactory. In almost all of the gangrenous cases, a fatal outcome is to be expected. The speaker said that under certain conditions he saw no objection to an exploratory operation before the diagnosis was absolutely made. For example, in a case of pneumonia with delayed resolution where we failed to find pus by the ordinary methods, he saw no objection to resecting a rib over the probable site, which could then be located definitely by the evidence of adhesions and thick-

ened pleura. Through the adherent pleura multiple punctures could be safely made in the expectation of finding pus. When adhesions were present, it made no difference how many punctures were made.

Dr. Tilton said he had had no personal experience in draining tubercular cavities. The results of others in that direction had been very unsatisfactory. Most of those cavities were in the upper lobe, and the results of opening them from the outside were not at all good. In dealing with simple abscesses of the lung, the prognosis after early operation was very good, as was shown by Dr. Murray's case. Medical men, as a rule, preferred to wait until the pus broke through into a bronchus, but personally, the speaker said, he thought it advantageous to operate early, even before the diagnosis was positive.

FRACTURE OF THE FIFTH METATARSAL BONE.

DR. GEORGE WOOLSEY reported this case, with X-ray findings. The patient was a woman who sustained the injury while the foot was strongly supinated. Examination showed some swelling and tenderness on the outer side of the foot between the fifth metatarsal bone and the cuboid. No displacement could be made out. An X-ray picture was then taken, which showed a fracture of the fifth metatarsal, with avulsion of its proximal end. The foot was put up in plaster, and the result, after five weeks, was very good.

TRANSACTIONS
OF THE
PHILADELPHIA ACADEMY OF SURGERY.

Stated meeting held May 6, 1907.

The President, JOHN B. ROBERTS, M.D., in the chair.

THE ANNUAL ADDRESS IN SURGERY.

DR. EDWARD MARTIN delivered the annual address for 1907.

SURGERY OF THE VASCULAR SYSTEM.

A symposium on the above subject was conducted, consisting of the following papers:

I. Ligation of the Ductus Arteriosus, by Dr. John C. Munro, of Boston; II. Arteriotomy for Embolism and Thrombosis, by Dr. Francis T. Stewart; III. Technique of Blood Vessel Suture, with Demonstration of Specimens, by Dr. J. Edwin Sweet; IV. Endo-Aneurismorrhaphy (Matas), with Report of Two Cases, by Dr. Charles H. Frazier; and V. Endo-Aneurismorrhaphy (Matas) with Report of Two Cases, by Dr. John H. Gibbon.

For these papers, see pages 335-366.

DR. GEORGE E. BREWER, of New York, said that for years he had been interested in this phase of surgery, particularly the Matas operation, and has long wished to hear the results of that procedure as detailed in the instances just reported. He has never carried out the procedure himself as none of the cases in which he expected to employ it proved suitable. He has, however, met with a case similar to one of those described by Dr. Frazier. It was one of aneurism of the first part of the femoral artery and the vessel above and below was ligated with the expectation of later excising the sac. Ten days later he began excision but found excessive hemorrhage, due, as in Dr. Frazier's case, to

two or three branches in the wall of the sac. Hemorrhage was with difficulty controlled. Such vessels are apt to be found in aneurismal sacs in this location. Dr. Munro's suggestion regarding the ligation of the ductus is to be thought of in suitable cases. If the diagnosis can be made the treatment is rational as the hopelessness of these cases is well known.

Dr. Brewer's own work has been experimental, based on efforts to close accidental wounds of arteries. The first accident was the wounding of an external iliac during a hernia operation, the suture being introduced from below upward instead of downward. Bleeding was profuse and it was found that a Hagedorn needle had passed through the vessel. Two attempts were made to suture the artery, in which the wound was one-fourth inch long. Tension was high and the sutures tore out each of two times they were inserted. The vessel was then ligated. Fortunately there was a free collateral circulation which maintained such satisfactory conditions that the patient never knew he had more than a hernia operation.

The second case was one of cancer of the breast in which a house surgeon who was operating plunged a knife into the axillary artery. The vessel was sutured and apparently no thrombus formed. Several mattress sutures of fine silk were inserted with a round needle, the walls of the vessel being so thick that the intima was probably not wounded. Six weeks later the clinical result was good. This is the only artery he has ever successfully sutured. These accidents led to the experimental work reported a few years ago, in which he used for wrapping the vessels, an elastic plaster made up of a strip of very thin gum, coated with an adhesive material like that used in the zinc oxide plaster. Experiments were made on a large number of animals and some of the results were good. He regards the method as worthy of trial in accidental wounds of the arteries.

DR. JOHN B. MURPHY, of Chicago, described a case of double embolism involving the right femoral below Poupart's ligament and the left common iliac, the case being one of sepsis and malignant endocarditis following extraction of a tooth. Removal of the obstruction in the legs was thought of but embolism of the brain caused death before the operation was undertaken.

The work of Dr. Sweet is appalling from the standpoint of the time and labor necessary. Dr. Murphy is pleased with the results obtained, not only in the technical work but also in the train of thinking in respect to thrombosis in arteries and veins. From this one comes finally to the practical results of arterial work shown in the cases of Frazier and Gibbon; the work from 1889 on by Matas and others is showing results. In analyzing the work done in the suture of arteries it may be reduced to three essential methods: first, end-to-end suture; second, end-to-end implantation; third, suture by mechanical support. The third, promulgated by Abbe, was not a bad idea.

For practical suturing of vessels two things are essential; there must be no immediate hemorrhage and no immediate thrombosis. Gangrene results from immediate primary ischemia. If ischemia come on gradually there is no thrombosis, this being shown clearly by specimens in the British museum. If therefore we can devise an operation that will tide over a few days, we will succeed. In an aneurism where it is impossible to employ the Matas operation if we can produce a gradually occluding endarteritis in the proximal vessel the lesion will be cured. Most of the work upon arteries previously reported was too coarse. The greatest element in the production of endarteritis is trauma and not infection; where the artery is pinched is the point of greatest danger. Carrel's great care in handling and suturing the vessels is his dominant point, and this adds more to his success than does any other feature of his work.

DR. J. C. HUBBARD, of Boston, said that his experience in arterial surgery had been obtained by doing an arterial venous anastomosis in two cases for reversal of the circulation.

The first case, already published in the *ANNALS OF SURGERY* for October, 1906, was that of a man of 80 years with senile gangrene of a portion of the right foot. Physical examination showed him to be a decidedly senile old man with atheromatous arteries and a systolic heart murmur. No pulsation could be felt in the right dorsalis pedis artery. In May, 1906, he was operated upon. The femoral artery and vein were isolated in Scarpa's triangle below the origin of the profunda and divided between Crile's clamps or elastic ligatures. The upper end of the artery was then invaginated into the lower end of the vein and the distal end of the artery into the proximal end of the vein.

A complete reversal of the circulation was thus established. The technique of the invagination was as follows: Three double headed sutures were passed equally distant through the entire wall of the artery from inside out. The needles were then passed into the lumen of the vein about a quarter of an inch and at this point through its wall. When these sutures were drawn tight the artery was drawn into the vein. Reënforcing sutures including only the outer portion of the arterial wall were then placed here and there to catch the edge of the overlying vein to the artery. Number 1 Pagenstecker thread was used for all these sutures. When the controlling clamps were removed there was no leaking at either suture line and weak pulsations could be felt in the vein for a short distance below the anastomosis. There was absolutely no shock shown by the patient and recovery from the operation was satisfactory in spite of the fact that the senile condition of the patient made it difficult to keep him in bed or a dressing on the wound. After the operation the appearance of the leg did not change. There was no œdema, dilatation of the veins or cyanosis. The gangrene which existed before the operation spread a little and then a line of demarkation formed. When the foot was later amputated at the point of election on the tibia both tibial arteries contained arterial blood. The stump healed satisfactorily but slowly. In March of this year, ten months after the operation he saw the patient. The stump was well supplied by the circulation and there was no difference in appearance or size of this leg and the unoperated one.

Clinically this case was most successful but the exact meaning of the presence of arterial blood in the tibial arteries at the time of the amputation he did not know. It seems that the arterio venous anastomosis must have increased in some way the amount of blood in the leg, for it is hard to believe that an amount of blood so small as to permit gangrene of the foot would be sufficient to nourish for ten months an amputation stump made only a short distance above the gangrenous area and had clots formed at the sites of the anastomoses it seems most probable that the gangrene would have extended up the leg instead of remaining localized.

The second case was that of an old woman of 60 years with senile gangrene of the foot and a portion of the leg. The arteries were atheromatous. She was operated upon during February of

this year. The femoral artery and vein were divided as in the first operation. The artery was much calcified and was so hard that some force was necessary to drive the needles through it and so brittle that the stitches tore out most easily. The intima formed a distinct lining to the vessel and was much like a second smaller tube inside a larger one. These characteristics of the wall complicated the technique immensely as the attempt was to make the anastomosis according to Carrel's method, turning the walls so that at the suture line intima should come in contact with intima. The artery was so much like a pipe stem that this was impossible although a conscientious attempt was made. The ends of the artery and vein were therefore cut off freshly and the artery invaginated into the vein as in the first case the only difference being in the use of vaseline to smear the ends of the vessels. The distal end of the artery and the proximal end of the vein were then ligated. The vein pulsated after the controlling clamps were removed. Pagenstecher No. 1 was used. There was no shock and no change in the appearance of the leg. Ten days later it was necessary to amputate above the knee for the gangrene which had been present before the operation. During these ten days it had become more pronounced but its limits had extended only a little. During the amputation the anastomosis was cut down upon and removed. The artery was found filled with a loose, easily detached clot. This case was therefore a distinct failure.

From these cases he believed it to be perfectly evident that there is no danger in continuing investigations further as there is no shock to the operation. Carrel's method is not applicable to a certain number of the cases where the operation is done on old persons with atheromatous arteries. On young persons and experimental arteries it doubtless is most satisfactory but as the operation has been proposed to cure conditions dependent upon lack of circulation in the extremities some other technique must be found as practically all cases, except perhaps some due to trauma, will necessarily be in elderly persons. An objection which may be raised to the invagination method as employed in the above cases is the fact that the divided end of the artery leaves a certain portion of its wall in the blood stream uncovered by intima which favors clot formation. This method was introduced by Murphy in 1897 (*Medical Record*, Jan. 16) for the

repair of the continuity of an artery and was recommended only after experimentation. The slight modification of invaginating the artery into a vein instead of into another portion of the same artery would seem not to invalidate the method. However, as at present this objection might be raised, he was working on some scheme to obviate this difficulty, but as yet could not report results. Two ways had occurred to him. One is by smearing vaseline or some other substance onto the cut end of the invaginated artery to keep it out of the blood stream. The other way was suggested by the appearance of the arterial wall in the second case where the intima formed a distinct layer inside the others and one which remained intact when the others cracked away from it. He had thought that it might be possible to cut the outer layers of the artery a quarter of an inch or so back of the intima and thus leave a greater length of intima as a cuff, the back of which could be covered with vaseline so that when invaginated into the vein it might stick to the venous wall and cover over the cut end of the outer portion of the artery.

DR. ROBERT H. M. DAWBARN, of New York, said Dr. Sweet's statement, that silk sutures were everywhere admitted to be the best, he must take exception to. A good many years ago Dr. Willy Meyer, of New York, proved by experiments that linen, cotton, and silk threads are tolerated equally well by the body tissues.

Of these linen is, size for size, the strongest, and is not seriously weakened by boiling; whereas silk is distinctly weakened.

For these reasons Dr. Dawbarn said he has not for years past used silk in surgery for any purpose whatever. In bowel and stomach work he has long advocated linen sutures—probably for ten years; though he would not bury it elsewhere in the body, except when exceedingly fine in diameter, as in Dr. Sweet's work upon arteries.

By asking at any large department store for such linen thread as is used in mending Renaissance lace, one can get size one thousand—which is as fine as can be used, practically, in vessel-work. It would seem to Dr. Dawbarn that if one employs women's finest sewing needles, removing the temper by heat enough to allow of curving them, and avoids having the thread

pass through the intima, so that it does not touch the blood current nor invite clotting, it might be a help. And yet Dr. Dawbarn did not wish to claim the least personal experience of work, such as that of Dr. Sweet, and would defer to his opinions in these matters.

Regarding Dr. Brewer's ingenious device for control of an important artery wounded accidentally at operation, Dr. Dawbarn said he must repeat his criticism offered upon the occasion when Dr. Brewer presented before the New York Surgical Society the results of his experimental work upon dogs. These experiments were very ably done, and the results satisfactory. To Dr. Brewer belongs the credit of the thought, and Dr. Dawbarn merely suggested a different material to wrap about the artery after its suture, and before allowing the current to be resumed; namely, Cargile membrane. This is always at hand, and, whether the adhesive or non-adhesive, will be equally satisfactory. It is very strong. After wrapping the vessel several times the final edge is sewn to the layer just beneath.

Being absorbable tissue it will in time disappear. As to the special kind of thin surgeon's rubber plaster advocated for this purpose by Dr. Brewer the life of rubber plaster is short, at best, and nobody would be likely to keep this specially thin kind on hand, and renewed often, to meet so very rare an accident. Also, being non-absorbable, it is capable at times of causing trouble later; becoming finally an irritant, however thoroughly aseptic it may be.

Dr. Dawbarn has tried upon two dogs' common carotids the gold-beater's skin adhesive plaster as just advocated by him, and with excellent results. The specimens, with others to be obtained by later work, he hopes to show in time.

DR. DUDLEY P. ALLEN, of Cleveland, said his first experience in suturing vessels was in connection with wounds of the veins. The first case occurred between ten and twelve years ago. It was a wound of the longitudinal sinus, the length of the wound being $\frac{3}{4}$ of an inch. The wound occurred in an operation upon the brain and it was closed by a continuous suture of fine silk, the skull was re-placed, and healing took place without any complications.

There is one condition which has not been mentioned in

which suture of the vessels might prove to be of great value. Occasionally sarcomata develop in the popliteal space, being unattached to bone. It may be impossible before operation to tell whether the sarcoma surrounds the popliteal vessels or has pushed them to one side. If the vessels are surrounded, it may be necessary to divide them in order to remove the growth. Under such conditions, if a suture of the vessels could be successfully made it would be an operation of very great value. In a recent case it was necessary to divide the vessels and the operation was followed by gangrene of the leg which required amputation. Could an anastomosis have been made the leg might have been saved.

DR. J. F. BINNIE, of Kansas City, said that in a typical case of sacculated aneurism with one opening of moderate size he closed this opening with a suture and then obliterated the sac in the Matas' fashion thus performing a reconstructive operation although he did not at the time recognize the fact. In other cases, named by Matas fusiform aneurisms, there are two openings into the sac, these two openings being connected by a groove or strip of comparatively healthy vessel wall, along the wall of the sac. Such aneurisms are *not* fusiform, they are sacculated, only a narrow strip of one side of the vessel being diseased and constituting the sac. In this class reconstructive operations are of much value; there is sufficient healthy tissue to give a good prospect of success. Even if complete success is not attained, *i.e.*, if the newly created arterial tube becomes obliterated, this obliteration may take place slowly enough to permit the circulation being kept up while collateral circulation is being established. In true fusiform aneurism the whole circumference of the vessel wall is diseased—no healthy material remains out of which to construct an artery—hence in these cases the ordinary Matas' oblitative operation is proper and easy, the reconstructive operation is out of the question.

DR. MUNRO, in closing, said he found in one case the same trouble experienced by Dr. Stewart. There was thrombosis of the femoral resulting from a fracture-dislocation. The clot stuck to the vessel wall and the artery was then opened below the thrombus and dislodgement attempted by hydrostatic pressure, but this was also unsuccessful.

DR. SWEET, in closing, said that the needles employed in arterial suture were so fine that if one attempted to sterilize and bend in a flame the steel would at once burn and be ruined. Regarding different suture material, silk probably has the finest individual strands and hence is to be considered better. A point to be considered in the case of arterio-venous anastomosis is that time is gained for the establishment of a collateral circulation.

DR. FRAZIER, in closing, said in answer to a question by Dr. Dawbarn regarding the control of hemorrhage from the femoral in operating upon aneurism, that the latter's suggestion to use McBurney's technic in securing a bloodless amputation by opening the abdomen and compressing the common iliac against the psoas was worthy of consideration.

DR. GIBBON, in closing, said regarding Dr. Stewart's suggestion that the vein be substituted for the artery, that in looking up the literature of the subject he had discovered the report of a case by Goyanes,¹ of Madrid, in which that suggestion had been put in practice. The popliteal was divided distally and the vein substituted for the artery, the expedient proving a success.

¹(Siglo Médico, Sept. 8, 1906.)

BOOK REVIEWS.

A STUDY OF THE HUMAN BLOOD VESSELS IN HEALTH AND DISEASE. By ARTHUR V. MEIGS, M.D., Physician to the Pennsylvania Hospital, Philadelphia. J. B. Lippincott Company, 1907.

This is a supplementary work to the author's admirable book on "The Origin of Disease." It is the outcome of the author's studies of the blood vessels at the bedside, at the autopsy and in the laboratory. Dr. Meigs was placed under the fortunate circumstance of having to make his own pathological examinations upon patients dying in his hospital service. This inconvenience has the merit of bringing a man into closer relation with his cases than when the labor is subdivided with the pathologist.

The illustrations—one hundred and three in number—are all original. Among these are some steel engravings which were drawn directly upon the metal from the microscope without any intervening sketch.

The studies of the blood vessels have made advances, perhaps, greater than any other of the departments of pathological anatomy during the last ten years. This knowledge has been recorded in the current literature, but heretofore it has not been collected in a single text-book. Dr. Meigs has set down his own observations, but they have been made in the light of a familiarity with the observations of other investigators and hence embody a fairly full description of these conditions.

Dr. Meigs calls attention to his contention that there is a "disease of age," characterized by anatomical changes in the blood vessels. These changes are just as pathognomonic as are the anatomical changes in the lungs characteristic of pneumonia.

This book shows the development of new blood vessels in diseased tissues, in scars, adhesions and tumors, and also in the walls of diseased vessels. The constant tendency to the production of new fibroid tissue in all diseases is demonstrated.

The author's illustrations of giant-cells surely cannot be regarded as accurate; conditions are pictured as giant-cells which

it would seem to the reviewer should not be classified as such. In Fig. 25, K is clearly an illustration of an alveolar structure. That the so-called giant-cell is, properly speaking, no cell at all is very true, still pathologists are pretty well agreed as to just what collections of nuclei and protoplasm are to have this title, and the term has served a good use.

In studying the diseases of the vessel walls, the author has found that chalk may be deposited in any of the coats of an artery. One illustration is given showing chalk in the muscularis alone. The usual changes incident to old age are found in the intima, causing a thickening of that layer. Meigs contends that such a thing as a "physiological old age" does not exist.

One of the common causes of death in persons over fifty years of age is the rupture of a vessel of the brain. This is usually associated with pronounced disease of the intima. The author expresses it as his opinion that in apoplexy ulceration of the blood vessels is the precedent disease. This causes a slowly increasing thinning of the arterial wall until perforation takes place just as in typhoid perforation of the bowel. Apoplexy, he contends, is not due to the rupture of a stiffened vessel by reason of some extra effort or increase of arterial pressure. Commonly it comes during sleep or when the patient is quiet. He has found this ulceration in several cases, and he has even been able to discover the perforation through the ulcerated area. The ulceration is often latent and slow, and not uncommonly there are certain symptoms preceding the attack which are well known to clinicians.

This book after dealing with the diseases of the blood vessels in general takes up the diseases of the vessels of the various organs. It consists mostly in descriptions of specimens which the author has found. The larger part of the book is given to these descriptions without reference to any particular application of the knowledge revealed. The author expresses the hope that it may be of some use as further study of the blood vessels is made.

It is to be regretted that more light is not thrown upon the etiology and nature of varicose veins and of aneurism. The book is a painstaking and scientific contribution to our knowledge of this subject which reflects much credit upon its author.

JAMES P. WARBASSE.

CORRESPONDENCE.

INFLUENCE OF PREGNANCY ON CANCER OF THE BREAST.

EDITOR ANNALS OF SURGERY:

SIR:—The symposium on cancer of the breast in your July number covers the ground very satisfactorily except in one particular, viz: the relations of pregnancy to the disease in question. All surgeons are aware, and the point is emphasized in many text books, that cancer of the breast under the stimulus of pregnancy takes on a specially malignant character and runs a furiously rapid course. This fact was sadly exemplified in my experience a dozen years ago. A lady aged 29, mother of three children, became pregnant for the fourth time. She had had an abscess of the breast after her first confinement and there remained a nearly imperceptible cicatrix in the gland. This made no trouble during two succeeding pregnancies. About the third month of her fourth pregnancy, however, she complained that this old scar was enlarged and tender. Examination showed a swollen indurated mass and axillary and supra clavicular lymphatics enlarged. A well known surgeon saw her with me at once, diagnosed carcinoma of rapidly malignant type, and did a thorough extirpation of the breast and all lymphatic connections. The wound healed kindly, but in spite of the sweeping thoroughness of the removal the disease seemed scarcely to have been checked. It broke out at once all over the area of operation, ulcerating and discharging, and finally involved the pleura. I brought on labor early in the eighth month, saving the child, now a well-grown healthy boy; but the young mother died in what would have been the ninth month of pregnancy.

I was thus in a measure familiar with the behavior of mammary cancer in pregnancy, but it needed another case to open my dull eyes to the important corollary deducible from this knowledge.

In March, 1905, I operated for cancer in a lady aged 36, mother of three children, doing the usual thorough removal of

axillary contents, and a wide circumsection of the breast, necessitating skin-grafts to close the defect. The wound healed well, only a soft pliable scar remaining. All went smoothly till in December, 1905, the patient reported herself two months' pregnant, and examination verified her suspicion. Her danger was instantly clear to me, and I recommended termination of the pregnancy in order to avert the danger of its re-lighting the disease. This view being concurred in by a consultant, I emptied the uterus of a two month's embryo.

But even at the second month we were too late. I had thought the scar a trifle red and hard before the curettage, but soon after there could be no doubt. A flame of reddened lymphatics spread from the scar to the other breast, which was swollen and glossy with indurated œdema. The patient recognized her own condition and asked: "Did my pregnancy bring this back again?" I had no need to answer; she read the truth, and asked again: "*Then why did you not warn me?*" Sure enough, why had I not warned her?

Before the assizes of conscience I have pleaded that the thought was a new one to me, that I had not read or heard that women should be warned against pregnancy after extirpation of cancer of the breast; but I have never been able to clear myself of blame for this woman's shortened life, and I propose in future to include this warning in my duties to such patients.

It may be that others have recognized this duty, but if so they have neglected, so far as I know, to acquaint the profession with what now seems to me an important rule of conduct, viz., to warn breast cases of the danger of pregnancy.

WILLIAM S. CHEESMAN,
Auburn, N. Y.

AUGUST 8, 1907.

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